THE RELATIONSHIP BETWEEN GEOGRAPHIC PROXIMITY AND STRATEGIC POSTURE: A LONGITUDINAL STUDY OF THE U. S. FIBEROPTICS INDUSTRY

by

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(ABSTRACT)

The purpose of this study is to investigate implications of geographic location for firm strategy and for the competitive climate in emerging higher technology industries. Hypotheses are generated based on concepts from institutional theory, transaction costs economics, economic geography, and strategic management. Specifically, tests are conducted to determine whether there is an association between establishments' geographic locations and the incidence of two collective strategies: strategic isomorphism and strategic complementarity. These tests are performed with respect to the U. S. fiberoptics industry at three-year intervals during the period 1976-1994. Tests are also performed (using 1994 data) to assess the influence that research institutes and economically dominant firms have on collective strategy formation.

The study's summary finding is that, to date, there is little, if any, empirical support for an association between geographic location and strategic posture in the

fiberoptics industry. While it is possible that the proposed phenomena do not occur in this industry, for all of the hypotheses there are several alternative explanations for the results. First, several of the findings suggest that too little time has elapsed for the proposed phenomena to be fully manifested in the fiberoptics industry. Second, some of the phenomena might be observable by changing sampling or measurement procedures. Third, certain characteristics of emerging higher technology industries might affect the strength of some hypothesized relationships. Based on the findings of this study, a number of suggestions are offered for further studies of the subject.

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TABLE OF CONTENTS

CHAPTER ONE: INTRODUCTION

The geographic concentration of industries is a phenomenon that has existed for many years and in many different parts of the world. For instance, in 1985, eighty-one percent of the synthetic woven fabric produced in Japan was produced in Fukui and Ishikawa, two of that country's forty-seven prefectures (Enright, 1990). The thousands of textile firms located in this region accounted for approximately thirty-two percent of world exports in synthetic weaves. In 1987, the Italian ceramic tile industry, concentrated mainly near the town of Sassuolo, produced approximately thirty percent of the ceramic tiles in the world (Porter, 1990). Nineteen of the top twenty carpet manufacturers in the U. S. are located in or near the town of Dalton, Georgia (Krugman, 1994).

While industry concentrations such as Silicon Valley and the Research Triangle Park have been identified, documented, and discussed by numerous authors (for example, Luger & Goldstein, 1991) relatively little work has been done with respect to the strategic implications of these clusters for communities of firms and individual firms. What are the implications of geographic concentration for the strategic postures of firms competing in these industries? Studies by both economic geographers and industrial organization economists (Dicken & Lloyd, 1990; Enright, 1990) have begun to reveal the importance of clustering, but many of its associated phenomena, specifically within emerging and higher technology industries, have yet to be addressed. The purpose of this study is to investigate some of the implications of geographic location for firm strategy and, by

extension, the competitive climate, in an emerging higher technology industry. The influence of geographic location, proximate research institutes, and proximate economically dominant firms on the dynamics of collective strategy are studied here within the context of an emerging higher technology industry.

The conceptual framework used to structure this study's literature review is depicted in Figure 1-1 (Lang & Lamb, 1996). Lang and Lamb developed this framework in order to explicate the concept of collective strategy. As with many other

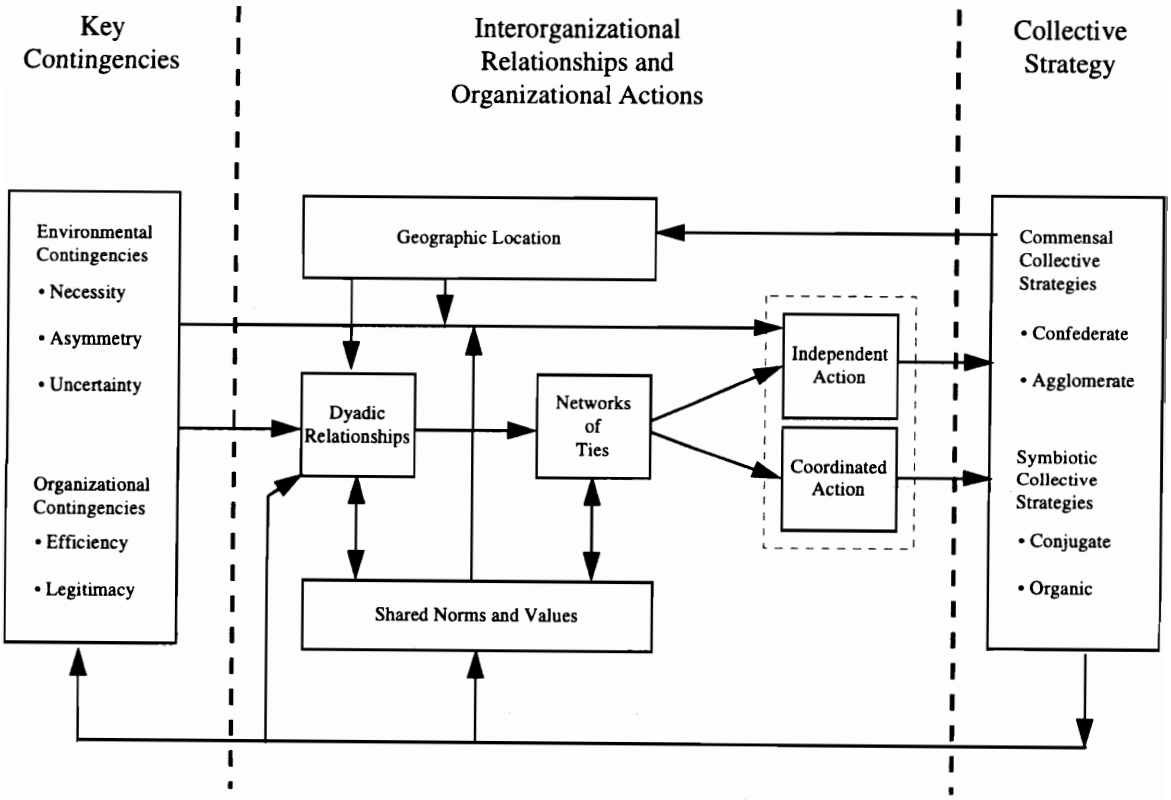

Figure 1-1: Conceptual Framework
(Lang & Lamb, 1996)

organizational phenomena, theorists have tended to oversimplify by explaining collective strategies in terms of one or two organizational or environmental contingencies, typically viewed from a single theoretical perspective. Lang and Lamb argue that better informed studies of collective strategy account for a variety of contingencies from a number of perspectives.

When defining collective strategy, it is useful first to consider the definition of firm-level strategy. Mintzberg & Quinn (1992: 5) define firm-level strategy as the "pattern or plan that integrates an organization's major goals, policies, and action sequences into a cohesive whole" (emphasis theirs). Explicit in their definition is the idea that firms' strategies are sometimes formed intentionally, but can also emerge over time, unintentionally (as discussed by Mintzberg, 1978).

The distinction between intentional and emergent strategies is also relevant when defining collective strategy. Collective strategy has most often been viewed as "the joint mobilization of resources and formulation of action within collectivities of organizations" (Astley & Fombrun, 1983: 578). This definition refers to instances of intentional cooperation such as joint ventures, strategic alliances, federations, or research consortia. In each of these cases, a collectivity forms a joint strategy with the goal of enhancing the competitive positions of individual members.

However, the Lang and Lamb framework builds more generally on the work of Astley & Fombrun (1983), Schelling (1978), and Axelrod (1984). Schelling (1978) and Axelrod (1984) use game theory to suggest ways in which collective strategies might

emerge even when firms do not intentionally work in concert. In order to capture both the intentional and emergent influence of interorganizational relationships, collective strategy is defined here as the pattern of competitive and cooperative strategic postures that exist within a collectivity of organizations, with or without active coordination by firms in the collectivity. Strategic postures of individual firms are operationalized in terms of firms' product and service offerings.

Astley & Fombrun (1983) argue that greater understanding of collective strategies will advance organization theory by illuminating processes through which individual firms can influence population-level phenomena. They argue that the collectivities to which firms belong play a significant role in the strategy options available, actions, and success or failure of these firms. Firms belong to many different collectivities simultaneously. Conditions in these various collectivities can influence different aspects of firm structure, strategy, and behavior. While some types of collectivities (for example, trade associations or research consortia) may have geographically dispersed memberships, this study focuses on collectivities of geographically proximate firms.

Contrary to some of the simplifying assumptions of micro-economics and normative strategic management, firms do not operate atomistically, but rather within a social and economic context. Nohria (1992) suggests that studies of organizations can be improved by accounting for the interorganizational networks that are an important part of a firm's context. He asserts that networks play a significant role in shaping the cooperative and competitive behavior of firms, and that many conceptual frameworks pay too little attention to this role. Interorganizational networks are important, in part,

because they can affect the way in which a firm interprets and responds to various survival pressures. For instance, firm success and survival hinges on the firm's ability to cope with:

- Coercive external pressures (e.g., DiMaggio & Powell, 1983)
- Power imbalances (e.g., Pfeffer & Salancik, 1978)
- Uncertainty (e.g., Thompson, 1967)

or on the firm's attainment of:

- Legitimacy (e.g., Meyer & Rowan, 1977)
- Efficiency (e.g., Williamson, 1975).

A firm's network of interorganizational relationships might be strongly affected by its location relative to others in the same industry. Porac, Thomas & Baden-Fuller (1989) found evidence of this phenomenon in the Scottish knitwear industry. In emerging industries, which are usually fragmented, geographic location may be a particularly important determinant of a firm's network of relations. In this case, an individual firm's optimal economic strategy for competition and cooperation might be modified by interorganizational relationships, which might in turn depend on the way firms in the immediate geographic area operate. Other contingencies can also vary with geographic location. For example, Porter (1980, 1985) stresses in his five forces model that managers must carefully consider interfirm factors such as buyer/supplier power, the threats of new entrants and substitute products, and the nature of rivalry within an industry, as well as their plans for coping with these forces, when deciding on whether to

enter (or remain in) that industry. As Porter notes (1990), geographic clustering is an important phenomenon in part due to the variability of these forces across regions.

Since the importance of organizational contingencies, the structure of interorganizational networks, and the nature of Porter's five forces can all vary according to geographic location, it seems that researchers and managers both stand to benefit from a clearer understanding of geography's influence. The questions addressed by this study can be broadly summarized as follows:

- Is there a relationship between geographic proximity and the formation of collective strategies?
- If there is a relationship between geographic proximity and the formation of collective strategies, how does this relationship evolve over time?
- Does the presence of a research institute affect collective strategy formation among geographically proximate firms?
- Does the presence of an economically dominant firm affect collective strategy formation among geographically proximate firms?

Studying collective strategy can provide insights into the evolution of an industry's competitive landscape. Understanding ways in which geographic location affects a firm's competitive environment can improve the explanation and prediction of the performance of individual firms, as well as geographically-defined groups of firms. The development of an industry's competitive climate is studied by testing for the formation of collective strategies in an emerging higher technology industry and by suggesting possible ramifications of these collective strategies for firms.

These questions are studied in the context of the fiberoptics industry. Fiberoptics is a relatively new technology with an extremely wide range of potential applications. This industry has enjoyed explosive growth over the last twenty years, and exhibits pronounced geographic clustering. The fiberoptics industry provides a unique opportunity to investigate the interplay of geographic location and strategy during the early stages of development of an emerging higher technology industry. Furthermore, the relative youth of the industry allows for longitudinal study virtually from its birth to its present state.

COMBINING PERSPECTIVES TO STUDY COLLECTIVE STRATEGIES

Strategic management researchers have studied a wide variety of influences on the nature of competition among firms, but have often ignored or understated the role of geographic location in shaping the competitive environment. In particular, there has been relatively little work done which explicitly accounts for both organizational phenomena and geographic location as determinants of strategic choices. By integrating an array of literature from economics, organization theory, and strategic management, we can hypothesize and test relationships between geographic concentration and individual firms' strategies.

In their efforts to better understand geography's influence on economic activity, economic geographers have tended to focus on observed locational patterns of firms, but have downplayed the dynamics of competition which have caused these patterns (Krugman, 1990, 1995). As a result, economic geography provides numerous insights as

to why economic activity might be geographically dispersed, but relatively few insights as to why such activity is often concentrated (Krugman, 1995).

Porter (1981) has offered a similar critique of Industrial Organization (IO) economics, which has focused on the performance implications of industry structure while downplaying the study of specific competitive processes. Porter argues that studies of organizational phenomena will be more informative and conclusive if they integrate thinking from organization theory, strategic management, and economics. Concepts from strategic management and organization theory provide insights as to how firms compete and cooperate with one another, while economic geography and IO economics suggest reasons for, and ramifications of, the outcomes of competition or cooperation among firms. These perspectives taken together provide greater insight into the formation of collective strategies than can any one perspective alone.

Although industry structure has been shown to affect firm performance, industry structure might affect firms in emerging higher technology industries differently than firms in the consolidated industries often studied. The competitive and cooperative environment is not yet firmly established in an emerging industry, and factors that help to create and modify this environment might vary somewhat by location. Within the conceptual framework in Figure 1-1, this study examines the influence of geographic proximity using three perspectives representative of the three domains suggested by Porter (1981): transaction costs economics, institutional theory, and the strategic management literature. Together, these perspectives bring to bear most of the current organization theory and strategic management thinking to supplement the economic

approaches noted above in explaining geographic location's role in the formation, and subsequent influence, of collective strategies.

GEOGRAPHIC PROXIMITY AND COLLECTIVE STRATEGY

By developing a better understanding of relationships among co-located firms, we can more accurately predict organizational responses to environmental stimuli. Relationships among geographically proximate firms are described here according to the collective strategies that form among these firms. Central to this study is the question of whether, in an emerging industry, geographic location defines a collectivity of significance to firms.

While a given firm can belong to any number of collectivities, memberships in certain collectivities can be more or less important for a number of reasons. For example, a technology-oriented firm's connections to other firms via professional societies will be important if technical information is shared at professional conferences. A local bank might, however, place greater value on its connections via the chamber of commerce than its links to professional societies.

Geographically-defined collectivities could be important for a number of reasons. A firm's location has a direct effect on situational contingencies with which it must cope. For example, available resources, potential customers, and the nature of competition can all vary across regions. Since these situational contingencies affect the strategic postures of individual firms, patterns in firms' strategies are expected to vary by region. Based on arguments from organization theory and economics, this study focuses on two distinct

collective strategies that are predicted to form in geographically-defined collectivities: strategic isomorphism and strategic complementarity.

The term "strategic isomorphism" is coined here to refer to similarities in the strategic postures of organizations. This term is somewhat more specific than institutional theorists' concept of structural isomorphism, which refers to the structural homogeneity that can develop among firms in an organizational field over time (Scott, 1987: 155). As with structural isomorphism, strategic isomorphism is defined in relative, rather than absolute, terms. Firms with comparable degrees of vertical integration, comparable types of products or services, and comparable positions in the value chain can be considered strategically isomorphic whether or not they actually compete for the same customers. Therefore, strategically isomorphic firms are not necessarily direct competitors, although they have the potential to compete directly.

"Strategic complementarity" refers to the potential for a group of firms to form mutually supportive relationships. Strategic postures are complementary to the extent that firms in a group occupy complementary value chain positions. Examples of complementary strategic postures include supplier/buyer (or other upstream/downstream) relationships. As with strategic isomorphism, strategic complementarity will be studied in terms of the potential for firms in a group to support each others' operations, whether or not these firms actually transact with one another.

Viewed at the group level, these two collective strategies are not mutually exclusive; a given group of firms can have high levels of both. Research questions as to the relationship between geographic location and these two collective strategies are

offered in the next section. Specific hypotheses are drawn for testing from each of these research questions.

RESEARCH QUESTIONS

Are nearby firms important reference points for a firm as it forms strategies, and if so, what effect might geographic location have on the formation of collective strategies? The first research question focuses on the possibility that geographically proximate firms will tend to become strategically similar.

R1: What is the relationship between geographic proximity and strategic isomorphism?

To the extent that geographic proximity affects the choice of reference points, it is reasonable to expect that co-located firms will develop isomorphic strategic postures. Fiegenbaum & Thomas (1995) argue that strategies are formed with direct reference to the strategies of other constituents of a strategic group. While Fiegenbaum & Thomas and many other strategic groups researchers (for example, Cool & Schendel, 1987) assume that all members of a strategic group are in one another's reference group, it is argued here that a firm's geographic location moderates the composition of its reference group.

Institutional theory suggests ways in which geographic proximity might encourage isomorphic tendencies. According to this perspective, economic efficiency is not the only explanation for the manner in which organizations are structured and operated. Institutional theorists argue that organizations deemed "legitimate" by individuals, other organizations, and society-at-large enjoy enhanced survivability (Meyer & Rowan, 1977).

DiMaggio and Powell (1983) argue that mimetic, normative, and coercive forces motivate firms to adopt institutionally acceptable structures. The influence of each of these forces might be moderated by geographic proximity.

Mimetic forces result from the tendencies of organizations to copy traits of more established, accepted, or successful organizations. This imitation might be manifested as strategic isomorphism within a collectivity. This phenomenon can occur as an organization is founded, or as an organization adapts to changing circumstances in its environment. Those firms with strategies and structures deemed most legitimate are most likely to be identified as reference points for a given firm and are most likely to be copied. If geographic proximity affects the selection of firms as role models, then we should see a relationship between proximity and strategic isomorphism.

Normative forces, which stem from attempts to define the proper conditions and methods of work in an occupation (DiMaggio & Powell, 1983: 152), may also encourage strategic isomorphism among geographically proximate firms. Firms gain greater legitimacy to the extent that their members adhere to the norms and values which predominate in their area of operation. Professional societies, trade associations, or educational/research institutions with activities specific to a given geographic region may strengthen the institutional environment formed in that region. As the interests and activities of institutions within a region achieve unique identities and become differentiated from others within the industry, strategic postures of firms should become more similar within geographic regions than they are across regions.

Coercive forces affect firms via regulatory mechanisms within an industry or governmental entities. To the extent that enforceable sanctions are possible, firms have a limited range of options with respect to coercive forces: compliance, attempts to influence regulations, or evasion (DiMaggio & Powell, 1983). The geographic location of industries, or firms within industries, will sometimes be affected by differences in laws across political jurisdictions. For example, favorable tax laws in Indiana have encouraged a significant number of mail-order sales firms to locate there.

This study's second research question is based on an alternative possibility for the relationship between geographic proximity and collective strategy formation. Whereas strategic isomorphism refers to the degree of similarity among firms' strategic postures, strategic complementarity refers to the potential that exists among firms for certain types of mutually supportive (symbiotic) relationships. Examples of such relationships include buyer and supplier linkages.

R2: What is the relationship between geographic proximity and strategic complementarity?

The theoretical foundation for this research question is formed predominantly from transaction costs economics and economic geography. Williamson (1975, 1985), building on the ideas of Coase (1937), has argued that firm structure and behavior can be explained in part by the costs of transactions in which the firm engages. Those transactions that can be carried out with relatively lower costs will take place in the market, while transactions subject to the risks brought on by opportunism, adverse selection, and bounded rationality are incorporated within the hierarchy of the firm. One

proposed effect of the geographic concentration of an industry is the general reduction of transaction costs for geographically proximate firms. Reductions in transaction costs for co-located firms lessen the need for vertical integration and enable firms to develop greater reliance on inter-firm transactions within their geographic area. Therefore, as transactions are facilitated within a geographic region, we should observe greater strategic complementarity among co-located firms.

Geographic concentration might favorably influence several sources of transaction costs by helping to: 1) reduce levels of information impactedness, 2) enhance the enforceability of contracts, and 3) reduce the risk of adverse selection. Information impactedness is a form of market failure which results primarily from "the pairing of uncertainty with opportunism," (Williamson, 1975: 14) and has been hypothesized as a major source of transaction costs. This condition exists when one party to a transaction is better informed than the other, and the less well-informed party can obtain additional information only at great cost, since the first party cannot be relied upon to alleviate this imbalance. If firms have more information about potential transactors located near them, then geographically proximate firms might benefit from reduced transaction costs.

Adverse selection refers to the potential that exists in any transaction for one party to choose an undesirable exchange partner. A homeowner with little knowledge of plumbing, for example, is not able to assess the skill of the plumber he hires until after the work is completed. The homeowner can ease this problem by incurring the costs of investigating the reputations of the plumbers who bid on the job.

Over time, all firms develop reputations according to their level of skill and degree of reliability. If geographic proximity makes it easier to obtain reliable information about firms, then there will be less risk of adverse selection when transacting with nearby firms. Geography might become less important to the transmission of reputations as an industry becomes more concentrated. In general, as transactions costs are reduced, the effectiveness of the market increases, which makes it possible for firms to perform fewer of their value-chain functions themselves and encourages more strategic complementarity.

According to economic geographers, firms locate in part based on the extent to which there is a market for their products in a given region. Since strategically isomorphic firms seek similar customers, they should be dispersed fairly evenly across the competitive landscape, according to where customers are located. If strategically isomorphic firms are geographically dispersed, and if firms locate based on the location of customers, then co-located firms are likely to have complementary strategic postures.

Since the phenomena suggested by research questions one and two are not necessarily mutually exclusive, it is possible that over time geographically proximate firms will exhibit both strategic isomorphism and strategic complementarity. In fact, Porter (1990) sees clusters with high levels of both characteristics as a key to national competitiveness in an industry. While research questions one and two ask whether either of two possible patterns exist in the strategic postures of co-located firms, research question three explores the issue of causality: whether geographic proximity enhances the likelihood of pattern formation over time.

The theoretical cases for research questions one and two tend to support an increase in both strategic isomorphism and strategic complementarity among geographically proximate firms over time. Levels of strategic isomorphism should increase as an industry grows and develops. First, firms that are good choices to mimic might become easier to identify over time. For example, information about the structure, strategies, and behavior of successful firms will be increasingly well known within their region. Second, norms of conduct within a group of firms should strengthen as an industry develops. As firms learn which behaviors encourage successful interactions within the industry, formal and informal rules of conduct are established. Third, coercive pressures might regionalize over time as government agencies institute regulations and incentive programs within their jurisdictions, the need for which is not apparent as an industry is founded.

Strategic complementarity among geographically proximate firms is also expected to increase as time progresses. Many of the factors cited above as contributing to transaction costs might be mitigated as transactions among firms become more commonplace. As firms' reputations for performing certain work are disseminated, the risk of adverse selection should decline. The short-term benefits of opportunistic behavior might also be offset by the long-term costs of ostracism as an organizational community is formed.

In general, institutional forces are expected to strengthen, and transaction costs are expected to lessen, as an industry develops. To the extent that interactions are more commonplace among geographically proximate firms, however, institutional forces

should be even stronger, and transaction costs even lower, among neighboring firms than they are among more dispersed firms. Based on these arguments, a third research question is proposed for this study:

R3: Does the relationship between geographic proximity and strategic isomorphism (or strategic complementarity) strengthen over time?

A longitudinal research approach is used to try to determine the extent to which the association, if any, between geographic location and strategic posture changes over time.

Certain types of organizations within a geographically-defined collectivity have the potential to influence the formation of collective strategies, either by enhancing institutional forces or by reducing transaction costs. Examples of such organizations include research institutes and economically dominant firms. This study investigates the influence of each of these entities on the formation of collective strategies among geographically proximate firms.

R4: Is there a relationship between the presence of a research institute and the collective strategies formed among geographically proximate firms?

The fiberoptics industry includes a number of research institutes, and therefore provides an opportunity to study the impact, if any, of these institutes on the patterns of strategic postures within a given region. In emerging higher technology industries, research institutes can provide a number of advantages to nearby firms. First, a research institute can enhance agglomeration economies in its region. For example, a university-based research institute might improve the quality of the local labor pool by graduating students in key technical areas. Research institutes also sometimes facilitate training sessions, technical meetings, trade associations and other mechanisms for improving the

technical know-how of personnel. Second, firms can pool their support for a research institute in order to encourage the development of technological prowess that they may not be able to attain alone. Third, a research institute can provide a means of obtaining public funding and support for the development and growth of the industry. Therefore, by affiliating with a nearby research institute, firms can enhance their access to government support.

These advantages are argued to promote greater strategic isomorphism and complementarity among geographically proximate firms. There are several ways in which research institutes might strengthen the institutional environment, thereby influencing isomorphic tendencies among firms in a given region. For example, research institutes can speed the process of "professionalization," which refers to the formation of cognitive frameworks that influence the thoughts and actions of those practicing in a given field (Scott, 1995). An industry's norms of conduct can be influenced by the educational, research, and coordinative activities of research institutes. Also, the research institute's unique position can make it a conduit for information. This increased flow of information can, for example, facilitate imitation of successful firms (or successful strategies) in the region.

By favorably influencing transaction costs, research institutes can also encourage the formation of complementary strategic postures among geographically proximate firms. For example, research institutes may help reduce information impactedness among co-located firms, thereby reducing transaction costs. Since this benefit exists only as far as the information travels, firms might be more likely to use nearby firms for outsourcing.

If it is perceived as a relatively impartial source of information, the research institute can enhance the level of trust that exists among nearby firms. Ring & Van de Ven (1992) argue that trust is an important moderator of transaction costs.

Also, if research institutes encourage specialization within a group of firms, it is possible that geographically-defined collectivities could become more insular microcosms of the fiberoptics industry. High levels of specialization within regions might lead to the development of unique, region-specific value chains, with co-located firms supplying many of the region's needs.

Enright (1990) asserts that dominant firms significantly affect the formation of geographic clusters and firm behavior within those clusters. While firms with different types of dominance might have differing effects on the strategic postures of their neighbors, this study addresses only the effects of economic dominance. Economically dominant firms often encourage geographic concentration by assisting in the formation of new firms in their immediate area (Enright, 1990). For example Leitz, an optics firm located in Wetzlar, Germany, helped former employees found firms in order to develop reliable sources for critical supplies and equipment (Enright, 1990). Since Leitz helped found these firms, and since it was often their sole customer, it is reasonable to expect that Leitz had substantial influence on the economic activities taking place in and around Wetzlar. Instances such as this suggest the following research question:

R5: Is there a relationship between the presence of fiberoptics-related economically dominant firms in a given geographic region and the collective strategies formed in that region?

Like research institutes, dominant firms are expected to strengthen the institutional environment in their immediate area. Dominant firms that assist in the formation of new ventures are likely to transmit norms, beliefs, and values to those who work for the new venture. In a higher technology industry, similarities in the world views of employees are expected to affect firms' strategic postures. For example, those firms located near Corning, a major producer of glass and related materials, might emphasize the use of glass or glass-based items in their own product offerings. This assumes, of course, that the smaller firm was founded after the dominant firm. As an important potential customer and an opinion leader, the dominant firm might also encourage mimetic tendencies among nearby firms, regardless of when the firms were founded.

Groups of firms which include economically dominant firms are also more likely to have high levels of strategic complementarity. If the dominant firm has a favorable reputation as a transaction partner, it (like a research institute) can contribute to a reduction in transaction costs in its region. A dominant firm can also reduce transaction costs by facilitating cooperation and exchange between nearby firms.

Studying the influence of economically dominant firms is important because of the central role such firms can play in the development of a higher technology industry. The computer industry, for example, was radically altered when IBM created the industry standard for the personal computer.

RESEARCH APPROACH

The hypotheses generated in support of the research questions are tested in the context of the U. S. fiberoptics industry. This industry is relatively young (fiberoptic

cable capable of data transmission was invented in 1974) and has been characterized by rapid growth and the formation of noticeable geographic concentrations. Plots of firm locations within the United States are presented in Appendix B. As a new industry based on a young technology, fiberoptic firms' location decisions are not as likely to be influenced by historical "hangovers" such as the location of natural resources, ports, or former industrial centers. In other words, the locations of fiberoptic firms are more likely to be a manifestation of current strategic choices, rather than being based on obsolete aspects of infrastructure or industry structure.

The data used in this study are drawn from an archival source, an annual directory of firms offering fiberoptic products in the optoelectronics industry, for the years 1976-1994. This directory contains information as to firm size, age, location, and product offerings. Although difficult to verify, it is likely that the data set contains nearly the entire population of firms offering fiberoptic products. All firms offering a "fiberoptic" product or service in the years surveyed are included in the study, whether or not they are predominantly fiberoptic firms. This directory captures the rapid growth seen in this industry, listing 49 U. S. firms in 1976 and 697 U. S. firms in 1994.

The latitude and longitude has been obtained for each city in the database, and is used to approximate the distances between all pairs of firms for each year studied. Indices of strategic isomorphism and complementarity are also calculated for each pair of firms based on the firms' product offerings. Spearman's rank-order correlations are then calculated to assess the relationship, if any, between geographic distance and the levels of strategic isomorphism and complementarity. These analyses are completed at three year

intervals for the years 1976 through 1994. Trends in the correlations over time are assessed to explore the longitudinal issues raised in the research questions. The specific approach used to test each hypothesis is presented in Chapter Three.

SIGNIFICANCE OF THE RESEARCH

The fiberoptics industry offers a unique opportunity to study strategy formation in an emerging industry from a time near its inception. This study tests the applicability of important strategic management principles to emerging higher technology industries. The hypotheses discussed in the next chapter are drawn from several streams of literature that together explain more about collective strategy formation than does any one of them alone. By studying the industry's evolution since this early stage, we can assess whether the processes and phenomena discussed by economists, strategy researchers, and organization theorists influence firm behavior as predicted.

It is argued here that a firm's community has an impact on the strategic choices it makes. It is also argued, however, that in emerging industries a firm's community is determined in large part by its geographic location. If geographic location is found to be associated with a firm's strategy making, then future studies of emerging industries should control for location. A clearer understanding of the role of geographically defined collectivities at various stages of industry development can also prove useful to managers, both when choosing a location for their firm and when forming their competitive and cooperative strategies.

An understanding of how research institutes and economically dominant firms influence the institutional and economic context within which transactions take place can

help both researchers and practitioners. If these entities help to shape the competitive landscape in a given industry or region, then firms might gain a competitive edge by attempting to influence them and by more closely monitoring them. A clearer understanding of the roles of research institutes and dominant firms can also help government policy-makers to decide whether to encourage these entities to form, and how to influence them once they exist.

This study sets the stage for subsequent studies of collective strategy formation in emerging industries. If patterns are identified in the strategic postures of firms, future studies can explore the relationship between these patterns and firm success and survival. In particular, studies of the advantages and disadvantages of various collective strategies for groups of firms, as well as individual firms within these groups, can be performed. This information would provide researchers with valuable explanatory and predictive tools. It would also help managers assess and adapt to their competitive environment, and provide economic policy-makers with ideas on how best to shape and influence this environment.

CHAPTER TWO: LITERATURE REVIEW AND HYPOTHESES

The purpose of this chapter is to provide a detailed review of the relevant literature and to show how this literature can inform the study of collective strategy formation among geographically proximate firms in emerging higher technology industries. The literature relevant to this study is reviewed within the context of the conceptual framework depicted in Figure 1-1 (Lang & Lamb, 1996), which integrates the theoretical streams that broadly underpin this study. The model specific to this study is then presented, and hypotheses are generated.

SECTION ONE: CONCEPTUAL FOUNDATION

The conceptual framework used as a foundation for this study is divided into three main sections: Key Contingencies, Interorganizational Relationships and Organizational Actions, and Collective Strategy. The key contingencies are adapted from the work of Oliver (1990). Each key contingency is the outgrowth of one or two major branches of research in the organization theory literature, including: institutional theory, resource dependence, systems theory, and transaction costs economics. At one time or another, each of these contingencies has been proffered as a determinant of organizational actions and outcomes. Collectively, the five account for important forces, both outside and within organizations, that can affect organizational actions and outcomes.

The concepts in the center section of Figure 1-1 are derived from the network analysis literature, including the work of Granovetter (1973, 1985), who maintains that economic and sociological theories must account for the embeddedness of interactions in a social system. In contrast to many traditional views of sociology and economics, Granovetter (1985) contends that neither environmental determinism nor individual choice alone offers an appropriate explanation for the formation of social structures.

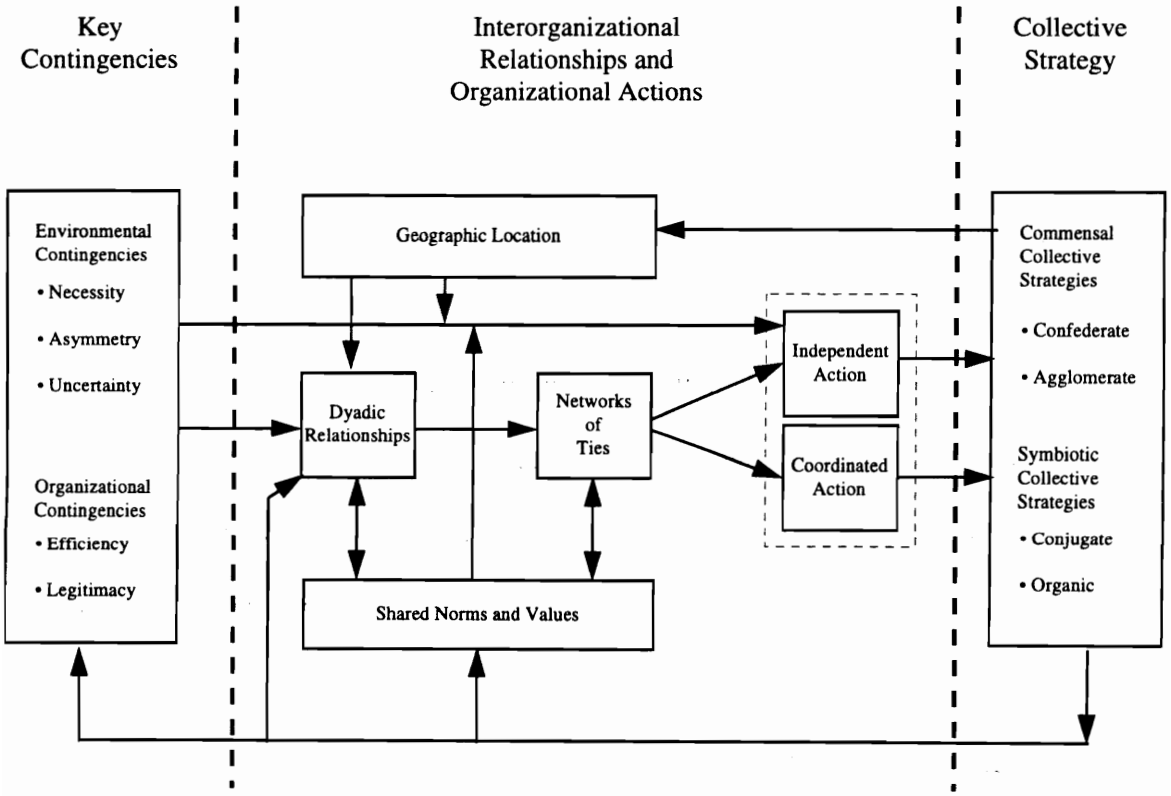

Figure 1-1: Conceptual Framework
(Lang & Lamb, 1996)

Granovetter posits that sociological and economic approaches can be enhanced by accounting for the impact that networks of relations have upon social (and economic) interactions. Hrebiniak & Joyce (1985) have made a similar argument with respect to the formation of strategies. They assert that a more complete picture of organizational phenomena can be obtained by combining frameworks that emphasize determinism with those that emphasize choice.

It is also important to account for the influence of a community's shared norms and values on the choices managers make on a daily basis. In discussing strategic groups, Porac, Thomas & Baden-Fuller refer to socially-shared beliefs as "crucial linking mechanism[s]...which define the relevant set of rivals and guide strategic choices about how to compete" (1989: 400). The strategic group to which a firm belongs is said to comprise a "cognitive community," directly affecting the interpretation of (and response to) environmental and organizational contingencies. In other words, the social norms and the systems of dyadic relations that exist within a community of firms act as filtering mechanisms, affecting firms' information processing and actions.

The third major section of the conceptual framework, "collective strategy," is drawn from the literature on interorganizational relationships (IORs) and game theory. Collective strategies resulting from coordinated action include such IORs as joint ventures, long-term contracts, federations, and trade associations, in which firms intentionally use links with other firms to respond to survival pressures. Coordinated action is characterized by various degrees of cooperation on the part of the firms involved, and sometimes entails the involvement of an agreed-upon third party.

Collective strategies resulting from independent action are patterns which form in the individual strategies of firms even though no conscious effort to cooperate has been made.

Each construct identified in this framework and the relationships among the constructs are discussed in more detail below. The specific model to be tested in this study, the literature relevant to this model, and the specific hypotheses tested are then introduced in subsequent sections.

KEY CONTINGENCIES

The group of key contingencies depicted in Figure 1-1 is adapted from Oliver's (1990) integrative survey of research into interorganizational relationships (IORs). Oliver identifies six key contingencies, each of which (or combinations of which) might motivate firms to form IORs: necessity, asymmetry, reciprocity, efficiency, stability, and legitimacy. Each contingency describes either an environmental condition which must be addressed or an organizational state which is typically sought by organizations. Reciprocity refers generally to the types of benefits derivable from cooperation and collaboration. While many studies into the determinants of IORs cite the importance of reciprocity, this contingency is omitted from Figure 1-1 for these reasons: 1) there is a high degree of overlap between reciprocity and the other contingencies; 2) reciprocity is fairly specific to the study of IORs, while the other contingencies relate to a wider array of organizational phenomena; 3) reciprocity has not been thoroughly developed theoretically, while each of the other five contingencies has been addressed in detail by one or more theoretical frameworks.

Oliver uses the term "stability" to refer to organizations' desire for control over their operating environments. This contingency has been addressed in great detail by systems theorists (for example, Thompson, 1967) who use the term "uncertainty" to describe the environmental state that makes stability difficult to achieve. In order to maintain consistency with the systems theory literature, this contingency is referred to in the framework as "uncertainty."

The five resulting contingencies are grouped in the model according to whether they describe environmental states or organizational attributes. Necessity, asymmetry, and uncertainty all describe environmental states with which organizations potentially must cope. While each of these contingencies tends to be fairly deterministic, in certain cases organizations might be able to exert influence on their environments and create more favorable competitive climates (Child, 1972). For example, organizations might be able to lobby government officials in favor of regulations that work to their own advantage. Efficiency and legitimacy describe desirable organizational states that have been suggested as determinants of firm success and survival. The following sections address the theoretical underpinnings of each of these contingencies in more detail.

Necessity

Necessity refers to those situations in which firms are coerced to respond to an outside pressure. Often organizations face regulatory or legal pressures to engage in certain activities. Mandates from governments, industry associations, professional societies, etc., fall under the category of coercive institutional pressures (DiMaggio & Powell, 1983). These pressures motivate organizational response only to the extent that

they are enforceable, and responses to such pressures are generally motivated by self-interest (Scott, 1995). In most such cases, organizations face a choice between compliance and sanctions.

Asymmetry

This environmental contingency refers to instances of power imbalance among organizations, as described in the resource dependence view (Pfeffer & Salancik, 1978). Resource dependence researchers have emphasized the importance of power imbalance as an environmental contingency, and have investigated the ways in which organizations cope with such imbalances. Organizations can choose from a number of strategies based on either a desire to control other organizations (or their resources), or based on a need to moderate the control other organizations can exert over them (Pfeffer, 1982). To the extent that an organization controls critical resources, that organization is deemed to be powerful relative to others. Empirical support has been found for the assertion that power imbalances affect organizational actions. For example, Salancik (1979) found that firms responded to government pressures according to their reliance on the government and according to their own power relative to the government.

Uncertainty

According to systems theorists (e.g., Thompson, 1967; Katz & Kahn, 1966) the central survival pressure facing organizations is how best to cope with environmental uncertainty. The term uncertainty describes a state of the world that makes it impossible for managers to perceive, interpret, and control all variables relevant to their firms' operations (Thompson, 1967). Uncertainty has generally been broken into three distinct

components: complexity, munificence, and dynamism (Dill, 1958). Complexity refers to "the dissimilarity of environmental elements and the extent of their interconnectedness" (Dollinger, 1990: 277, referring to Keats & Hitt, 1988). According to Scott (1987: 128) munificence is "...the extent to which the resources required by the organization are available in its environment..." Dynamism is the degree to which the environment is stable or rapidly shifting (Dill, 1958).

Much empirical support has been found for the influence of these variables on organizational actions (for example: Duncan, 1972; Emery & Trist, 1965). According to systems theorists, many firm activities are motivated by the need to mitigate these forces. For example, Thompson (1967) notes the role of inventory management in shielding operations from the discontinuities of the external environment.

Efficiency

Many organization theorists and economists view organizational efficiency as being the critical determinant of firm success and survival. In fact, the reason systems theorists have so carefully specified and investigated environmental uncertainty is that uncertainty can seriously hamper the organization's ability to maintain efficient (negentropic) operations (Katz & Kahn, 1966). Miles and Snow (1978) found evidence that a significant percentage of firms, described by them as "defenders," make the attainment of efficiency the primary focus of their efforts.

Porter (1980, 1985) contends that a firm's efficiency is a key determinant of its competitive prowess. While some firms (e.g. low cost strategists or defenders) specialize

in improving their efficiency, all firms must be concerned with efficiency to some extent (Porter, 1985).

Legitimacy

While managers are able to exercise a high degree of control over the efficiency of their organizations' internal operations, there are institutional pressures in their environment over which they have very little control. These institutional pressures are important because they specify appropriate and inappropriate organizational structures and actions (Scott, 1995). Organizations whose actions and structures are consistent with socially determined (institutional) norms are said to be legitimate. While it is unlikely that managers can establish or strongly influence an institution on their own, managers can choose from a variety of responses to institutional pressures. Organizations achieving a sufficient level of legitimacy enjoy enhanced survivability (Meyer & Rowan, 1977). Therefore, legitimacy can be seen as encompassing organizational motivations other than the efficiency concerns discussed above. Efficiency and legitimacy are complementary organizational attributes that together account for many of the motivations behind organizational actions and outcomes.

INTERORGANIZATIONAL RELATIONSHIPS

The contingencies in Figure 1-1 have generally been linked directly to organizational phenomena such as collective strategy. Alternatively, by accounting for interorganizational relationships, this framework incorporates the mechanisms and processes that mediate or moderate the influence of contingencies on collective strategy. Granovetter (1985) maintains that all economic action is embedded in networks of social

relations, and that an understanding of these relations, though largely neglected to date, is crucial to a more complete understanding of economic action.

Classical and neoclassical economists (including Williamson) have typically under-stated the influence of networks on human action. They have traditionally viewed social interactions as "frictional" and dysfunctional with respect to rational choice and the development of perfect markets. The atomized view of economic actors that is derived from this conceptualization results in an incomplete picture of economic action. At the same time, sociological theorists have tended to over-socialize human action by trying to explain behavior as being controlled by societal or institutional forces, while under-emphasizing the role of individual choice and self-maximization.

The missing link, according to Granovetter, is the notion of embeddedness:

> "Embeddedness" refers to the fact that economic action and outcomes, like all social action and outcomes, are affected by actors' dyadic (pairwise) relations and by the structure of the overall network of relations. (Granovetter, 1992: 33, emphasis in original)

Accounting for the mediating and moderating effects of social networks is important because it provides a mid-point between the over- and under-socialized conceptions that more accurately represents the true nature of economic behavior and institutional forces. Rather than attempting to atomize human actors, Granovetter argues that we should take their social relations into account when analyzing behavior.

While Granovetter refers to the individual level of analysis, the basic concepts of network analysis have often been applied to the organizational level of analysis as well. In their volume on network analysis, Nohria & Eccles (1992), for example, include

articles relating both to individuals and organizations, and Nohria (1992) makes a persuasive case for the use of network analysis in relation to both levels of analysis. Belotti (1995: 2) has also argued that "the concepts of inter-firm relationships or of strategic alliances most often embrace technical and economic dimensions while social, cultural and political dimensions are not further explored."

Social theory and classical and neoclassical economics can be informed by explicitly accounting for how an organization's network of relationships influence its actions. Therefore, the conceptual framework in Figure 1-1 accounts for the mediating effect of dyadic relations and social networks, and also for the moderating effect of social norms and values, as well as geographic location, on each contingency.

Dyads and Networks

Dyadic relations form the basic building blocks of all social and economic interactions, and are argued to have a mediating effect on the formation of collective strategies (Dollinger, 1990). A dyad consists of any two individuals, or organizations, that maintain some form of relationship. A variety of exchanges can be made within a dyad, including information, money, or other resources. Game theorists use the dyad as their primary unit of analysis. While game theory includes analyses of multiple-party games, such games are often best understood by breaking them down into components comprising dyadic relations (Dixit & Nalebuff, 1991).

Each organization belongs to a number of dyads, and multiple dyadic relationships constitute interorganizational networks. The structure and functioning of such networks is central to an understanding of organizations' positions, as well as how they interpret,

respond to, and influence their world. Burt (1992) has referred to networks of relations as "social capital" due to the economic benefits that can be derived from them. According to Burt, organizations find opportunities to use their financial and human capital according to the quality of their social capital. An organization identifies and interprets environmental and organizational contingencies according to the information received through its network of relations. As a result, a firm's network of relations affects the information upon which managers base decisions, and therefore affects the organization's actions. For example, managers interpret their position relative to competitors, the trustworthiness of potential exchange partners, and the appropriateness of their actions largely according to information obtained via firms in their network.

Granovetter (1973) provides insights into the nature and functioning of dyads. In particular, he distinguishes between "strong" and "weak" ties, and explains the relative importance of each type of tie. A tie's strength is determined by the amount of time, emotional intensity, intimacy, and reciprocal services that characterize it. To the extent that two organizations are tied to one another, their circles of ties overlap, resulting in a system of strong and weak, direct and indirect, ties within a system.

Granovetter (1973) stresses that weak ties are important because they act as bridges between collectivities, enhancing the degree to which information is disseminated. Bridges are referred to as having "degree *n*" where n refers to the number of links that would connect two parties if that bridge did not exist. A local bridge becomes more significant as its degree increases. Granovetter suggests that the removal of the typical weak tie would do more damage to transmission of information within the

entire network than would removal of the typical strong one. Also, organizations with many weak ties (as opposed to those with many strong ties) are more likely to assist in the dissemination of information. This argument is counter-intuitive, since those organizations with mainly weak ties are often viewed as "marginal." Granovetter cites studies in support of this assertion; these studies indicate that the networks most capable of disseminating information were comprised of people linked weakly. An example of this phenomenon is the impact of trade associations and national meetings on the dissemination of information within a profession.

The fragmentation that can occur when there are few bridges between networks can be dysfunctional when mobilization of a larger social unit is required. Granovetter (1973) notes the case of several neighborhoods, each characterized by strong ties and local cohesion, but unable to mobilize against unwanted development due to a lack of weak ties (bridges) between the neighborhoods. Leaders could not mobilize group members effectively because they lacked the means to disseminate key information across neighborhoods, and because residents had difficulty assessing trustworthiness and coordinating efforts with respect to those from outside their neighborhood. An understanding of the relevant networks of relations offers insights into why such cohesive communities failed to mobilize against a threat. The network is the mechanism which determines how individual wants and needs might (or might not) be translated into macro-level outcomes. By understanding how the network affects organizations' actions, we can more accurately predict the likely consequences of these actions.

Shared Norms and Values

Astley and Fombrun (1983a) also discuss the role of the "superstructure" in collective strategy formation. The term superstructure refers to the shared understanding among firms in a collectivity with respect to competitive and cooperative behavior. The effects of norms and values have been studied by institutional theorists, who argue that organizational actions are strongly affected by socially constructed, transmitted, and monitored institutions.

> Institutions consist of cognitive, normative, and regulative structures and activities that provide stability and meaning to social behavior. Institutions are transported by various carriers--cultures, structures, and routines--and they operate at multiple levels of jurisdiction. (Scott, 1995: 33)

While organizations can identify and address the demands of these institutions when seeking legitimacy, the creation of such institutions and the determination of whether an organization is indeed legitimate is generally beyond the control of a single organization. Norms and values can affect an organization's choice of transaction partners, conduct in dyadic relations, and response to key contingencies.

Strategic group researchers have also discussed the impact of shared norms and values on the choices made by individual firms. Porac et al. (1989), in their study of the Scottish knitwear industry, point out the relationship between shared beliefs about the competitive environment and strategy formation within these firms. They view this group of firms as a distinct group based on the degree of unanimity regarding the relative merits of certain strategic options. In other words, these researchers identified shared beliefs

that affected perceptions of the external environment as well as the selection of adaptive mechanisms.

Geographic Location

As implied by Porac et al. (1989) the strategic groups concept can be informed by the study of geographic location. Geographic location is likely to have an influence on the formation of dyadic relationships in fragmented industries. The norms and values underlying an organization's behavior can also vary with location, assuming that communities of firms are in part defined by geography. The influence of geographic location is the focus of this study, and is therefore discussed in greater detail below.

Organizational Actions

Organizations can act independently or in concert with other organizations. Any study of collective strategies must account for the distinct implications of each type of organizational action. Some of these distinctions are addressed by the discussion of collective strategy presented below.

COLLECTIVE STRATEGY

Collective strategy is a rich construct with a wide variety of descriptors, practical applications, and theoretical implications. Astley (1984) describes collective strategy as a vital adaptive device for organizations facing increasingly turbulent environments; the prevalence today of interorganizational linkages in a wide variety of industries seems to bear out this assertion. Astley makes a convincing case that an improved understanding of collective actions and outcomes is an important step in the development of organization theory and strategic management.

According to Astley, the early development of organization theory and strategy were both typified by an emphasis on environmental **constraint**. Systems theorists, contingency theorists, and those studying business-level strategy emphasized the ways in which organizations adapt to demanding external environments. Organization success and survival was deemed to depend most directly on the degree to which an organization's structure and processes "fit" these external constraints. In the early 1970's, many researchers shifted their focus to **choice**. Rather than merely adapting to their environments, it was argued, managers can select the environment within which they operate (Child, 1972). Also emphasized by these theorists was the effect that an organization can have on its environment. More recently, scholars in organization theory and strategic management have focused on populations of organizations as their level of analysis. Organizational ecologists (beginning with Hannan & Freeman, 1977) and industrial organization economists (as discussed by Porter, 1981) have called for a focus on **competition** for resources among organizations within a given industry. Both of these perspectives downplay the effect of individual organizations on the long-term results of the competitive process. Population or industry structure, and an organization's suitability for this structure, are argued to drive performance.

While each of these perspectives can still inform our understanding of organizations and their environments, Astley calls for yet another shift in focus--from competition to **collaboration**. Such a shift has a number of implications for practitioners and theorists alike. From the viewpoint of practitioners, it implies that organizations do not have the option of completely independent action. Increasingly, interdependency is a

way of life in a wide variety of industries and geographic settings. For many organizations, links to suppliers, customers, and competitors, among others, are more explicit in strategic decisions and more important than ever before. Therefore, to the extent that collaboration exists within a population of organizations, organizational performance should relate to managers' abilities to effectively identify and manage these interdependencies. Recent interest in such organizational forms as the "virtual" or "hollow" corporation (e.g., Jonas, 1986) indicates that managers might now need to actively seek new and complex interdependencies as a source of competitive advantage. As collaboration becomes more prevalent, a new conception of the organizational environment is needed that accounts for the fact that "the boundary between organizations and their environments begins to dissolve" (Astley: 533). Not only can collective strategy affect an organization's environment, it is also a strategic alternative.

Astley and Fombrun (1983a) developed a comprehensive typology of collective strategy that utilizes bioecology's concept of communal adaptation. Communal adaptation refers to the tendency of organizations to develop commonalities with other organizations. Astley and Fombrun argue that these common traits define collectivities of organizations; the more important a commonly found trait is to a given organization, the more significant that collectivity is to the organization.

There are two types of collectivities: commensal and symbiotic. Commensal collectivities are comprised of firms of the same species, whether or not these firms compete directly for resources. Symbiotic collectivities contain firms of different species that have the potential to be mutually supportive. Astley and Fombrun suggest two

dimensions to distinguish between these types of collectivities (Figure 2-1). "Type of Association" refers to the character of the links that exist among organizations in a collectivity. In general, members of a large collectivity are indirectly linked with one another (and small collectivities, or pairs, directly). "Form of interdependence" refers to whether links between firms in a collectivity tend to be "within-type" or "across-type." Examples of each type of link are also indicated in the cells.

		Form of Interdependence	
		Commensal	Symbiotic
Type of Association	Direct	Confederate *e.g., Research consortia, Cartels* **1**	Conjugate *e.g., Interlocking directorates* **2**
	Indirect	**3** Agglomerate *e.g., Trade/Industry Associations*	**4** Organic *e.g., Chambers of Commerce*

Figure 2-1: The Collective Strategy Framework
(From Astley & Fombrun, 1983)

Confederate collectivities (cell one) are characterized by direct interaction, often resulting in the replacement of competition with oligopoly or monopoly. Typical control mechanisms in this type of collectivity include collusion and informal leadership made

possible by the close ties between firms. "Confederates" are organizations of the same type that must vie for comparable resources in the same general domain.

Conjugate collectivities (cell two) are populated by organizations with linked primary tasks, sometimes described as being "sequentially interdependent" (Katz & Kahn, 1966). These relationships include such pairwise couplings of firms as supplier/buyer relationships. Control mechanisms used in this type of collectivity include interlocking directorates, joint ventures, and long-term contractual obligations. Rather than competing for the same resources, these organizations actually help to create resources for one another.

Agglomerate collectivities (cell three) contain many similarly-sized firms that compete aggressively on a relatively equal footing. Information tends to flow freely within an agglomerate collectivity, reducing the benefits of opportunistic behavior. Cooperative efforts in this type of collectivity are coordinated via such mechanisms as trade associations or cartels. While members of an agglomerate collectivity all require similar resources, they are not necessarily competing directly with one another for a share of the same resource pool. For example, they might serve similar customers in different geographical regions.

Organic collectivities (cell four) are also described by Astley & Fombrun as "the corporate web." Subtle inter-species network relationships can exist and can influence the actions of individual firms. Organic collectivities facilitate wide dissemination of institutional forces. Members of organic collectivities are linked via such mechanisms as chambers of commerce, business schools, political bodies, and other remote influencers.

While Astley and Fombrun (1983b), Bresser and Harl (1986), and Bresser (1988) acknowledge that collective strategies can be formed both intentionally and unintentionally, none explicitly addresses unintentional collective strategies. The definition of collective strategy developed for this study acknowledges intentional cooperation, or "coordinated action," as well as other types of collective strategies that form as the result of independent, or non-coordinated, actions of organizations. A comprehensive definition of collective strategy needs to address three main mechanisms: intentional cooperation among organizations, unintentional (emergent) cooperation, and the unintended outcomes of organization-level interactions in general.

Collective Strategy Resulting from Coordinated Action

Most definitions of collective strategy presented to date have focused on intentionally cooperative behavior, described here as "coordinated action." Collective strategy via coordinated action is defined for purposes of this study as "the joint mobilization of resources and formulation of action within collectivities of organizations" (Astley & Fombrun, 1983: 578). Some of the mechanisms used to form and manage intentional collective strategies include: joint ventures, strategic alliances, federations, cartels, and research consortia. Each of the four collective strategies depicted in Figure 2-1 can result from the coordinated actions of organizations in a collectivity. In some cases, one or more of the organizations in a collectivity coordinates cooperative activities, while in other cases the organizations opt to have a third party act as coordinator. For example, firms themselves might manage research consortia or

interlocking directorates, but often agree to autonomous management of trade associations or chambers of commerce.

Collective Strategy Resulting from Independent Action

Intentional cooperation is not the only way that collective strategies can form. Strategic management and game theory point to a broader conception of collective strategy, how it is formed, and why it is of theoretical and practical importance.

The expression 'collective strategy via independent action' refers to observable patterns of behavior that result from individual organizational actions without active coordination. Schelling (1978) uses a game theoretic approach to describe ways in which individual actions aggregate to group-level patterns that individuals do not foresee and might not even desire. While individuals generally act purposefully, Schelling points out that behavior can be contingent on the behavior of others. In spite of our most preferred outcome, we often are compelled to act in a non-optimal way because of our position in the larger system within which we reside and act. In situations like those described by Schelling, an organization's own choices can contribute to the patterns of strategies that form within its collectivity.

Axelrod, in his 1984 book "The Evolution of Cooperation," applies game theory to an analysis of interpersonal (and interorganizational) relationships. The basic question addressed by Axelrod is this: in a world populated by self-interested parties, how and why does cooperation proliferate when there is no central authority? In particular, what elements of interaction between parties make it possible for each party willingly to open themselves to the risk of opportunistic behavior on the part of others? While cooperation

often results from selflessness or coordinated action, Axelrod makes a persuasive case that cooperation can also develop among the self-interested, even without coordination. The characteristic of an interaction that makes cooperation an attractive alternative is the likelihood of future interactions. Therefore, if organizations in a collectivity expect to interact with one another again in the future, collective strategies are likely to form among these organizations, even without coordination.

Definition: Collective Strategy

For purposes of this study, collective strategy is defined as the pattern of competitive/cooperative strategic postures that exist within a collectivity of organizations with or without explicit coordination. In that sense, strategic isomorphism and strategic complementarity, as defined in Chapter One, can be considered collective strategies. The formation of these two collective strategies is argued to be influenced by the geographic location of organizations, as well as by the institutional forces and transaction costs with which organizations must cope.

RELATIONSHIPS AMONG CONSTRUCTS

The constructs described above are grouped into sets, and these sets are arranged in Figure 1-1 according to the relationships that are proposed to exist between them. While hypotheses are generated in this study with respect to only a few of these relationships, they are all discussed briefly in order to provide the theoretical context for the study.

Direct Relationships Between Key Contingencies and Collective Strategy

While studies of interorganizational relationships have often linked one of the key contingencies directly to organizational actions or outcomes (as discussed by Oliver, 1990) there is likely to be only one instance of unmediated relationship between the contingencies and collective strategy: to the extent that firms observe and react to other firms with which they have no dyadic relations, extra-network formation of collective strategy via independent action is possible. The moderating influences of geographic location and shared norms and values on this relationship, indicated in Figure 1-1, are discussed below.

The Mediating Effect of Interorganizational Relationships

A firm's dyads and networks will affect its reactions to key contingencies and, as a result, will affect the collective strategies to which it contributes. A firm has more complete information about the strong and weak points of role models with which it has dyadic relationships. Therefore, when firms select role model firms to mimic, as described by institutional theorists, it is likely that they will select role models from within their network. A firm can also select a role model based on information available through other sources in the network. Therefore, the network is likely to affect a firm's independent actions, and can contribute to the formation of collective strategies.

Dyads and networks also influence a firm's entry into coordinated action with other firms. For example, joint ventures are an increasingly valuable competitive approach, offering firms a variety of ways to cope with survival pressures (Lewis, 1990). Firms are most likely to form joint ventures with other firms about which they have

reliable information. To the extent that dyadic relationships and networks provide such information, they will influence a firm's willingness to form partnerships, as well as its choice of partners.

Axelrod (1984) analyzes dyadic and multiple-party exchanges in which cooperation might arise, even though each party is interested in outperforming his or her counterparts. His analysis, which focuses on cooperation, can also help us analyze the formation of collective strategies. Axelrod suggests that one of the most important motivations of cooperative behavior is the "shadow of the future." If future exchanges between firms are expected, and expected to be valuable, then any cooperation between them holds more promise. Another factor in dyadic relationships that can affect the nature and extent of cooperation is the payoff structure. If exchange partners have a well-constructed system of payoffs, defection will be less attractive and coordinated action will be easier to control. Axelrod also contends that the level of cooperation within a community can be increased by members' feelings of group membership and sense of obligation to the community. If a firm defines its community in terms of its dyadic relationships, then coordinated action is more likely between a firm and the members of its community.

Shared Norms and Values

Norms and values shared among firms in a network can both affect, and be influenced by dyadic relationships. Norms and values most strongly affect dyadic relationships by suggesting criteria by which firms evaluate potential exchange partners. The experiences of transacting firms help to shape their expectations of what is

acceptable or unacceptable behavior, thereby encouraging the development of norms and values within the community.

Geographic Location

Pouder and St. John (1996) discuss the influence of geographic location on managers' mental models. They argue that geographic proximity is a "segregating mechanism" that influences the choice of competitors which managers scrutinize most closely. Therefore, firms are more likely to react to, and interact with, competitors that are located in closer proximity.

While firms' geographic location influences the formation of collective strategies, the collective strategies that form in a geographic area can also influence where new firms will locate, and where existing firms choose to re-locate.

The Feedback Loop

Once collective strategies form, they have the potential to affect the formation of norms and values, dyads and networks, and also the key contingencies to which firms must respond. This phenomenon is reflected in the conceptual framework by way of a feedback loop that indicates the varied effects of collective strategies on other aspects of the model.

SECTION TWO: FOCUSED LITERATURE REVIEW

The part of the conceptual framework specific to this study is presented in Figure 2-2. The key concepts in this framework are drawn from institutional theory, transaction costs economics, and strategic groups research. Theoretical and empirical support for this framework is discussed below.

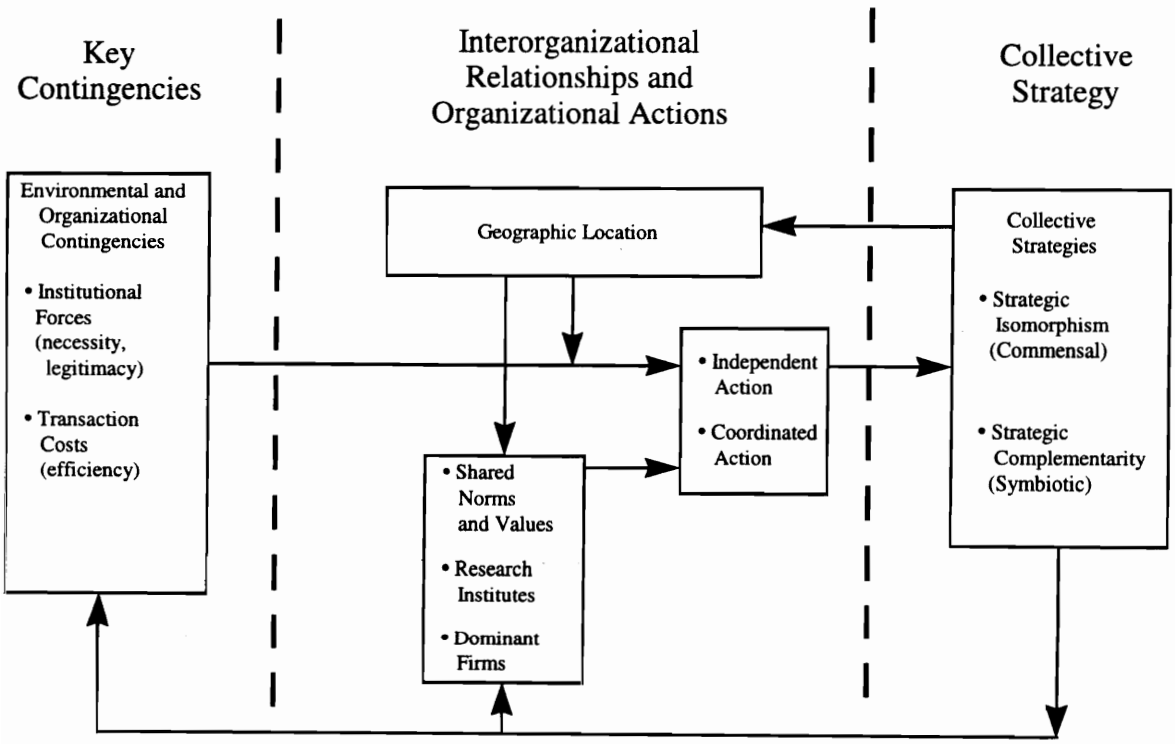

Figure 2-2: Study-Specific Conceptual Framework

INSTITUTIONAL FORCES

While many perspectives on organizations have emphasized the importance of operational efficiency, institutional theorists suggest that many organizational actions are motivated by requirements other than efficiency. Specifically, they argue that organizations operate within an "institutional environment" that places demands on the ways in which they structure themselves and operate.

Institutional theorists argue that a critical determinant of organizational success and survival is legitimacy (e.g., Meyer & Rowan, 1977). Legitimacy is defined as "the property of a situation or behavior that is defined by a set of social norms as correct or appropriate" (Scott, 1987: 286). Therefore, to the extent that a firm's strategy, structure, or behavior are in alignment with beliefs held in its community, that firm is deemed legitimate, and enjoys enhanced survivability as a result (Meyer & Rowan).

DiMaggio and Powell (1983) argue that the institutional environment influences firms via coercive, mimetic, and normative forces. Coercive forces, as discussed with respect to the general conceptual framework, affect firms via regulatory mechanisms within an industry or via governmental entities. Professional societies or trade associations, if given power to enact and enforce rules of professional conduct, might also affect whether certain strategies are deemed acceptable or desirable. Mimetic forces result from the tendencies of organizations to copy traits of more established, accepted, or successful organizations. Imitation can contribute to strategic isomorphism within a group of organizations as organizations are founded and as they adjust their operations to changing circumstances. Normative forces result from the professionalization of a field,

and are usually transmitted via educational institutions, professional societies, trade associations, and other similar entities.

TRANSACTION COSTS

Transaction costs theorists, beginning with Coase (1937) and strongly influenced by Williamson (1975, 1985) propose that the existence of firms, as well as firm structure and behavior, can be explained in part by characteristics of the transactions in which the firm engages (Ricketts, 1987). Transactions with relatively little expense or risk are likely to take place in the market. Others, which require monitoring of exchange partners, carefully specified contracts, and enforceable sanctions, are more expensive. Transactions that are relatively more expensive or risky are incorporated within the hierarchy of the firm, where greater control through fiat makes the transaction more efficient.

Three root sources of transaction costs (market failures) are identified by Coase: bounded rationality, adverse selection, and opportunism. **Bounded rationality** refers to the limited ability of managers to understand the complexity and uncertainty of their environments. Since no one can afford the time or money it would cost to know all facts pertaining to a choice, we must choose with the hope that we can identify (and understand) the most relevant facts. **Adverse selection** is the problem created when many of a potential exchange partner's qualities are obscure. Since obtaining all relevant information about an exchange partner's skills and background is too costly, there is always the risk of choosing to transact with someone who is less than the ideal partner. An insurance agent cannot, for example, know that a new driver is a poor driver until

after the policy is sold and claims are received. All insurance agents would prefer to insure only the best drivers, but even with careful screening, some undesirable clients receive policies. Once the terms of a transaction are agreed upon, transactors still face the risk of **opportunism**, also referred to as the "moral hazard" problem. Opportunistic behavior occurs when one transactor makes promises that they do not plan to keep, or otherwise takes unfair advantage of their exchange partners. While only a few transactors might act opportunistically, it can become expensive to sort out the honest from the dishonest.

These three basic causes of market failure have been amplified and augmented by Williamson (1975, 1985) and others (Ouchi, 1980; Williamson & Ouchi, 1981; Walker & Weber, 1984). **Asset specificity** refers to the extent to which a firm makes investments that are durable and non-marketable (Williamson & Ouchi: 352). In other words, if the firm's exchange partners do not act as promised, or if the transaction falls through, these assets are wasted. Whenever a firm invests in transaction-specific assets, they are at risk of losing this investment. **Information impactedness** is a form of market failure which results primarily from "the pairing of uncertainty with opportunism," (Williamson, 1975: 14). This condition exists when one party to a transaction is better informed than the other, and the less-well-informed party can obtain additional information only at great cost, since the first party cannot be relied upon to alleviate this imbalance. All of these transaction costs can directly affect firms' strategic postures by influencing whether a firm makes or buys the items and expertise it needs.

STRATEGIC GROUPS

Cool and Schendel define a strategic group as "a set of firms competing within an industry on the basis of similar combinations of scope and resource commitments" (1987: 1106). Since the idea of strategic groups was first proposed, strategic management researchers have attempted to identify such groups and detect performance differences across groups. While many studies have identified strategic groups, the means of operationalizing strategic groups have varied widely. For instance, Newman (1972) identified strategic groups in the U. S. chemical process industry based on the degree to which firms were vertically integrated. Cool and Schendel (1987, 1988) identified groups based on such factors as: market segments served; products and services offered; geographic reach; and deployments of human, financial, and physical assets. This approach was limited in its ability to make comparisons across industries.

Mascarenhas and Aaker (1989) have offered what appears to be the most useful approach to operationalizing strategic groups. They suggest that mobility barriers are a more valid and reliable way of distinguishing between groups. Mascarenhas and Aaker define mobility barriers as exit and entry barriers generated by the assets and skills of individual firms (1989: 475). Examples include: costs of plant and equipment, brand identity, long-term contracts, specialized training of employees, and manager pride. Therefore, while the Mascarenhas and Aaker approach also reflects industry-specific phenomena, it offers a stronger framework for comparison across groups and industries than does the Cool and Schendel approach.

The identification of collective strategies in this study offers at least two ways to build on these attempts at operationalizing strategic groups. First, measuring the level of strategic isomorphism is proposed as a useful way of operationalizing the idea of "competitive closeness." Most attempts to study strategic groups have hinged on identifying close competitors. The actual overlap of product and service offerings might prove a more accurate representation of closeness than the sometimes vague industry segmentations used in prior studies.

Second, by testing for a relationship between collective strategies and geographic distance, this study can help identify the relative importance of geographic location as a dimension for identification of strategic groups in higher technology industries. Geographic location, though rarely accounted for in strategic group studies, might be a significant determinant of managers' perceptions of their competitive environments. The collectivities studied here comprise geographically proximate firms. To the extent that such industries are reliant on frequent interorganizational relationships to spur technological advancement, geographic location is likely to be an important determinant of strategic groups. Alternatively, the advent of express mailing services, facsimile, and electronic mail, as well as the ease with which many higher technology products can be shipped, might make geographic proximity less important in these industries.

The strategic groups concept also offers theoretical support for the hypotheses generated below. Factors that influence firms' choices of strategic reference points will have a pivotal role in all of the hypothesized relationships. Fiegenbaum & Thomas (1995) tested the extent to which firms in the insurance industry use their strategic groups

as reference points when formulating strategies. While the insurance industry is far more mature and consolidated than the fiberoptics industry, their approach is still relevant to the relationships being addressed in this study. Fiegenbaum & Thomas identified stable strategic groups in the insurance industry, and also found that firms in this industry appear to use their group as a strategic reference point. Porac, Thomas & Baden-Fuller (1989) noted the formation of cognitive communities in the Scottish knitwear industry, and Pouder and St. John (1996) have stressed the importance of geographic clustering in determining which mental models will predominate within a group of firms. Peteraf and Shanley (1997: 175) have distinguished between strong and weak strategic group identities, and propose that greater geographic proximity will correspond to stronger group identity.

This study amplifies the ways in which geographic location can influence competitive choices, and tests whether geographic location is indeed an important factor in the choice of strategic reference points, and by extension whether it is an important factor in the identification and formation of strategic groups.

SECTION THREE: HYPOTHESES

Based on the relationships suggested in the research questions and the conceptual frameworks, hypotheses are generated with respect to the influence geographic distance has on the development of strategic isomorphism and strategic complementarity. Strategic isomorphism and strategic complementarity are studied here as examples of commensal and symbiotic collective strategies that can form within a given industry. The hypothesized relationships to be tested here are depicted in Figure 2-3.

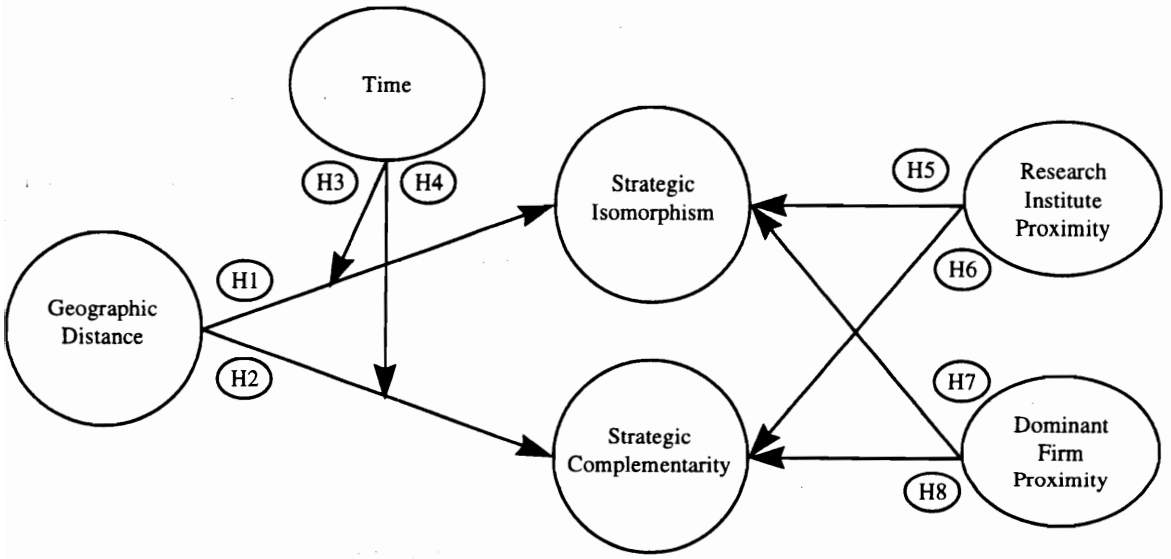

Figure 2-3: Hypothesized Relationships

Describing operating units as "firms" implies that each unit is an independent, self-sufficient organization, and as a result does not accurately encompass the variety of business units included in the database. In his analysis of the British manufacturing sector, Gorecki (1975) uses the term "establishment" to refer to operating units of varied size and scope. Therefore, the term "establishment" is used here to encompass the various types of operating units studied. These types include such organizational forms as independent firms, divisions of larger firms, and operating units within divisions.

GEOGRAPHIC DISTANCE AND STRATEGIC ISOMORPHISM

Research question one asks whether there is a relationship between geographic proximity and strategic isomorphism. The term 'strategic isomorphism' is introduced in this study to refer to the extent to which establishments have similar strategic postures. Strategic isomorphism is an instance of an emergent commensal collective strategy. We identify similarities in strategic posture based on the kinds of products establishments provide as well as in the value-chain activities they perform with respect to these products.

Institutional theory suggests ways in which geographic distance between establishments might influence isomorphic tendencies. Specifically, geographic distance might moderate the influence of the coercive, mimetic, and normative forces with which establishments must cope. If establishments located in geographic proximity to one another face similar isomorphic pressures, then they might develop similarities in their strategic postures.

Variations in the structure and behavior of establishments can sometimes result from differences in coercive pressures across local political jurisdictions. Although the influence of local political jurisdictions can sometimes be dramatic, it is not anticipated to be strong in emerging higher technology industries. First, higher technology industries are often relatively free of externalities (such as pollution or traffic) which are the focus of local attention. Second, the newness of emerging industries makes it difficult to identify the problems these industries might eventually cause for surrounding communities. Since government regulation tends to lag the problems it is intended to address (Stone, 1975), we expect to see relatively little local regulation of emerging higher technology industries. Finally, local governments are often accommodating to establishments in emerging higher technology industries since these industries are generally perceived as providing attractive economic development opportunities.

As noted above, mimetic pressures can contribute to strategic isomorphism among geographically proximate establishments as organizations are founded. New establishments often model themselves after successful existing establishments when formulating their product and service mix (DiMaggio & Powell, 1983). By offering a line of products similar to an existing establishment, the new establishment signals to potential customers what sort of establishment they intend to be. It is hypothesized here that new establishments have better information on local "role models," and that, as a result, imitation is more likely to occur within the immediate geographic area.

Mimetic forces in higher technology industries can also result from significant ties between new and existing establishments. Porter (1990) and Enright (1990) note that

existing establishments actively encourage and support the formation of new establishments, often near one of their own facilities. When this occurs, certain aspects of the establishment's structure and behavior are sometimes copied from the "mentor" establishment. Even when existing establishments do not actively support the founding of new establishments, there are forces encouraging imitation within their geographic area. For example, founders of new establishments usually develop their expertise by working for an existing establishment, and might incorporate into the new operation certain traits of their previous employers' operations. An establishment's long-term employee, knowing the pros and cons of the establishment's product line, influences the product line of her start-up based on this knowledge. Since spin-off entrepreneurs often choose to locate their new establishments near their former employer's establishment, we would expect to see these mimetic tendencies in firms which are close to the establishments being imitated.

After an establishment is formed, mimetic forces can influence the way in which it adapts to changing circumstances in its environment. Fiegenbaum & Thomas (1995) suggest that strategies are formed with direct reference to the strategies of other members of a strategic group. In an emerging industry geographic proximity is expected to influence the choice of reference points for an establishment formulating its own strategy. Therefore, to the extent that "...group members will adjust their strategic behavior toward a group reference point" (Fiegenbaum & Thomas, 1995: 464) we would expect strategic postures of some establishments in the same geographic area to become more alike. Those establishments with strategies and structures deemed most legitimate are most

likely to be identified as reference points for a given establishment and are most likely to be copied.

Normative forces, which stem from attempts to define the proper conditions and methods of work in an occupation (DiMaggio & Powell, 1983: 152), might also play a role in the tendency towards strategic isomorphism within a geographic area. Establishments gain greater legitimacy to the extent that their members adhere to the norms and values that predominate in their institutional environment. Professional societies, trade associations, or educational/research institutions with activities specific to a given geographic area can strengthen the institutional environment of that region. Rules of conduct developed during repeated interactions with other establishments can also encourage isomorphic tendencies. If establishments interact more often with geographically proximate counterparts, it is possible that region-specific behavioral norms will develop, further enhancing the tendency for establishments within a region to become strategically isomorphic.

While much empirical support exists in the organization theory literature for the structural isomorphic tendencies brought on by coercive, mimetic, and normative forces, the influence of geographic location on these forces as they relate to strategic isomorphism has not been explored. By accounting for geography, we might enhance our understanding of institutional processes in emerging higher technology industries. Therefore, based on the above arguments, it is hypothesized that:

H1: In an emerging industry, the geographic distance between two establishments and their level of strategic isomorphism will be inversely related.

GEOGRAPHIC DISTANCE AND STRATEGIC COMPLEMENTARITY

Research question two asks whether there is a relationship between geographic proximity and another collective strategy: strategic complementarity. The term "strategic complementarity" is coined here to refer to establishments engaged in complementary value chain activities, such as buyer/supplier (or other upstream/downstream) relationships.

Establishments in close geographic proximity might develop high levels of strategic complementarity in part due to the need to be near customers and away from competitors. According to economic geographers, as discussed in Dicken & Lloyd (1990), establishments with similar customer bases are often geographically dispersed so as to avoid direct competition. This tendency for direct competitors to disperse increases the likelihood that establishments will be located closer to their buyers and suppliers. Therefore, high levels of strategic complementarity among geographically proximate establishments may provide support for the market-driven dispersion patterns suggested by economic geography.

If geographically proximate establishments are found to have high levels of strategic complementarity and low levels of strategic isomorphism, then this argument would receive even stronger support, since it would indicate that establishments with isomorphic strategic postures were indeed dispersed. If geographically proximate establishments exhibit high levels of both of these collective strategies, then an additional explanation of strategic complementarity might be needed. Higher technology industries might not be as tightly bound to the location of their customers as are establishments in

more traditional, resource-intensive industries. If this is the case, and if establishments in close proximity are found to be strategically complementary, then forces other than customer-driven dispersion might be at work.

Transaction costs economics (Coase, 1937; Williamson, 1975, 1985) offers possibilities as to why geographically proximate establishments might exhibit complementary strategic postures. In an emerging industry, geographic proximity can favorably influence each of the sources of transaction costs noted earlier in this chapter. To the extent that geographically proximate establishments form a "cognitive community" (Porac et al., 1989), the problem of **bounded rationality** can be lessened. Bounded rationality refers to the "limits of human intellective capacities in comparison with the complexities of the problems that individuals and organizations face" (March & Simon, 1958: 169). March and Simon argue that individuals and organizations cope with bounded rationality by developing problem-solving models, including techniques for identifying alternative solutions and their consequences. The establishments located in a geographic region can form a microcosm that is somewhat less complex and uncertain than the industry as a whole. Identifying and understanding the facts relevant to a given transaction should therefore be less costly with exchange partners located nearby than with those that are more remote.

As establishments engage in more and more transactions, information about their performance is disseminated throughout the community. This reputation effect should reduce the risk of **adverse selection** if exchange partners are located nearby. An establishment's reputation becomes increasingly important because, all other things being

equal, potential exchange partners prefer to transact with those who have favorable reputations. Since, in fragmented industries, geographic location is expected to affect the dissemination and trustworthiness of reputations, establishments in such industries are likely to transact more with co-located establishments than with geographically remote establishments. As transactions become more commonplace within a group of establishments, favorable first-hand experiences encourage the development of greater trust. High levels of trust reduce transaction costs, making otherwise prohibitively expensive or risky transactions possible (Ring & Van de Ven, 1992).

There are several ways in which dealing with geographically proximate establishments can reduce an establishment's exposure to the problems brought on by **opportunism**, **asset specificity**, and **information impactedness**. The reputation effect cited above can make it less expensive for an establishment to sort out the honest from the dishonest when selecting exchange partners. It is argued here that, in emerging or fragmented industries, geographically close firms can more accurately assess each other's reputations with relative ease. Therefore, geographic proximity helps make promises more enforceable. The more likely it is that opportunistic behavior will be reported to potential exchange partners, the greater the economic costs of such behavior (Williamson, 1975) and the less common it will become. Since establishments are likely to more readily trust nearby exchange partners, they are also more likely to become reliant on these establishments for key inputs to their production process.

As transactions costs are reduced, the relative efficiency of markets increases, thereby decreasing pressures to vertically integrate and increasing dependence on inter-

establishment transactions. Since inter-establishment transactions are facilitated by geographic proximity, we should observe high levels of complementarity in the strategic postures of proximate establishments.

H2: In an emerging industry, the geographic distance between two establishments and their level of strategic complementarity will be inversely related.

TRENDS OVER TIME

Having posed the question of whether certain collective strategies exist among geographically proximate establishments, the next two hypotheses are offered to explore the dynamics of geographic proximity and collective strategy in a developing industry. Research question three asks whether, over time, establishments become increasingly strategically isomorphic or complementary with nearby establishments. It is possible that, in an emerging industry, levels of both strategic isomorphism and strategic complementarity tend to increase over time as a function of geographic proximity. It is likely, however, that this is not a monotonic function over the life of an industry. Therefore, the scope of the following hypothesis is limited to the early stages of an industry's development.

In an industry's early stages of development, strategic isomorphism in a given region is likely to increase steadily. Organizational ecologists (for example: Hannan & Freeman, 1977, 1989) describe a process of industry evolution that leads us to expect this trend. As an industry is formed, both new and existing establishments enter in increasing numbers, attempting to capitalize on a new niche. In this early stage of industry development, Brittain & Freeman (1980) argue that establishments finding new ways of

exploiting the niche are at a competitive advantage. For a time, establishments emphasize finding unique ways of identifying and serving customers, thereby avoiding direct competition. As establishments flood into the niche and new ideas become harder to find, strategies of new establishments increasingly overlap those of existing establishments. Numerous establishments can continue to serve similar customers until the niche's carrying capacity is reached (Hannan & Freeman, 1977). Since the fiberoptics industry is still growing rapidly (approximately one hundred new entrants per year), it is likely that its carrying capacity has yet to be reached.

Evidence of the general strengthening of institutional environments over time has been found by Tolbert and Zucker (1983), among others. Therefore, many of the institutional forces argued above to encourage strategic isomorphism should over time strengthen within a given group of establishments. As an industry grows, the number of transactions between establishments and the amount of information exchanged by establishments will increase, thereby amplifying and clarifying institutional norms. For example, norms of conduct are made more explicit as a field becomes more professionalized (DiMaggio & Powell, 1983). Higher technology industries have many traits that promote rapid professionalization, including a proliferation of societies and associations to which practitioners belong. These norms influence establishments' product offerings by prompting certain combinations of products and discouraging others. As the institutional environment stabilizes, establishments develop more stable identities with potential customers (quality, area of specialty, technological prowess, etc.).

Mimetic forces can also strengthen over time. Galaskiewicz and Wasserman (1989) note that networks serve as a source of information for member organizations, and as such can enhance mimetic processes. It is likely that in emerging industries networks are geographically influenced. As regional and industry leaders emerge, and as establishments' reputations are built, these mimetic forces are expected to strengthen. Existing establishments and new entrants alike look to exemplary (i.e., legitimate) establishments to help guide their actions. As the industry develops, exemplars become easier to identify, and the advantages of copying these establishments can become more readily apparent. Such information is likely to be more reliable and readily available within a establishment's immediate geographic area.

Since institutional forces strengthen over time, and since geographic location is argued to moderate the formation of these institutional forces, we expect to see increases over time in the levels of strategic isomorphism among geographically proximate establishments.

H3: In an emerging industry, the inverse relationship between geographic distance and strategic isomorphism will become increasingly negative over time.

Strategic complementarity is also expected to increase steadily during the early stages of industry development. This expectation is based in part on the relative advantages enjoyed by generalist and specialist establishments, as discussed by Brittain and Freeman (1980) and Zammuto and Cameron (1985). Specialists are those establishments with fairly narrow product/service offerings, while generalists offer a wider array of products and services. When resources are plentiful, both generalist and

specialist strategies are viable. The relative advantages of these strategies are influenced by the general stability or dynamism of the industry (Zammuto and Cameron, 1985). In dynamic industries, the generalist establishment's broad range of activities spread risk and provide it with a measure of insurance against unexpected changes in demand conditions. Therefore, during an industry's early growth phase, we would expect to see greater numbers of generalist establishments, and the need for complementarity should be correspondingly low.

As the niche's carrying capacity is approached, specialists enjoy competitive advantages due to the operational efficiencies that result from producing in greater scale (Zammuto & Cameron). Therefore, as establishments proliferate and specialism is increasingly favored, finding establishments with complementary strategic postures becomes increasingly likely and advantageous. This level of complementarity should remain fairly stable until either carrying capacity increases, or until the number of establishments attempting to exploit the niche decreases.

In addition to strengthening institutional forces, as discussed above, the increased reliability and availability of information within a geographic area also reduces transaction costs among establishments within that area. First, the reputation effect strengthens over time. For example, trust among satisfied exchange partners strengthens over time, while the incidence of exchange with opportunists tends to decline. Second, since, in an emerging industry, information about opportunistic behavior is disseminated more completely among geographically proximate establishments, the incidence of opportunistic behavior among these establishments will decrease as time progresses.

Third, increases in the amount and quality of transaction-specific information available to geographically proximate establishments can ease the bounded rationality and adverse selection problems. Decreases in transaction costs make complementary strategic postures increasingly viable and attractive. Therefore, it is hypothesized that:

H4: In an emerging industry, the inverse relationship between geographic distance and strategic complementarity will become increasingly negative over time.

The fourth and fifth research questions addressed in this study focus on two types of organizations, research institutes and economically dominant firms, that might influence the strategic postures of establishments located in close geographic proximity to them. Each of these entities plays an important enough role within their industry and region that many establishments located near them are likely to interact with them. Therefore, geographic proximity to research institutes or economically dominant firms is hypothesized to affect the formation of collective strategies (which is reflected in strategic isomorphism and strategic complementarity).

THE INFLUENCE OF RESEARCH INSTITUTES

Research question four suggests that in higher technology industries, research institutes are likely to affect the strategic postures of establishments located near them. Arguments based upon economic geography, institutional theory, and transaction costs economics are made with respect to which collective strategies are likely to form among establishments located in the vicinity of a research institute. Even though it is unlikely that all establishments in a region have formal ties to nearby research institutes, the strategic postures of many establishments in the region can be affected by their presence.

Research institutes can provide a number of valuable services and strategic advantages for the establishments with which they are directly associated, as well as for other establishments located nearby. Many of the benefits of locating near a research institute can be considered agglomeration economies. For example, research institutes affiliated with universities might improve the quality of the local labor pool by graduating students in key technical disciplines. A local cluster of technical firms would then encourage these graduates to remain in the local area. Research institutes can facilitate seminars and technical meetings that improve the technical know-how of local practitioners. Establishments might also gain economies by pooling resources for research and development through contributions to a nearby research institute. This pooling might lead to technological advantages over establishments (possibly with individually deeper pockets) that are not affiliated with that institute. Finally, establishments can enhance their political influence through a research institute, seeking public support for the growth and development of their industry. As the benefits of interacting with a research institute become more obvious to local establishments, the extent of its influence on the strategies and operations of these establishments is expected to increase.

To the extent that establishments concede power over shared activities, a research institute might be a source of coercive pressures, motivating establishments to engage in certain activities while discouraging involvement in other activities. A research institute can act as a "weak tie" or bridge (Granovetter, 1973) in the interorganizational network, transmitting information on establishment behavior as well as managers' opinions of

establishment behavior. A conduit for information, a research institute can enhance mimetic and normative tendencies among associated establishments. Mimetic forces can be strengthened by the dissemination of success stories and the enhancement of role models. A research institute held in high esteem by nearby managers might help shape the opinions of these managers. As certain establishments emerge as desirable role models in the opinion of the research institute, the establishments associated with the institute might develop increasingly similar structures and strategies. Research institutes can also have a significant effect on normative forces in their immediate area. If an institute helps to educate industry personnel, it can influence their values and technological perspectives.

Research institutes' effect on strategic postures as suggested by economic geography is consistent with these institutional arguments. Establishments for which technology is a crucial determinant of success and survival have reason to locate near a research institute. To the extent that an institute specializes in a single technology or product category, we expect to see establishments with isomorphic strategic postures locating near this source of expertise. Therefore, based on this argument and on the institutional arguments presented above, it is hypothesized that:

H5: In an emerging industry, pairs of establishments that are in close proximity to the same research institute will exhibit greater strategic isomorphism than will pairs that are not in close proximity to the same research institute.

Economic geography and transaction costs economics also suggest ways in which research institutes might encourage strategic complementarity among geographically proximate establishments. It is argued above that research institutes encourage

specialization of nearby establishments according to which technological specialty they emphasize. An institute's specialty is also likely to motivate both existing and new establishments to establish operations nearby, in order to take advantage of its services and agglomeration economies. As the number of co-located establishments specializing in a given technology or product category increases, a substantial customer base with specific needs can develop in the region. As predicted by economic geographers, we expect supporting establishments to choose their locations based on the location of these potential customers.

The influence of research institutes on transaction costs might also encourage greater strategic complementarity among co-located establishments. By acting as conduits for information transfer, research institutes might mitigate the effects of bounded rationality, opportunism, and adverse selection.

Research institutes can lessen the effects of bounded rationality by improving an establishment's problem-solving capabilities. First, the generation and dissemination of knowledge, which are two of the more important goals for a research institute, can help managers make sense of their competitive environment. Second, research collaboration among establishments can help them identify solutions to specific problems. Third, a research institute can lessen the problem of bounded rationality to the extent that it encourages specialization. By suggesting the aspects of a given technology which are most promising, research institutes can help managers ease the effects of environmental complexity. In other words, a research institute can help mitigate the problem of bounded

rationality if it helps managers "set limits to [their] definitions of situations" (Thompson, 1967: 9).

Research institutes ease the problems of opportunism and adverse selection by facilitating the exchange of information. As stated above, opportunistic behavior among co-located establishments is expected to decline as reputations are disseminated and become more reliable. Research institutes can enhance trust among nearby establishments in several ways. First, managers from different establishments who are trained together develop working relationships that facilitate cooperation between their establishments. Second, establishments that work with one another on a research institute's projects develop working relationships that encourage other joint projects. Finally, research institutes can help disseminate information about unacceptable behavior, and can punish malfeasance by excluding an establishment from future activities.

The term "adverse selection" refers to the possibility that an individual or organization will choose a transaction partner without complete information as to the skills and experience of that partner (Ricketts, 1987). Since a potential partner's skill level is often difficult to discern, there is always the risk that an establishment will choose poorly. The risk of adverse selection is reduced as information about the specialties and skills of potential partners is disseminated. As with opportunism, the development of trust among establishments can reduce the likelihood that an undesirable partner will be chosen.

By reducing the cost of each of these transaction-inhibitors, a research institute can reduce the incentives for establishments to internalize important activities.

Therefore, both economic geography and transaction costs economics suggest that, in addition to exhibiting greater strategic isomorphism:

H6: In an emerging industry, pairs of establishments that are in close proximity to the same research institute will exhibit greater strategic complementarity than will pairs that are not in close proximity to the same research institute.

THE INFLUENCE OF DOMINANT FIRMS

An economically dominant firm is a firm that possesses enough market power to strongly influence the actions of supplier establishments. For example, a firm with very high market share is likely to be powerful relative to its suppliers, since this limits the pool of customers available to suppliers. Dominance is operationalized in this study according establishments' longevity in the fiberoptics industry, their size, and the scope of their activities.

Dominant firms can also affect neighboring establishments by forming alliances with them, or by helping them to form in the first place. According to Enright (1990), dominant firms are often motivated by the desire to farm out certain tasks to outside establishments. In some cases, these firms assist in the formation of new establishments in order to develop reliable suppliers of certain items. Frequently the dominant firm assists smaller establishments in exchange for favorable prices on a pre-determined amount of their output, making the smaller establishment captive to the demands of its benefactor. Therefore, it is important to note that patterns in the strategic postures of a dominant firm's suppliers will be at least partly due to the needs of the dominant firm, and might therefore be somewhat idiosyncratic.

As with research institutes, dominant firms can contribute to agglomeration economies within a region. The dominant firm can improve the labor pool by attracting highly qualified employees, many of whom subsequently move on to other establishments in the region. Also, these employees will develop specialized knowledge and skills based on their experience working for the dominant firm. In some cases, local governments will attract large firms to their area by modifying and improving the technical training available at local schools. The more similar another fiberoptic establishment is to the dominant firm, the more likely it is to benefit from these agglomeration economies.

Dominant firms will also affect the institutional environment in their immediate area. To the extent that it engages in frequent transactions with its neighbors, a dominant firm can exert coercive pressure on them. Whether or not it transacts with nearby establishments, the dominant firm can also influence mimetic and normative forces. Its size and relative success can affect the types of products and services that establishments find most promising. Its size also makes it likely that the dominant firm's employees will have a greater influence on professionalization than will employees of other establishments. On the one hand, a dominant firm is likely to have a greater percentage of the membership in local professional societies, and on the other hand the stature of the dominant firm makes it more likely that its employees will take on leadership roles in these societies.

The agglomerative and institutional forces that exist in a dominant firm's region make it more likely that establishments located nearest the same dominant firm will have similar distinctive competencies, similar types of employees, and therefore, similar

specialties. Therefore, whether or not they transact with the dominant firm, establishments located nearest the same dominant firm are expected to develop strategic postures that are similar to one another.

H7: In an emerging industry, pairs of establishments that are in close proximity to the same dominant firm will exhibit greater strategic isomorphism than will pairs that are not in close proximity to the same dominant firm.

Because of its disproportionate size. the dominant firm helps to create a critical mass of business for related establishments in its region. The dominant firm's presence in a region therefore has a multiplier effect; it inspires related establishments to locate nearby to service not only its own needs, but also the needs of its suppliers. The result is a network of economic relationships among related establishments in the dominant firm's region. It is argued that the presence of this network should result in greater strategic complementarity among establishments when they are nearest the same dominant firm.

Strategic complementarity is also expected to be greater in a dominant firm's region due to the lower transaction costs that are likely to exist among establishments that are near the dominant firm. In those cases in which a dominant firm helped to found a nearby establishment, long-term relationships might facilitate market transactions. If former employees are encouraged to found new establishments, then they are likely to have long-term friendships and professional relationships with individuals at other local establishments, as well as the dominant firm. To the extent that the dominant firm acts as an intermediary in multiple-establishment transactions, it can also reduce transaction costs in ways similar to research institutes. The dominant firm can encourage

relationship building, transmit information on establishments' reputations, and increase the costs associated with opportunistic behavior.

H8: In an emerging industry, pairs of establishments that are in close proximity to the same dominant firm will exhibit greater strategic complementarity than will pairs that are not in close proximity to the same dominant firm.

CHAPTER THREE: METHODOLOGY

The purpose of this chapter is to describe the methodology used to test each of the hypotheses presented in Chapter Two. The research setting, population, and variables are described, and the approach for each hypothesis test is then explained. Each of the hypotheses will be tested with respect to the behavior of establishments in the fiberoptics industry during the period 1976-1994.

RESEARCH SETTING: THE FIBEROPTICS INDUSTRY

Fiberoptic technology: Brief Background

Fiberoptics takes its name from its most basic element: thin optical glass fibers used to transmit information in the form of light. The first optical fibers were developed in 1956 by N. S. Kapany, who used them only for the transmission of images (EC&M, 1991). With the invention of the laser in 1960, it became technically feasible to transmit large quantities of information using light, assuming that a suitable medium (i.e. an optical fiber with the proper specifications) could be developed. The first optical fiber suitable for transmitting information was developed in 1974 at Corning Glass Works. This fiber was a breakthrough because it was the first to bring signal power loss (attenuation) down to an acceptable level. In 1977, Siecor, a joint venture of Corning and Siemens AG, conducted the first successful field trial of fiberoptic technology. In 1983 fiberoptic cables (developed by Siecor) were put into practical use for the first time.

Fiberoptic technology proved to be a revolutionary development for the telecommunications industry because of the dramatically improved data transmission

capability it offered. Fiberoptic cables offer 10,000 times as much capacity as traditional copper cable. Fiberoptic systems are smaller, lighter, and require less frequent signal boosting than do traditional copper systems, reducing the amount of equipment installed and maintained, and are also immune to electromagnetic interference. The extra capacity of fiberoptic cable makes possible myriad new uses of telephone networks, facilitating the transfer of data between computers and making it possible for phone companies to offer such new services as cable television.

The possible uses of fiberoptic technology do not end with telephony, however. In fact, new uses for fiberoptic technology seem to materialize at least as quickly as improvements are made to existing uses. The construction industry, for example, has started to install fiberoptic sensors in various structures to aid in the detection of stress damage. Computer makers have also started to experiment with optical data storage techniques and light-based CPUs, while auto makers are developing fiberoptic devices to assist with navigation and to monitor the condition of a vehicle. Medical researchers have identified a number of possible applications of fiberoptic technology, including surgery, testing, and imaging.

Identifying Fiberoptics Establishments

The units of analysis for this study are pairs of establishments. As discussed in Chapter Two, the term "establishment" is used because it is more generic than the term "operating unit" and more specific than "firm," and therefore reflects the variety of entities included in the database. Establishments studied here include small start-up firms

with one location; more mature firms with one or more locations; and plants or divisions of extremely large firms, some of which are conglomerates.

As with any industry, it is difficult to definitively identify boundaries for the fiberoptics industry. Fiberoptic technology is still being developed and applied to new uses at an extremely rapid rate. These applications are the result of efforts in diverse industries, including aerospace, telecommunications, electronics, medical equipment, defense, automotive, computing, construction, glass, and plastics, among others. It seems clear that the scientific and commercial organizations connected to the fiberoptics industry have just begun to scratch the surface when it comes to advancing this technology. Some have argued that fiberoptic technology represents an advancement comparable to (and as widely applicable as) the semiconductor (Carey & Gross, 1993; Gilder, 1997). As a result, it is difficult to identify distinct boundaries between the fiberoptics industry and other, related industries, such as optics and electronics. The vast array of Standard Industry Classification (SIC) codes relating to fiberoptics establishments, examples of which are presented in Table 3-1, is evidence of this.

SIC Code	Description
3229	Pressed and Blown Glasses, not elsewhere classified
3315	Steel Wire and Related Products
3357	Nonferrous Wiredrawing and Insulating
3569	General Industrial Machinery, not elsewhere classified
3661	Telephone and Telegraph Apparatus
3669	Communications Equipment
3674	Semiconductors and Related Devices
3827	Optical Instruments and Lenses
3845	Electromedical Equipment

Table 3-1: Sample SIC Codes of Fiberoptics Establishments

"Fiberoptic establishments" are identified for inclusion in the database according to their mix of product or service offerings. Fiberoptic establishments are designers, manufacturers, distributors, and importers of 1) The basic components of fiberoptic equipment (e.g. fibers, cable, connectors, couplers, laser diodes, etc.); 2) Fiberoptic equipment and systems (e.g. communication systems, data links, fiberscopes, networks, etc.); 3) Items used to manufacture fiberoptic components (e.g. furnaces, curing systems, preforms, materials, etc.); and 4) Items used in conjunction with fiberoptic components "in the field" (e.g. detectors, accessories, alignment systems, inspection equipment, etc.). Also included are those establishments providing fiberoptics-related design and engineering services.

The list of fiberoptic establishments used in this study was drawn from Laurin Publishing's Photonics Directory, a popular directory of opto-electronics establishments and the products they make. This directory, published annually for approximately forty

years, has listed establishments in the fiberoptics industry since its inception. In 1976, the first year for which data were obtained for the study, there were 50 establishments reporting that they made or sold "fiberoptic" products. By 1994, this worldwide list grew to over 900 establishments.

One possible weakness in using this directory is that establishments are responsible for self-reporting their vital statistics and product offerings. There is good reason to believe, however, that self-reporting does not pose a serious problem for this study. First of all, the publisher does not charge establishments for appearing in the directory; any establishment can submit a form and be included. The publishers generate their revenue through advertisements and by selling the directory itself for approximately $130 per set. Second, since the directory is targeted to (and only relevant for) experts in opto-electronics, there is a strong incentive for establishments to be listed; it is a free source of advertising that is targeted to their customer base. Third, the publisher makes a concerted effort to track down new establishments for inclusion in the directory, since a large portion of their revenue comes from selling the directory to interested parties. In order to assess the appropriateness of this data source, several fiberoptics researchers were contacted through professional societies. These researchers indicated that they always see this publisher represented at conferences and professional meetings, and that it is unlikely that anyone actively involved in the opto-electronics or fiberoptics industries would be unaware of this directory or its publisher. They also agreed that this directory provided as comprehensive a listing of fiberoptics establishments as could be found.

Historical Trends in the Fiberoptics Industry

The growth of the fiberoptics industry is reflected in Table 3-2, which indicates the number of U. S. and non-U. S. establishments for each year of the database. The number of establishments making fiberoptic products appears to have been fairly stable until 1975. For example the 1967 edition of the Photonics Directory lists approximately 40 establishments as making such products. The stability in the number of establishments until 1975 is most likely due to the limited uses of fiberoptic technology prior to 1974. After data-transmission via fiberoptic cable became possible, the number of product categories and establishments began to increase steadily. In the period immediately after 1983, the year when fiberoptic cables were put into practical use, the number of fiberoptics establishments grew by approximately 25% per year. After 1986, the yearly growth rate leveled off to approximately 10%, and remained consistent through 1993-94.

Year	US Estabs.	Non-US Estabs.	Total
1975	41	0	41
1976	49	1	50
1977	61	2	63
1978	70	3	73
1979	73	2	75
1980	127	20	147
1981	143	28	171
1982	167	41	208
1983	208	64	272
1984	260	84	344

Year	US Estabs.	Non-US Estabs.	Total
1985	335	97	432
1986	392	118	510
1987	434	128	562
1988	452	184	636
1989	502	193	695
1990	531	201	732
1991	581	221	802
1992	593	208	801
1993	635	192	827
1994	697	239	936

Table 3-2: Number of Fiberoptics Establishments, 1975-1994

This steady growth in fiberoptics establishments occurred in spite of a substantial number of withdrawals from the industry. The numbers of establishments exiting and entering the database in each year are summarized in Table 3-3. An establishment is considered to have withdrawn only if it stops providing fiberoptic products without re-entering at a later date in the study period. Establishments are reported as "exiting" in the year after their final appearance in the database. For example there are 79 establishments from 1989 that never appear in the database again, and these establishments are listed in Table 3-3 as having exited the database in 1990.

An establishment is counted as being "new" to the industry only in the year in which it first appears in the directory during the years 1975-1994. Therefore, the forty-one establishments listed as "entries" in 1975 are new to the database, though not necessarily new to the industry. In 1990, for example, 128 establishments appear in the database for the first time. Calculations denoted with an asterisk (*) should be viewed with caution since data in these cells are inconclusive. An establishment entering the industry in 1976, for example, might have offered fiberoptic products prior to 1975, yet this is not reflected in the database.

Year	Exits	%	Entries	%
1975	--	--	41*	--
1976	7	17%	18*	31%
1977	7	14%	23*	31%
1978	7	11%	24	34%
1979	17	24%	33	45%
1980	12	16%	71	56%
1981	17	13%	46	32%
1982	18	13%	42	25%
1983	33	20%	85	41%
1984	18	9%	76	29%

Year	Exits	%	Entries	%
1985	26	10%	101	30%
1986	44	13%	113	29%
1987	60	15%	112	26%
1988	103	24%	137	30%
1989	65	14%	126	25%
1990	79	16%	128	24%
1991	102	19%	119	20%
1992	93*	16%	116	20%
1993	103*	17%	105	17%
1994	112*	18%	124	16%

Table 3-3: Exit and Entry in the Fiberoptics Industry, 1975-1994

The number of exits and entries listed for each year may not correspond exactly with the reported number of establishments for that year. For example, forty-one establishments are identified in 1975. Of these, seven never appear in the database again, while in 1976 there are eighteen new establishments identified. These figures (41 - 7 + 18) lead one to expect to see fifty-two establishments in 1976 (Table 3-2), yet only forty-nine establishments are identified for 1976. This discrepancy occurs because three establishments that appear in 1975 are not listed in 1976, yet these three re-appear in subsequent years of the study. This phenomenon occurs to some extent in each year of the study. A missing entry might be due to an establishment's failure to report to the publisher in a given year, or might result when an establishment stops offering a product for a time. Since it is impossible to infer with certainty the meaning of each missing entry, no attempt is made to fill in the gaps.

There is also a dramatic expansion of the number of fiberoptic product categories during the nineteen years of the study. The number of categories reported each year, as well as the number of new and extinct categories in a given year are identified in Table 3-4. The years that contain the greatest percentage of new product categories are 1979 (78%), 1985 (53%), and 1988 (58%).

Year	Number of New Product Categories	Number of Categories Becoming Extinct	Total Number of Product Categories	Number of Estabs. Offering Products	Number of Estabs. Per Product Category
1976	--	--	5	49	12.25
1979	14	1	18	69	3.83
1982	3	0	21	159	7.57
1985	19	4	36	335	9.31
1988	45	0	78[1]	448	5.74
1991	17	3	92	578	6.28
1994	19	3	109[2]	695	6.38

Table 3-4: Numbers of Fiberoptic Product Categories by Year

SAMPLE

As noted above, the data used in this study are from the years 1976, 1979, 1982, 1985, 1988, 1991, and 1994. For U. S. establishments, this sample is very nearly a census of firms offering fiberoptic products.

[1] In 1988, four existing categories split into twenty-one sub-categories (e.g., the category "cable" from 1985 evolves into four kinds of cable in 1988). Also, one product category from a previous year re-enters the sample this year.

[2] In 1994, one product category from a previous year re-enters the sample.

Since the data in the directory are self-reported, some information is missing for certain establishments in each year. The number (and percentage) of establishments reporting each statistic in each year of the study is reported in Table 3-5. Prior to 1980, the publisher listed neither the number of engineers nor the square footage of establishments. Geographic locations are reported for all establishments in each year of the database. Product offerings are reported by at least ninety-five percent of the establishments in each year. To be included in a hypothesis test, an establishment must have offered at least one product in that year. Therefore, the sample sizes reported for each hypothesis test are often slightly smaller than the total number of establishments reported in Table 3-5.

Year	Number of U. S. Estabs.	Number Reporting Product Offerings	Number Reporting Employees	Number Reporting Engineers	Number Reporting Square Feet	Number Reporting Zip Code
1976	49 (100)	49 (100)	0 (0)	0 (0)	0 (0)	49 (100)
1979	73 (100)	69 (95)	65 (94)	0 (0)	0 (0)	69 (100)
1982	167 (100)	159 (95)	145 (91)	104 (65)	92 (58)	159 (100)
1985	335 (100)	335 (100)	285 (85)	240 (72)	214 (64)	335 (100)
1988	452 (100)	448 (99)	398 (89)	347 (77)	314 (70)	448 (100)
1991	581 (100)	578 (99)	527 (91)	478 (83)	450 (78)	578 (100)
1994	697 (100)	695 (99)	573 (82)	520 (75)	480 (69)	695 (100)

Table 3-5: Reporting Rates for U. S. Establishments (% in parentheses), 1976-1994

Means, standard deviations, and ranges for descriptive statistics reported in the database are specified in Table 3-6. The number of products or services offered by establishments each year is fairly low in all seven years of the study. Though the range widens substantially over time, the median never exceeds two offerings. The number of employees per establishment tends to decrease from 1976-1991, then increases slightly in

1994. The number of engineers per establishment stays fairly consistent throughout the term of the study, and the proportion of engineers to employees increases over time. Finally, facility square footage decreases over time. Taken together, these data describe an industry increasingly populated by small, engineering-intensive establishments.

Year	Statistic	Number of Products or Services	Number of Employees	Number of Engineers	Facilities' Square Footage
1976	Mean	1.73	NR	NR	NR
	Median	1	NR	NR	NR
	Std. Dev.	0.93	NR	NR	NR
	Range	1 - 4	NR	NR	NR
1979	Mean	1.96	3,035	NR	NR
	Median	1	40	NR	NR
	Std. Dev.	1.59	13,491	NR	NR
	Range	1 - 9	1 - 100,000	NR	NR
1982	Mean	2.45	1,143	34	85,698
	Median	1	45	5	20,000
	Std. Dev.	2.21	4,567	128	283,255
	Range	1 - 13	1 - 30,350	1 - 810	100 - 2,355,000
1985	Mean	2.93	2,774	38	101,893
	Median	2	40	5	15,000
	Std. Dev.	2.47	23,345	192	568,522
	Range	1 - 15	1 - 373,000	1 - 2,500	100 - 7,800,000
1988	Mean	3.56	940	79	88,983
	Median	2	40	5	13,000
	Std. Dev.	3.17	5,659	721	454,964
	Range	1 - 27	1 - 84,000	1 - 11,814	300 - 7,000,000
1991	Mean	3.71	324	35	66,210
	Median	2	32	5	12,000
	Std. Dev.	3.52	2,003	214	261,813
	Range	1 - 21	1 - 27,500	1 - 3,500	200 - 4,000,000
1994	Mean	3.50	413	33	50,185
	Median	2	33	5	12,000
	Std. Dev.	3.43	3,468	204	160,824
	Range	1 - 29	1 - 70,000	1 - 3,500	500 - 2,355,000

NR = Data not reported for this year

Table 3-6: Means, Standard Deviations, and Ranges for Descriptive Statistics

This study's statistical tests are performed not at the individual establishment level, but instead with respect to pairs of establishments. Therefore, the sample sizes for each year are obtained using the following equation:

$$n = [(Y \times Y)/2] - (Y/2)$$

where "Y" indicates the number of establishments in that year's sample, and "n" refers to the resulting number of unique pairs of establishments. The results of this calculation for each year of the study are summarized in Table 3-7.

Year	Number of U. S. Estabs. Offering Products	Number of Unique Pairs
1976	49	1,176
1979	69	2,346
1982	159	12,561
1985	335	55,945
1988	448	100,128
1991	578	166,753
1994	695	241,165

Table 3-7: Number of Unique Pairs of Establishments, by Year

Such large sample sizes offer the advantage of providing extremely accurate statistics (Kerlinger, 1986). Extreme care must be taken, however, when interpreting the statistical significance of these results. Samples this large make it possible for extremely small effects to achieve statistical significance. Therefore, we might identify small effects that are statistically significant but that are too small to be theoretically interesting or useful.

For the hypotheses that refer to trends over time (H3 and H4) subsamples of establishments are generated. Table 3-8 lists the number of establishments for each year of the study, as well as the number of establishments that each year's sample has in common with subsequent years.

Year	Number of Estabs	Number in Common with Year: 1979	1982	1985	1988	1991	1994
1976	49 (100%)	18 (37%)	21 (43%)	21 (43%)	16 (33%)	13 (27%)	13 (27%)
1979	69 (100%)	- -	34 (49%)	38 (55%)	23 (33%)	17 (25%)	20 (29%)
1982	159 (100%)	- -	- -	98 (62%)	70 (44%)	55 (35%)	54 (34%)
1985	335 (100%)	- -	- -	- -	177 (53%)	148 (44%)	123 (37%)
1988	448 (100%)	- -	- -	- -	- -	276 (62%)	215 (48%)
1991	578 (100%)	- -	- -	- -	- -	- -	361 (62%)

Table 3-8: Number of Establishments in Common, From Year to Year

APPROACH

The relationships hypothesized in Chapter Two are tested separately at three-year intervals over a nineteen-year period.[3] The levels of strategic isomorphism and strategic complementarity in a given year are determined by calculating an index along each dimension for each possible pair of U. S. establishments. Correlations

[3] Exceptions to this procedure are H5-H8, which involve research institutes and dominant firms. These hypotheses are tested only for 1994 due to limits in data availability.

are performed to test the hypothesized relationships between geographic distance, research institutes, and dominant firms and the levels of strategic isomorphism and strategic complementarity. Changes in these relationships are also assessed across years in order to examine the dynamics of collective strategy formation. This section describes the ways in which each variable is operationalized, as well as the approach used for each hypothesis test.

Variables

Strategic isomorphism. For each of the seven years studied, an index (IsoScore) indicating the level of strategic isomorphism between all pairs of establishments is calculated by comparing the set of product and service offerings of each establishment to the offerings of every other establishment in that year. Two points are added to a pair's score each time these two establishments perform the same value chain activity with respect to the same product or service. The maximum IsoScore possible between any two establishments for a given product or service is ten points. This would occur when each establishment performs all five value chain activities with respect to the same product or service.

Strategic complementarity. As with strategic isomorphism, an index (CompScore) is calculated to determine the degree of strategic complementarity among pairs of establishments. In this case, each pair of establishments is said to have complementary strategic postures based on the value chain activities they perform. Each time complementary value chain activities are identified within a pair (for example, one establishment manufactures and one distributes the same product), a specified number of

points is added to the score for that pair. Table 3-9 lists the number of points assigned for the various configurations of complementarity. The maximum CompScore possible between any two establishments for a given product or service is twenty-eight points. This score would occur when two establishments each perform all five value chain activities with respect to a given product or service.

		Firm Two				
		Stock Mftr.	Custom Mftr.	Distribute	Design /Prototype	Import
Firm One	Stock Mftr.	-	1	2	2	1
	Custom Mftr.	1	-	2	2	1
	Distribute	2	2	-	1	1
	Design /Prototype	2	2	1	-	1
	Import	1	1	1	1	-

Table 3-9: Points Assigned for Complementary Activities

Geographic distance. The latitude and longitude of every establishment's city or town has been entered into the database. The variable "Distance" is operationalized as the great circle distance, in statute miles, between the cities of every pair of establishments. The great circle distance is calculated via a spherical trigonometry algorithm. When two establishments are located in the same city, the value for Distance is set to zero.

Research institutes. The seventy-two fiberoptic research institutes included here are all university-affiliated and engage in some amount of scholarly research. All also offer some amount of coursework in fiberoptics.

The list of research institutes was generated in two phases. First, a list was generated, using library resources, of schools which conduct optics research, maintain graduate programs, and offer courses in optics and optics-related fields. During this phase, seventy-eight schools and programs were identified.

Second, a detailed questionnaire (included in Appendix D) was sent to all the schools on this list. Program directors were asked to indicate whether their program was involved with fiberoptics research, and if so, the extent of that involvement. Of the seventy-eight research institutes contacted, twenty-nine (37%) responded to the initial survey. One survey was unusable, reducing the effective response rate to thirty-six percent. While this response rate is in line with typical response rates, for purposes of this study it was necessary to determine conclusively whether or not a school engaged in fiberoptics-related activities. Toward this end, a brief survey form (also included in Appendix D) was completed with respect to all non-respondents. Each school's internet homepage was searched for evidence of fiberoptics research and fiberoptics-related coursework. If the information could not be obtained via the homepage, the brief survey was completed via telephone. In this manner, information was collected for all of the survey's non-respondents.

Six of the research institutes contacted (8% of those surveyed) indicated that they do not perform fiberoptics-related activities at their institution. These six programs were

removed from the sample, leaving a total of seventy-two research institutes. The historical data provided by respondents was quite limited. Therefore, the sample of research institutes was only used to test hypotheses within the most recent (1994) timeframe.

For 1994, the distance between each establishment and all research institutes is calculated. The classification variable "RIProx" is assigned for each pair of establishments according to whether or not both establishments in the pair are nearest to the same research institute. Those pairs that are nearest to the same research institute are classified as "RIProx," while pairs that are not nearest the same research institute are classified as "NonRIProx." It should be noted that some establishments may be substantially removed from all of the research institutes studied. When an establishment is more than 150 miles from the nearest research institute, all pairs to which that establishment belongs are classified as "NonRIProx."

Dominant firms. The dominant firms identified for this study are dominant in several different respects: longevity, size, and product offerings. A few of these firms, including Corning, played pivotal roles in the development of fiberoptic technology. 1994's dominant firms all exhibited the following characteristics:

- Founded before 1985
- Employed more than 100 people
- Occupied 25,000 or more square feet
- Offered 10 or more fiberoptic products and services

The distance between each establishment and each dominant firm was calculated for the 1994 data set. The classification variable "DFProx" is assigned for each pair of

establishments according to whether or not both establishments in the pair are nearest to the same dominant firm. If the nearest dominant firm is the same for both establishments, then the pair is classified as "DFProx." Otherwise, the pair is classified as "NonDFProx." As with the research institutes, some establishments are distant from all of the dominant firms studied. When an establishment is more than 150 miles from the nearest dominant firm, all pairs to which that establishment belongs are classified as "NonDFProx."

Hypothesis Testing

The relationships to be tested, as well as the predicted directions for each relationship, are summarized in Table 3-10. Detailed descriptions of each test used are provided below. For cases in which proposed tests do not yield significant results, exploratory tests on potentially mitigating factors are conducted.

Independent Variables	Dependent Variables: Strategic Isomorphism (IsoScore)	Dependent Variables: Strategic Complementarity (CompScore)	Method	Years Studied
Distance	H1 (-)	H2 (-)	Spearman's Rank-Order Correlation One Tailed Test p = 0.05	1976 1979 1982 1985 1988 1991 1994
Distance	H3 (+)	H4 (+)	Spearman's Rank-Order Correlation = f (year of study) Tested for subgroups, survivors & cohorts	1976 1979 1982 1985 1988 1991 1994
Research Institute Proximity (RIProx)	H5 (+)	H6 (+)	*t* test: H_0: $\mu_{RIProx} = \mu_{NonRIProx}$ One Tailed Test p = 0.05 Tested for subgroups, survivors & cohorts	1994
Dominant Firm Proximity (DFProx)	H7 (+)	H8 (+)	*t* test: H_0: $\mu_{DFProx} = \mu_{NonDFProx}$ One Tailed Test p = 0.05 Tested for subgroups, survivors & cohorts	1994

Table 3-10: Summary of Predicted Relationships

Hypotheses One and Two. The two main hypotheses are tested in the same manner. As discussed in Chapter two, the following relationship is expected to exist between geographic location and strategic isomorphism:

H1: In an emerging industry, the geographic distance between two establishments and their level of strategic isomorphism will be inversely related.

Likewise, the following relationship is expected to exist between geographic location and strategic complementarity:

H2: In an emerging industry, the geographic distance between two establishments and their level of strategic complementarity will be inversely related.

For each possible pair of establishments we calculate the IsoScore and CompScore, as well as Distance. Neither IsoScores nor CompScores can have values less than zero, and neither index is normally distributed; the frequency distribution for each index is skewed heavily towards lower scores. Therefore, use of parametric measures such as Pearson's product-moment correlation coefficient would be inappropriate (Gibbons, 1993b). IsoScores and CompScores are relative measures of each phenomenon. It would be incorrect, for example, to say that a pair for which IsoScore = four is "twice as isomorphic" as a pair for which IsoScore = eight. Therefore, the indices are best treated as ranks (ordinal data), and hypotheses one and two are tested by calculating Spearman's Rank-Order correlations (r_s) between distance and each index. This test is repeated for each of the seven years of the study.

Hypotheses Three and Four. Hypotheses three and four predict trends over time in the relationships of levels of strategic isomorphism and strategic complementarity with distance:

H3: In an emerging industry, the inverse relationship between geographic distance and strategic isomorphism will become increasingly negative over time.

H4: In an emerging industry, the inverse relationship between geographic distance and strategic complementarity will become increasingly negative over time.

In order to test these hypotheses, three-year interval comparisons are made between the correlations. Spearman's Rank-Order correlations are performed to test the following relationships:

(H3) Correlation (IsoScore, Distance) = f (Time)

(H4) Correlation (CompScore, Distance) = f (Time)

Each focal year of the study is assigned a number from one to seven (1976 = one, 1979 = two, etc.). Spearman's r is calculated between these assigned values and the correlation between IsoScore (or CompScore) and Distance for each focal year. If r_s is negative and statistically significant, then hypotheses three and four are supported.

Results for these hypotheses could prove inconclusive due to the fact that sample membership varies substantially from one year to the next. To create more comparable data sets for the year-to-year comparisons, three different kinds of subsamples are generated: subgroups, survivor groups, and cohort groups. A *subgroup* is defined as all establishments in a given year that also appear in a designated subsequent year. For example, the 1979/1994 subgroup would include all establishments that report product offerings in both 1979 and 1994. In contrast, *survivor groups* consist of all establishments that appear in a given year and in all subsequent years of the study. For example, the 1985 survivor group consists of all establishments that report product offerings in 1985, 1988, 1991, and 1994. Establishments reporting in 1985 that fail to

report in any of the subsequent three years of the study are excluded from the survivor group. *Cohort groups* are generated in the same manner as survivor groups, but with one additional step. A cohort group consists of all establishments appearing in a given year (and all subsequent years), but that did not appear in any preceding years of the study. The 1985 cohort group, for example, includes all establishments that enter the study sample for the first time in 1985, and that also report product offerings in 1988, 1991, and 1994. A cohort group, therefore, is a subsection of a given year's survivor group.

The tests for hypotheses three and four are performed with respect to the entire sample, as well as each of these subsamples for each year of the study. As with hypotheses one and two, Spearman's rank-order correlation is calculated for IsoScores (or CompScores) and Distance. Changes, if any, in the relationships from year-to-year are then assessed.

Hypotheses Five and Six. Research institutes are hypothesized to have the following influence on collective strategy formation:

H5: In an emerging industry, pairs of establishments that are in close proximity to the same research institute will exhibit greater strategic isomorphism than will pairs that are not in close proximity to the same research institute.

H6: In an emerging industry, pairs of establishments that are in close proximity to the same research institute will exhibit greater strategic complementarity than will pairs that are not in close proximity to the same research institute.

The null hypothesis for these predictions is as follows:

$$H_0: \mu_{RIProx} \leq \mu_{NonRIProx}$$

where μ is the mean of IsoScores (hypothesis five) or CompScores (hypothesis six) for each group. The pair is classified as "RIProx" when both establishments in a pair are

nearest the same research institute. In each case, a *t* test is used to determine whether the mean IsoScore (or CompScore) is significantly different for the two groups (RIProx and NonRIProx). If mean scores are statistically significantly greater for cases in which pairs are classified as RIProx, then hypotheses five and six are supported.

Hypotheses Seven and Eight. Dominant firms are also predicted to affect collective strategy formation, as stated below:

H7: In an emerging industry, pairs of establishments that are in close proximity to the same dominant firm will exhibit greater strategic isomorphism than will pairs that are not in close proximity to the same dominant firm.

H8: In an emerging industry, pairs of establishments that are in close proximity to the same dominant firm will exhibit greater strategic complementarity than will pairs that are not in close proximity to the same dominant firm.

The null hypothesis for these predictions is as follows:

$$H_0: \mu_{DFProx} \leq \mu_{NonDFProx}$$

where μ is the mean of IsoScores (hypothesis seven) or CompScores (hypothesis eight) for each group. A pair is classified as "DFProx" when both establishments are nearest the same dominant firm. In each case, a *t* test is used to determine whether the mean IsoScore (or CompScore) is significantly different for the two groups (DFProx and NonDFProx). If mean scores are statistically significantly greater for pairs classified as DFProx, then hypotheses seven and eight are supported.

CHAPTER FOUR: RESULTS

This chapter reports the results of each hypothesis test described in Chapter Three. Results of additional analyses performed to further explore a given hypothesis appear in Appendix A. Unless otherwise indicated, sample size refers to the number of pairs of establishments in a given data set. The term "focal year" is used to refer to those years out of the nineteen year study period for which tests are conducted.

HYPOTHESIS ONE

Not Supported. Spearman's rank-order correlation coefficients (r_s) for IsoScore and Distance for each year are reported in Table 4-1. Due to the large sample size, the results of this hypothesis test are statistically significant in the predicted direction in the last five of the seven focal years.

Focal Year	Sample Size	Spearman's Rank-Order Correlation Coefficient (r_s) for IsoScore and Distance	Mean IsoScore	IsoScore Standard Deviation
1976	1,176	0.03528	0.85	1.59
1979	2,346	-0.00357	0.38	1.08
1982	12,561	-0.02153*	0.46	1.32
1985	55,945	-0.01490**	0.39	1.15
1988	100,128	-0.00930**	0.28	0.95
1991	166,753	-0.00546*	0.25	0.91
1994	241,165	-0.01059**	0.22	0.85

* = significant at the 0.05 level
** = significant at the 0.01 level

Table 4-1: Spearman's Correlations for Hypothesis One

However, while this result is consistent with the predicted relationship, the extremely low values identified for r_s cast doubt that there is a meaningful relationship. In order to test the relationship further, an additional analysis was completed with respect to two geographic subsets of the data: 1) the northeastern United States (Northeast), and 2) California. The Northeast was defined as including Pennsylvania, New Jersey, New York, and New England. These two regions were selected because they have contained concentrations of fiberoptic establishments since the earliest stages of the industry's development, and have contained a substantial number of fiberoptic establishments in all years of the study (see Appendices B and C for graphical representations of establishment locations). Testing the hypotheses in these regional subsets also helps to explore the possibility that similar effects on either coast could cancel each other out in tests conducted with respect to the entire sample.

The IsoScore mean and standard deviation for each year of the study are reported in Appendix A, Table A-1, and correlations are reported in Table A-3. In California, IsoScore and Distance are inversely related (as predicted) in five of the seven years, but none of the results is statistically significant. In the Northeast, IsoScore and Distance are positively related in five years and negatively related in two years. Only one year's result (1982) is statistically significant for establishments in the Northeast. These regional results rule out the possibility that the phenomenon is local, with the effects masked due to the sample's national scope. This result casts further doubt on the existence of a meaningful relationship that would conform to hypothesis one.

HYPOTHESIS TWO

Not Supported. Spearman's rank-order correlation coefficients (r_s) for CompScore and Distance for each year are reported in Table 4-2. The variables are positively related in 1976 (statistically significant at the 0.05 level) and inversely related in each of the remaining years of the study. The inverse relationship is statistically significant for the last five years of the study. As with the results for hypothesis one, the strength of the correlations is too low to be considered meaningful.

Focal Year	Sample Size	Spearman's Rank-Order Correlation Coefficient (r_s) for CompScore and Distance	Mean CompScore	CompScore Standard Deviation
1976	1,176	0.06431*	1.71	2.07
1979	2,346	-0.01792	0.80	1.54
1982	12,561	-0.03941**	0.63	1.54
1985	55,945	-0.01631**	0.44	1.18
1988	100,128	-0.01513**	0.28	0.93
1991	166,753	-0.01128**	0.28	0.96
1994	241,165	-0.01591**	0.24	0.90

* = significant at the 0.05 level
** = significant at the 0.01 level

Table 4-2: Spearman's Correlations for Hypothesis Two

Means, standard deviations, and correlations for CompScore and Distance in California and the Northeast were also calculated, and are reported in Appendix A, Tables A-2 and A-4. As with the subset results for hypothesis one, these additional tests fail to show stronger results than did the overall sample. In California, CompScore and Distance are positively correlated in the first three years of the study, and none of these

results is statistically significant. The relationship is negative in the study's final four years, and this relationship is statistically significant in 1985, 1991, and 1994.

Although the California subset exhibits the predicted direction of the relationship in the final three periods, the Northeast subset does not. CompScore and Distance are positively related in five of the seven years, but no trend is apparent from period to period. The positive relationship is statistically significant in 1976 and 1994, while the inverse relationship is statistically significant in 1982. As with hypothesis one, the results for the California subset resemble the results for the overall sample, while the results for the Northeast do not. In neither case, however, do the regional subsets suggest a more meaningful relationship than the slight correlations indicated by the overall sample.

HYPOTHESIS THREE

Modest Support. The inverse relationship between IsoScore and Distance (as described in hypothesis one) is predicted to become increasingly negative over time. Using the full sample for each focal year, the correlation (r_s) between the focal years and the IsoScore/Distance correlations for each year is -0.393. While the result is in the predicted direction, it is not statistically significant.

In addition to testing this trend with respect to the total sample, tests were conducted using three different subsamples: subgroups, survivor groups, and cohort groups. Results for subgroups are reported in Table 4-3. A *subgroup* contains all establishments that appear in a focal year and also appear in one or more subsequent years.

Focal Year		Focal Year	Establishments from Focal Year that appear in: 1979	1982	1985	1988	1991	1994
1976	r_s	0.0353	-0.0157	-0.1467*	-0.0460	-0.1170	-0.1553	-0.3484**
	n	1,176	153	210	210	120	78	78
	Estabs.	49	18	21	21	16	13	13
1979	r_s	-0.0036		-0.1688**	-0.1072**	-0.0678	0.0287	-0.0716
	n	2,346		561	703	253	136	190
	Estabs.	69		34	38	23	17	20
1982	r_s	-0.0215*			-0.0740**	-0.0318	-0.0199	-0.0393
	n	12,561			4,753	2,415	1,485	1,431
	Estabs.	159			98	70	55	54
1985	r_s	-0.0149**				-0.0183*	0.0094	-0.0072
	n	55,945				15,576	10,878	7,503
	Estabs.	335				177	148	123
1988	r_s	-0.0093**					-0.0148**	-0.0126
	n	100,128					37,950	23,005
	Estabs.	448					276	215
1991	r_s	-0.0055*						-0.0159**
	n	166,753						64,980
	Estabs.	578						361
1994	r_s	-0.0106**						
	n	241,165						
	Estabs.	695						

* = significant at the 0.05 level
** = significant at the 0.01 level

Table 4-3: Correlations of IsoScore and Distance for Subgroups Over Time

In order to obtain uniform subsamples and enhance the accuracy of the year-to-year comparisons, two additional types of subgroups were generated: survivor groups and cohort groups. Survivor group results are presented in Table 4-4, while cohort group results are presented in Table 4-5. *Survivor groups* consist of all establishments that reported product offerings in a focal year and in all subsequent years of the study. *Cohort groups* were generated in the same manner as survivor groups, but with one additional qualification. A cohort group consists of all establishments that appeared in a focal year (and all subsequent years) and that did not appear in any preceding years of the study. Therefore, establishments are included in survivor groups regardless of their founding date, while all establishments in a particular cohort group entered the fiberoptics industry in the same three year span.

Focal Year		Establishments from Focal Year that appear in: 1979	1982	1985	1988	1991	1994
1979	r_s *n = 36* *9 Estabs.*	0.0207	-0.3648 *	-0.2953	-0.3399 **	-0.1758	-0.2599
1982	r_s *n = 561* *34 Estabs.*		-0.0251	-0.0617	-0.0458	-0.0601	-0.1079 *
1985	r_s *n = 4,465* *95 Estabs.*			0.0155	0.0029	-0.0076	0.0086
1988	r_s *n = 18,145* *191 Estabs.*				-0.0281 **	-0.0220 **	-0.0121
1991	r_s *n = 64,980* *361 Estabs.*					-0.0111 **	-0.0159 **
1994	r_s *n = 241,165* *695 Estabs.*						-0.0106 **

* = significant at the 0.05 level
** = significant at the 0.01 level

Table 4-4: Correlations of IsoScore and Distance for Survivor Groups Over Time

Focal Year		Establishments from Focal Year that appear in: 1979	1982	1985	1988	1991	1994
1979	r_s *n = 10* *5 Estabs.*	-0.4062	-0.2659	-0.5698	-0.5222	-0.5222	-0.8461 **
1982	r_s *n = 300* *25 Estabs.*		-0.0113	-0.0725	-0.1303 *	-0.1293 *	-0.1640 **
1985	r_s *n = 1,770* *60 Estabs.*			0.0178	0.0142	-0.0202	0.0228
1988	r_s *n = 4,560* *96 Estabs.*				-0.0431 **	-0.0381 **	-0.0370 *
1991	r_s *n = 14,028* *168 Estabs.*					0.0087	-0.0034
1994	r_s *n = 45,753* *303 Estabs.*						0.0002

* = significant at the 0.05 level
** = significant at the 0.01 level

Table 4-5: Correlations of IsoScore and Distance for Cohort Groups Over Time

Mean IsoScores for subgroups are reported in Table 4-6, but no trend is apparent from these results. For all possible subgroups (results reported in Table 4-3) nineteen out of twenty-one correlations are in the predicted direction, though only eight of these nineteen results are statistically significant. A consistent pattern appears in the results for 1979-1994: in each year the correlation for the first subgroup is statistically significant, is in the predicted direction, and yields the most strongly negative result among that year's

subgroups. Of the three subsamples, least weight is given to these results since subgroup membership changes from period to period (due to inconsistencies in establishment reporting).

Focal Year		Total Sample	Establishments from Focal Year that appear in: 1979	1982	1985	1988	1991	1994
1976	***Mean***	0.85	0.98	0.51	0.71	0.45	0.31	0.41
	n	1,176	153	210	210	120	78	78
	Estabs.	49	18	21	21	16	13	13
1979	***Mean***	0.38		0.50	0.55	0.27	0.29	0.22
	n	2,346		561	703	253	136	190
	Estabs.	69		34	38	23	17	20
1982	***Mean***	0.46			0.72	0.52	0.53	0.41
	n	12,561			4,753	2,415	1,485	1,431
	Estabs.	159			98	70	55	54
1985	***Mean***	0.39				0.38	0.39	0.38
	n	55,945				15,576	10,878	7,503
	Estabs.	335				177	148	123
1988	***Mean***	0.28					0.33	0.35
	n	100,128					37,950	23,005
	Estabs.	448					276	215
1991	***Mean***	0.25						0.27
	n	166,753						64,980
	Estabs.	578						361
1994	***Mean***	0.22						
	n	241,165						
	Estabs.	695						

Table 4-6: Mean IsoScores for Subgroups Over Time

Results are reported for survivor groups (Table 4-4) for all years except for the group first appearing in 1976. Only four establishments survive from 1976 to 1994, yielding a prohibitively small sample size of six possible pairs. Seventeen of the twenty-one remaining correlations are in the predicted direction, although only eight of these seventeen results are statistically significant. Three different patterns are apparent in these results. In 1979 and 1982, the correlations between IsoScore and Distance are strongly negative, with three of the eleven correlations statistically significant. The 1979 correlations do not exhibit the pattern suggested by hypothesis three, while the 1982 correlations tend to follow the predicted trend (by becoming more negatively correlated over time). In 1985, only one of four correlations is in the predicted direction, and none of these results is statistically significant. Finally, in 1988-1994, five of the six correlations are inverse and statistically significant. The explained variance for these correlations is extremely low, however.

As with survivor groups, results are reported for cohort groups (Table 4-5) from all years of the study except 1976. Sixteen of twenty-one correlations are in the predicted direction, and seven of these sixteen results are statistically significant. As with the survivor groups, there are three different patterns in these results. For focal year 1979 and 1982 cohorts, the predicted trend (correlations becoming increasingly negative) is observed. In fact, the 1979 cohort group has, for the year 1994, the strongest statistically significant inverse relationship reported for this entire study. The focal year 1985 cohort, however, has only one of four correlations in the predicted direction, and none of these correlations is statistically significant. Focal 1988, 1991, and 1994 cohorts exhibit

correlations similar to those for the overall sample, and these correlations do not become increasingly negative over time.

These results are reported as "modest support" for hypothesis three based on the results from the earliest focal years of the study. For focal year 1976 subgroups, focal year 1982 survivor groups, and focal year 1979 and 1982 cohort groups, the correlations tend to change in the predicted pattern, becoming more inverse as time progresses. In focal years 1985-1994, there is no support for the hypothesis. For focal year 1985, the correlations tend not to move in a coherent pattern for any of the subsamples. The results for focal years 1988, 1991, and 1994 move in the predicted pattern only twice, and in all cases the explained variance is so low as to make the pattern not meaningful.

HYPOTHESIS FOUR

Little Support. The inverse relationship between CompScore and Distance (as described in hypothesis two) was predicted to become increasingly negative over time. Using the full sample for each focal year, the correlation (r_s) between the focal years and the CompScore/Distance correlations for each year is 0.107. This result is in the opposite direction of that which was predicted, and it is not statistically significant. This trend was also tested with respect to subgroups, survivor groups, and cohort groups for each focal year. Results for 1976 are not reported for survivors and cohorts due to the extremely low sample size for these groups (four establishments, n = six).

Among subgroups (results reported in Table 4-7) eighteen out of twenty-one correlations are in the predicted direction, and five of these are statistically significant. While the focal year 1976 subgroups tend to follow the predicted trend, none of the other

subgroups do. The focal year 1982 subgroup shows a statistically significant relationships in the years 1991 and 1994, but in the opposite direction of that which is predicted. Five of six correlations for subgroups for the focal years 1985-1994 are statistically significant in the predicted direction, but have very low explained variance.

Focal Year		Focal Year	Establishments from Focal Year that appear in: 1979	1982	1985	1988	1991	1994
1976	r_s	0.0643*	-0.0033	-0.0453	-0.0590	-0.1114	-0.0416	-0.1704
	n	1,176	153	210	210	120	78	78
	Estabs.	49	18	21	21	16	13	13
1979	r_s	-0.0179		-0.0754	-0.0662	0.0017	-0.1130	-0.0979
	n	2,346		561	703	253	136	190
	Estabs.	69		34	38	23	17	20
1982	r_s	-0.0394**			-0.0132	-0.0244	0.0589*	0.0772**
	n	12,561			4,753	2,415	1,485	1,431
	Estabs.	159			98	70	55	54
1985	r_s	-0.0163**				-0.0220**	-0.0160	-0.0264*
	n	55,945				15,576	10,878	7,503
	Estabs.	335				177	148	123
1988	r_s	-0.0151**					-0.0225**	-0.0182**
	n	100,128					37,950	23,005
	Estabs.	448					276	215
1991	r_s	-0.0113**						-0.0091*
	n	166,753						64,980
	Estabs.	578						361
1994	r_s	-0.0159**						
	n	241,165						
	Estabs.	695						

* = significant at the 0.05 level
** = significant at the 0.01 level

Table 4-7: Correlations of CompScore and Distance for Subgroups Over Time

Correlations of CompScore and Distance for survivor groups (Table 4-8) are inverse (as predicted) fifteen out of twenty-one times. Ten of these fifteen correlations are statistically significant. As with the results for hypothesis three, the focal year 1979 survivor groups provide the results most consistent with the predicted trend.

Focal Year		Establishments from this Year that Appear in: 1979	1982	1985	1988	1991	1994
1979	r_s *n = 36* *9 Estabs.*	0.2858	0.2163	-0.2321	-0.4072 *	-0.5555 **	-0.3514 *
1982	r_s *n = 561* *34 Estabs.*		0.0564	0.0555	-0.0496	0.0769	0.0836 *
1985	r_s *n = 4,465* *95 Estabs.*			-0.0016	-0.0336 *	-0.0080	-0.0025
1988	r_s *n = 18,145* *191 Estabs.*				-0.0516 **	-0.0383 **	-0.0172 *
1991	r_s *n = 64,980* *361 Estabs.*					-0.0125 **	-0.0091 *
1994	r_s *n = 241,165* *695 Estabs.*						-0.0159 **

* = significant at the 0.05 level
** = significant at the 0.01 level

Table 4-8: Correlations of CompScore and Distance for Survivor Groups Over Time

Among focal year 1979's survivors, CompScore and Distance are positively correlated in 1979. They are less positively correlated in 1982 and negatively correlated in 1985-94. The negative correlations between CompScore and Distance for focal year 1979's survivors are statistically significant in 1988, 1991, and 1994. Survivor groups in subsequent years do not exhibit the predicted trend.

For cohort groups (Table 4-9) two of the twenty-one correlations are not reported because in 1979 and 1982 none of the focal year 1979 cohorts are complementary to one another. These five establishments exhibit an inverse, but non-significant, relationship between CompScore and Distance in the years 1985-1994. Overall, results for cohort groups do not provide support for the hypothesized relationship. Fourteen of the nineteen correlations are in the predicted direction, but only three are statistically significant. Each of the statistically significant inverse relationships provides an extremely low explained variance.

Focal Year		Establishments from Focal Year that appear in: 1979	1982	1985	1988	1991	1994
1979	r_c **n = 10** ***5 Estabs.***	NR	NR	-0.1741	-0.5450	-0.5222	-0.1038
1982	r_s **n = 300** ***25 Estabs.***		-0.0186	0.0493	-0.0676	0.1949 **	0.1148 *
1985	r_s **n = 1,770** ***60 Estabs.***			-0.0223	-0.0398	-0.0218	-0.0148
1988	r_s **n = 4,560** ***96 Estabs.***				-0.0460 **	-0.0814 **	-0.0235
1991	r_s **n = 14,028** ***168 Estabs.***					0.0026	0.0034
1994	r_s **n = 45,753** ***303 Estabs.***						-0.0140 **

* = significant at the 0.05 level
** = significant at the 0.01 level
NR = not reported

Table 4-9: Correlations of CompScore and Distance for Cohort Groups Over Time

Mean CompScores for subgroups are reported in Table 4-10. In general, the average CompScores decrease over time. The one exception to this observation is for the focal year 1976 subgroups, whose average CompScores decrease from 1979 to 1988. From 1988 to 1994, however, average CompScores for the focal year 1976 subgroups increase.

Focal Year		Total Sample	Establishments from Focal Year that appear in: 1979	1982	1985	1988	1991	1994
1976	***Mean***	1.71	2.07	0.99	0.85	0.50	0.97	1.09
	n	1,176	153	210	210	120	78	78
	Estabs.	49	18	21	21	16	13	13
1979	***Mean***	0.80		0.71	0.70	0.38	0.38	0.25
	n	2,346		561	703	253	136	190
	Estabs.	69		34	38	23	17	20
1982	***Mean***	0.63			0.67	0.35	0.39	0.25
	n	12,561			4,753	2,415	1,485	1,431
	Estabs.	159			98	70	55	54
1985	***Mean***	0.44				0.35	0.32	0.32
	n	55,945				15,576	10,878	7,503
	Estabs.	335				177	148	123
1988	***Mean***	0.28					0.33	0.33
	n	100,128					37,950	23,005
	Estabs.	448					276	215
1991	***Mean***	0.28						0.28
	n	166,753						64,980
	Estabs.	578						361
1994	***Mean***	0.24						
	n	241,165						
	Estabs.	695						

Table 4-10: Mean CompScores for Subgroups Over Time

Results for hypothesis four are described as offering "little support" because they do not exhibit as clear a pattern as that found in the results for hypothesis three. While there is limited support found among survivor groups with the most longevity, neither subgroups nor cohort groups exhibit the predicted association between CompScore and Distance.

HYPOTHESIS FIVE

Modest Support. Hypothesis five asserts that pairs of establishments that are nearest the same research institute will exhibit greater IsoScores than will pairs of establishments that are not nearest the same research institute. The results of this hypothesis test are reported in Table 4-11 (subgroups), Table 4-12 (survivor groups), and Table 4-13 (cohort groups). Because of the lack of historical data on institutes, all tests were conducted with respect to 1994 data. In Table 4-11, for example, the row for focal year 1988 refers to the 215 establishments that reported in both 1988 and 1994, and the *t* test is performed with respect to 1994 data for those establishments. Based on hypothesis five, the *t* test is in the predicted direction when the mean IsoScore is higher for those establishments nearest the same research institute (RIProx = yes).

The relationship is in the predicted direction for two of the five subgroups (Table 4-11), one of the four survivor groups (Table 4-12), and three of the four cohort groups (Table 4-13). For each of these groups, the 1994 results are in the predicted direction and are statistically significant. None of the other *t* tests is statistically significant. Since the population of IsoScores is not assumed to be normally distributed,

results are only reported for those *t* tests in which both samples have an *n* greater than thirty (Neter, Wasserman & Whitmore, 1993).

Focal Year		RIProx	*n*	H5 Mean IsoScore	H6 Mean CompScore
1994	*n* = 241,165 695 Estabs.	No	232,837	0.221	0.239
		Yes	8,328	0.240	0.248
				a *	a
1991	*n* = 64,980 361 Estabs.	No	62,660	0.267	0.281
		Yes	2,320	0.248	0.263
1988	*n* = 23,005 215 Estabs.	No	22,018	0.349	0.322
		Yes	987	0.334	0.342
					a
1985	*n* = 7,503 123 Estabs.	No	7,150	0.378	0.319
		Yes	353	0.385	0.360
				a	a
1982	*n* = 1,431 54 Estabs.	No	1,371	0.416	0.246
		Yes	60	0.333	0.233
1979	*n* = 190 20 Estabs.	No	187	--	--
		Yes	3	--	--
				--[1]	--[1]
1976	*n* = 78 13 Estabs.	No	74	--	--
		Yes	4	--	--
				--[1]	--[1]

[1] *t* tests for these cells are not reported due to low sample sizes for RIProx = Yes
a = result is in the predicted direction
* = significant at the 0.05 level

Table 4-11: *t* Tests for Hypotheses Five and Six Using Subgroups

Focal Year		RIProx	*n*	H5 Mean IsoScore	H6 Mean CompScore
1994	*n* = 241,165 695 Estabs.	No	232,837	0.221	0.239
		Yes	8,328	0.240	0.248
				a *	a
1991	*n* = 64,980 361 Estabs.	No	62,660	0.267	0.281
		Yes	2,320	0.248	0.263
1988	*n* = 18,145 191 Estabs.	No	17,372	0.370	0.351
		Yes	773	0.339	0.361
					a
1985	*n* = 4,465 95 Estabs.	No	4,251	0.445	0.419
		Yes	214	0.421	0.453
					a
1982	*n* = 561 34 Estabs.	No	539	--	--
		Yes	22	--	--
				--[1]	--[1]
1979	*n* = 36 9 Estabs.	No	35	--	--
		Yes	1	--	--
				--[1]	--[1]
1976	*n* = 6 4 Estabs.	No		--	--
		Yes		--	--
				--[1]	--[1]

[1] *t* tests for these cells are not reported due to low sample sizes for RIProx = Yes
a = result is in the predicted direction
* = significant at the 0.05 level

Table 4-12: *t* Tests for Hypotheses Five and Six Using Survivor Groups

Focal Year		RIProx	*n*	H5 Mean IsoScore	H6 Mean CompScore
1994	*n* = 45,753 303 Estabs.	No	44,301	0.173	0.209
		Yes	1,452	0.222	0.227
				a *	a
1991	*n* = 14,028 168 Estabs.	No	13,580	0.167	0.216
		Yes	448	0.214	0.241
				a	a
1988	*n* = 4,560 96 Estabs.	No	4,390	0.310	0.308
		Yes	170	0.282	0.265
1985	*n* = 1,770 60 Estabs.	No	1,675	0.362	0.408
		Yes	95	0.379	0.474
				a	a
1982	*n* = 300 25 Estabs.	No	285	--	--
		Yes	15	--	--
				--[1]	--[1]
1979	*n* = 10 5 Estabs.	No	10	--	--
		Yes	0	--	--
				--[1]	--[1]
1976	*n* = 6 4 Estabs.	No		--	--
		Yes		--	--
				--[1]	--[1]

[1] *t* tests for these cells are not reported due to low sample sizes for RIProx = Yes
a = result is in the predicted direction
* = significant at the 0.05 level

Table 4-13: *t* Tests for Hypotheses Five and Six
Using Cohort Groups

The relationships are in the predicted direction for establishments in both the Northeast and California (results reported in Appendix A, Table A-9) although the results are statistically significant only among California's establishments.

HYPOTHESIS SIX

No Support. According to hypothesis six, pairs of establishments that are nearest the same research institute should exhibit greater CompScores than pairs of establishments that are not nearest the same research institute. As with hypothesis five, this test was performed with respect to 1994 data using subgroups (Table 4-11), survivors (Table 4-12), and cohorts (Table 4-13). As with IsoScores (hypothesis five) the population of CompScores is not assumed to be normally distributed and results are only reported for those *t* tests in which both samples have an *n* greater than thirty.

Although the relationships are in the predicted direction for three of the five subgroups, three of the four survivor groups, and three of the four cohort groups, none is statistically significant. Additional tests were completed with respect to establishments in California and the Northeast. These results are presented in Appendix A, Table A-9. As with the overall sample, the relationship between CompScore and RIProx is in the predicted direction, but is not statistically significant.

HYPOTHESIS SEVEN

No Support. Hypothesis seven predicts that pairs of establishments located nearest the same dominant firm will exhibit greater IsoScores than will pairs of establishments that are not nearest the same dominant firm. Unlike the results for hypothesis five, the results of this hypothesis test are inconsistent across groupings.

Among subgroups (results reported in Table 4-14) only one relationship out of five is in the predicted direction, and this relationship is not statistically significant. Three of the five relationships are statistically significant, but in the opposite direction.

Focal Year		DFProx	*n*	H7 Mean IsoScore	H8 Mean CompScore
1994	*n* = 241,165 695 Estabs.	No	229,634	0.222	0.240
		Yes	11,531	0.204	0.212
				*	*
1991	*n* = 64,980 361 Estabs.	No	61,944	0.268	0.282
		Yes	3,036	0.231	0.256
				*	
1988	*n* = 23,005 215 Estabs.	No	21,925	0.351	0.325
		Yes	1,080	0.280	0.278
				*	
1985	*n* = 7,503 123 Estabs.	No	7,148	0.377	0.320
		Yes	355	0.406	0.358
				a	**a**
1982	*n* = 1,431 54 Estabs.	No	1,374	0.416	0.245
		Yes	57	0.316	0.246
					a
1979	*n* = 190 20 Estabs.	No	184	--	--
		Yes	6	--	--
				--[1]	--[1]
1976	*n* = 78 13 Estabs.	No	74	--	--
		Yes	4	--	--
				--[1]	--[1]

[1] *t* tests for these cells are not reported due to low sample sizes for DFProx = Yes
a = result is in the predicted direction
* = significant at the 0.05 level

Table 4-14: *t* Tests for Hypotheses Seven and Eight Using Subgroups

Focal Year		DFProx	*n*	H7 Mean IsoScore	H8 Mean CompScore
1994	*n* = 241,165 695 Estabs.	No	229,634	0.222	0.240
		Yes	11,531	0.204	0.212
				*	*
1991	*n* = 64,980 361 Estabs.	No	61,944	0.268	0.282
		Yes	3,036	0.231	0.256
				*	
1988	*n* = 18,145 191 Estabs.	No	17,302	0.372	0.353
		Yes	843	0.306	0.314
1985	*n* = 4,465 95 Estabs.	No	4,242	0.446	0.422
		Yes	223	0.386	0.399
1982	*n* = 561 34 Estabs.	No	535	--	--
		Yes	26	--	--
				--[1]	--[1]
1979	*n* = 36 9 Estabs.	No	35	--	--
		Yes	1	--	--
				--[1]	--[1]
1976	*n* = 6 4 Estabs.	No		--	--
		Yes		--	--
				--[1]	--[1]

[1] *t* tests for these cells are not reported due to low sample sizes for DFProx = Yes
a = result is in the predicted direction
* = significant at the 0.05 level

Table 4-15: *t* Tests for Hypotheses Seven and Eight Using Survivor Groups

Focal Year		DFProx	*n*	H7 Mean IsoScore	H8 Mean CompScore
1994	*n* = 45,753 303 Estabs.	No	43,457	0.175	0.212
		Yes	2,296	0.153	0.166
					*
1991	*n* = 14,028 168 Estabs.	No	13,311	0.167	0.213
		Yes	717	0.198	0.287
				a	a *
1988	*n* = 4,560 96 Estabs.	No	4,368	0.311	0.306
		Yes	192	0.260	0.297
1985	*n* = 1,770 60 Estabs.	No	1,679	0.361	0.408
		Yes	91	0.396	0.473
				a	a
1982	*n* = 300 25 Estabs.	No	283	--	--
		Yes	17	--	--
				--[1]	--[1]
1979	*n* = 10 5 Estabs.	No	10	--	--
		Yes	0	--	--
				--[1]	--[1]
1976	*n* = 6 4 Estabs.	No		--	--
		Yes		--	--
				--[1]	--[1]

[1] *t* tests for these cells are not reported due to low sample sizes for DFProx = Yes
a = result is in the predicted direction
* = significant at the 0.05 level

Table 4-16: *t* Tests for Hypotheses Seven and Eight Using Cohort Groups

Among survivor groups (Table 4-15) four out of four relationships are in the opposite of the predicted direction, and two of these results (1991 and 1994) are statistically significant. Two of the four results for cohort groups (Table 4-16) are in the predicted direction, but none of the cohort group *t* tests is statistically significant.

The test is conducted also for establishments in the Northeast and California (see Appendix A, Table A-10). Among California's establishments, the relationship is in the predicted direction, but is not statistically significant. In the Northeast, the relationship is statistically significant, but runs counter to the predicted relationship.

Subgroups, survivor groups, and the Northeast subset indicate that the relationship is in the direction opposite of that which is predicted, while cohort group results show no coherent pattern. This suggests that greater strategic similarity might exist among establishments that are not nearest the same dominant firm than exists among establishments that are nearest the same dominant firm.

HYPOTHESIS EIGHT

No Support. According to hypothesis eight, pairs of establishments located nearest the same dominant firm will exhibit greater CompScores than will pairs of establishments that are not nearest the same dominant firm. In contrast to hypothesis seven, no clear pattern emerges in these results.

Results for two of the five subgroups (Table 4-14) are in the predicted direction, but the only statistically significant result is in the opposite direction. For survivor groups (Table 4-15) four out of four results run counter to the prediction, and one of these (1994)

is statistically significant. Two out of four results for cohort groups (Table 4-16) are in the predicted direction, but only one of these three is significant.

Regional subsets are also tested; in California the relationship is in the predicted direction, but is not statistically significant, while in the Northeast the relationship is statistically significant in the opposite direction of that which is predicted. These results are reported in Appendix A, Table A-10.

SUMMARY

Little or no support is found for hypotheses one, two, four, six, seven, and eight. In contrast, modest support is found for hypotheses three and five. Results for hypothesis three tend to be closest to the predicted relationship for the earliest focal years. This tendency supports the arguments made with respect to trends over time, and suggests that the fiberoptics industry might be early in the process of developing the predicted relationships.

Hypothesis five's *t* tests indicate modest support for the predicted relationship among cohorts. This result suggests that a pair's proximity to the same research institute is related to their strategic postures if both establishments in the pair entered the fiberoptics industry at approximately the same time.

Results for hypothesis seven support the opposite relationship of that which is predicted. These results suggest that dominant firms may have different types of relationships with neighboring establishments than those predicted in Chapter Two.

While there is little support, overall, for the predicted relationships, certain attributes of these results are noteworthy. Interpretations and implications of the results are discussed in Chapter Five.

CHAPTER FIVE: CONCLUSION

This study investigates the implications of geographic location for collective strategy formation. Collective strategy is defined in Chapter Two as the pattern of competitive and cooperative strategic postures that exist within a collectivity of organizations. This study's hypotheses explore whether the geographic distance between establishments affects the formation of two such patterns, strategic isomorphism and strategic complementarity. Strategic isomorphism and complementarity are operationalized by comparing each establishment's strategic posture to the strategic postures of all other establishments in the fiberoptics industry.

The summary finding of the study is that, to date, there is little, if any, empirical support for an association between geographic proximity and strategic posture in the fiberoptics industry. Most of the hypotheses have yielded neutral results. While it is possible that the proposed phenomena do not occur in this industry, for all of the hypotheses there are several alternative explanations for the results. One possibility is that the hypothesized relationships are mid-range (or otherwise restricted) phenomena which might be observable by changing the sampling or measurement procedures. A second possibility is that the phenomena are more sensitive to industry or firm maturity differences and relationships than originally suspected. A third possibility is that the strength of the hypothesized relationships might be industry sensitive. All of these possibilities are considered below as they relate to the individual hypotheses. In addition, methodological considerations common to all the hypotheses are considered. These issues are addressed

within the context of directions for future research. The study raises a number of interesting issues for future consideration. In this chapter, the results reported in Chapter Four are interpreted, implications of these results are discussed, and suggestions for further avenues of research are proposed.

INTERPRETATIONS OF RESULTS

Hypotheses One and Three

Hypothesis one predicts an inverse relationship between strategic isomorphism and distance. Hypothesis three predicts that this inverse relationship will become more pronounced as time progresses. Spearman's rank-order correlations for hypothesis one are statistically significant and in the predicted direction for the last five years of the study, but too little variance is explained for the result to be considered consequential. The geographic distance between two establishments is not strongly associated with their level of strategic isomorphism.

Changes in the association between strategic isomorphism and distance over time (hypothesis three) are assessed with respect to the total sample as well as to the three different subsamples for each focal year of the study. The association between IsoScore and Distance tends to be strongest (and most consistent with predictions) among establishments that have been in the industry the longest. It is also noteworthy that the strongest inverse relationships tend to occur near the end of the study (1994).

Among survivor groups and cohort groups, the predicted trend is observed in focal years 1979 and 1982. In 1985, survivors and cohorts do not exhibit the predicted relationship, while in 1988-94, the predicted relationship is observed, but with very little

explained variance (as with the total sample). The fact that the strongest inverse relationship is observed with respect to cohort groups (in 1982) suggests that industry conditions at the time of an establishment's founding might be a factor worth further study.

Additional testing: regional subsets. To explore whether a relationship might be restricted with respect to distance with the possibility that an effect is being "canceled out" in the nationwide sample, correlations of IsoScore and Distance are also calculated with respect to two regional subsets: California and the Northeast. These two regions are used, in part, because they have been home to significant numbers of fiberoptic establishments since the industry's inception. Therefore, intra-industry institutional forces have therefore had more time to form in these regions.

Results of the regional analyses are reported in Appendix A, Tables A-1 and A-3. The means and standard deviations for IsoScore for these two subsets are similar to the means and standard deviations for the national sample (Table A-1). Spearman's rank-order correlations for IsoScore and Distance (for the total sample and each regional subset) are reported in Table A-3. Among establishments located in California, five of the seven correlations are in the predicted direction, but none of these correlations is statistically significant. Correlations for the Northeast establishments are in the predicted direction in only two of the seven years, with only one of these correlations statistically significant. Therefore, while the predicted relationship is weakly supported in the total sample, it is not supported within the regions.

Theoretical insights. It is hypothesized in Chapter Two that normative forces might encourage co-located establishments to form similar strategies. While normative forces (such as professionalization) might indeed influence establishments' strategic postures (DiMaggio & Powell, 1983), the results do not indicate that this is more of a regional than national phenomenon. In fact, norms such as professionalization might decrease the importance of distance by enhancing the transmission of norms and values throughout the industry. Conferences, industry publications, and professional societies, to the extent that they have a national scope, might contribute to a national set of norms that is insensitive to distance.

Alternatively, more time may need to elapse before the full effect of normative forces and any evidence of regionalization are observed. Reliance on professional societies and communication with far-flung establishments might be more important during the early stages of industry evolution than it is during later stages. Therefore, emerging higher technology industries might exhibit less "balkanization" than more entrenched industries.

Mimetic forces might also be less influential than the discussion in Chapter Two suggests. It is possible that, in a higher technology industry, such an emphasis is placed on innovation that copying the product offerings of nearby establishments might actually harm an establishment's reputation. Rather than signaling one's strategic emphasis by mimicking existing establishments, the newly founded establishment might want to signal innovativeness by offering a different mix of products and services.

Additional testing: establishment longevity. To explore this possibility, tests are performed to distinguish between the effects of entry behavior and the effects of interactions among existing establishments. To this end, correlations of IsoScore and Distance are calculated in each year of the study for "new" and "existing" establishments. For each year, new establishments are defined as those that did not appear in any of the preceding focal years. For example, new establishments in 1982 are those that appear in neither 1979 nor 1976. All establishments that are new to the database as of a given focal year are included, whether or not they appear in the database in subsequent focal years.

The results of these analyses are reported in Appendix A, Tables A-5 and A-7. As shown in Table A-5, mean IsoScores are higher for existing establishments than they are for new establishments in six of the study's seven years. For new establishments, correlations between IsoScore and Distance (Table A-7) are in the predicted direction for only three of the seven years, and no correlations are statistically significant. In contrast, all six correlations of IsoScore and Distance for existing establishments are in the predicted direction, and four of these six correlations are statistically significant. While the degree of correlation is small in later focal years, trends in the correlations over time support this finding. Strategic similarities tend to be greater among existing establishments than they are among new establishments. Since the number of potential product-offering combinations increases exponentially with the number of product categories, it is significant that this relationship holds even as the number of product categories expands dramatically. Based on these results, the predicted relationship

between strategic isomorphism and distance is stronger for existing establishments in a given year than it is for new establishments.

Summary of findings. Geographic proximity tends to be a stronger predictor of the level of strategic isomorphism between two establishments when those establishments have both operated in the fiberoptics industry for a long period of time. The growth of the fiberoptics industry has been rapid and turbulent. For instance, in the final focal year of the study (1994), forty-four percent of all establishments had entered the database in 1992-94. Therefore, these findings are compatible with the institutional arguments made in Chapter Two, since institutional forces might not have had enough time to build among all establishments.

Mimetic forces, for example, may not be observable until there is greater stability in industry membership with a commensurate increase in the visibility of industry leaders. Likewise, fiberoptics establishments originated in so many different industries that normative forces unique to this industry may not have formed in only twenty years. Studies of subsequent years are needed to further test this relationship. It might also be beneficial to control for "industry of origin" in future studies. This control might make it easier to distinguish between institutional forces relating to other industries that have previously affected an establishment and those that affect it once it begins making fiberoptic products.

Hypotheses Two and Four

According to hypothesis two, strategic complementarity and distance will be inversely related. According to hypothesis four, this relationship will become more inverse

as time progresses. The pattern of correlations found for hypothesis two is similar to that found for hypothesis one. CompScore and Distance are inversely related (as predicted) in six of the study's seven years. For the last five years of the study (1982-1994) the correlations are statistically significant in the predicted direction. However, the explained variance for each of these results is extremely low, casting doubt on the importance of the finding. From these results it appears that strategic complementarity is not strongly associated with the distance between establishments.

The total sample, subgroups, survivor groups, and cohort groups are used to test changes over time in the relationship between complementarity and distance (hypothesis four). The 1976 survivor group provides the only results that are consistent with the predicted relationship, are statistically significant, and provide a meaningful R-square. Therefore, contrary to the predictions in Chapter Two, there is not strong support for an association between strategic complementarity and the distance between establishments, and there is no clear indication that the relationship between these variables becomes more strongly negative over time.

Additional testing: regional subsets. Correlations are also calculated with respect to regional subsets (California and the Northeast). These results are reported in Appendix A, Tables A-2 and A-4. As with the regional results for hypothesis one, the results for the California subset more closely resemble the results for the overall sample than do the results for the Northeast. In the Northeast, correlations between CompScore and Distance are in the predicted direction in only two out of seven years, and two of the three statistically significant correlations are in the opposite direction of that which is

predicted. Among California establishments, correlations between CompScore and Distance are in the predicted direction in the last four years of the study, and three of these results are statistically significant. As is the case with the nationwide sample, these correlations explain a very small amount of the variance.

Theoretical insights. An inverse relationship between CompScore and Distance is predicted in part because establishments might intentionally locate near their customers and suppliers, and away from their competitors (Dicken & Lloyd, 1990). Geographic proximity has the potential to facilitate such business functions as logistics and customer service. It is possible, however, that the nature of many fiberoptics products makes these benefits less important in this industry than they are in other industries. Many specialized products, such as connectors, couplers, and LEDs are small and lightweight, and can therefore be shipped with minimal expense to points throughout the world. Also, many customers for fiberoptic products are themselves engineers or technicians who can easily understand the product's features and benefits. As customers, they might require less personalized attention than customers in other industries. Factors such as these might make an establishment's location relative to customers (and competitors) less important. In higher technology industries such as the fiberoptics industry, when a region contains many similar establishments, it is not necessarily the case that they primarily serve customers in the immediate vicinity.

The specificity of the product categories, and the use of generally defined value chain activities, used here might also help explain this result. If a significant number of

potential buyer/supplier linkages are overlooked in the current study, then these results are suspect. This is discussed in detail below (see "Suggestions for Further Research").

Finally, the development of trust (and the commensurate lowering of transaction costs that comes with trust (Ring & Van de Ven, 1992)) is predicted to increase the level of complementarity among establishments. Since trust is built upon experience, it is reasonable to expect greater complementarity among establishments that have operated for a longer period. Since no strong association is found between complementarity and distance it is apparent that transaction costs are not lower for closely located establishments than they are for more distant establishments. However, as with institutional forces (see discussion of hypotheses one and three, above) it might be that too little time has elapsed for transaction costs to be dramatically reduced within regions, especially considering the high number of new entrants into the industry in each year. In order to test this possibility, exploratory correlations are calculated with respect to "new" and "existing" establishments in each year of the study.

Additional testing: establishment longevity. Although not as pronounced as for hypothesis one, new and existing establishments do exhibit differences in the degree of correlation between CompScore and Distance. In five of six years, CompScore and Distance are more negatively correlated for existing establishments than they are for new establishments (see Table A-8). Therefore, longer-lived establishments exhibit greater potential for buyer/supplier linkages with nearby establishments than do new entrants. This result supports the assertion that too little time has elapsed for establishments in this

industry to form long-term, transaction-facilitating, relationships. It also casts further doubt on the proposition that new establishments choose to locate near their customers.

Summary of findings. To the extent that this industry is highly fragmented, there may not be enough transactions between establishments to encourage the formation of trusting long-term relationships. It is also possible that instability of the industry's membership makes geographic proximity to partners less important than might otherwise be the case. For example, the reputation effect might benefit only a very few large establishments that have been in the fiberoptics industry since its inception. Finally, rapid movement in and out of this industry might reduce the perceived penalties of opportunistic behavior. In an industry in which forty-four percent of the establishments in focal year 1994 are less than three years old, managers might be willing to take greater advantage of exchange partners because they know that next year there will be many new establishments with which to transact.

Hypothesis Five

It is proposed in hypothesis five that the IsoScore for a given pair of establishments will be higher if both establishments are located nearest the same research institute. The arguments made in Chapter Two with respect to this hypothesis are mainly from the institutional perspective (e.g. Meyer & Rowan, 1977; Scott, 1995); to the extent that research institutes might strengthen institutional forces, they are expected to encourage similarities in the strategic postures of proximal establishments.

Results of *t* tests performed with respect to 1994 data are reported for subgroups, survivors, and cohorts. Six of the thirteen *t* tests are in the predicted direction, and three

of these six results are statistically significant. The 1994 result for each *t* test is statistically significant in the predicted direction. Therefore, in 1994, pairs in which each establishment is nearest the same research institute have (on average) higher average IsoScores than do pairs in which the establishments are not nearest the same research institute. For cohort groups, three out of the four *t* tests are in predicted direction, although only one of these three results is statistically significant.

Additional testing: regional subsets. As with hypotheses one and three, this relationship is also tested with respect to regional subsets. Results for these additional tests are reported in Appendix A, Table A-9. Among Northeast establishments, the association is in the predicted direction, but is not statistically significant, and the means are separated by only one one-thousandth of a point. Among California establishments, the association between RIProx and IsoScore is statistically significant in the predicted direction. In summary, in California (and not in the Northeast) pairs of establishments that are nearest the same research institute exhibit, on average, greater strategic isomorphism. Is it possible that California research institutes have a more pronounced effect than do Northeast research institutes on establishments' strategic postures? Further research will be necessary to determine whether this is the case.

Theoretical insights. For tests conducted with respect to the national sample, it is cohort groups that exhibit an association between research institute proximity and strategic isomorphism that most closely resembles the predicted association. Since cohort groups consist of establishments founded within a three year period, this result may indicate that research institute proximity is most important as it affects entry behavior.

While further research is necessary to better understand this finding (see below) it is possible that it arises due to research institutes' role in encouraging and assisting start-ups. It is also possible that rapid advances in technology and application might contribute to this pattern. A research institute might influence start-ups to adopt one type of strategic posture during a given three-year period, then change its focus, and its advice to new establishments, during a subsequent three-year period. Therefore, two establishments may have both commenced operations near the same research institute, but if they were not founded at about the same time, they might not necessarily have similar strategic postures. As a result, the predicted relationship might only exist within relatively narrow timespans.

Hypothesis Six

Hypothesis six states that the CompScore for a given pair of establishments will be higher if both establishments are located nearest the same research institute. In Chapter Two, it is proposed that research institutes contribute to the reduction of transaction costs in their region. This reduction in transaction costs would make transactions with nearby establishments more viable and profitable than transactions with more remote establishments, increasing the likelihood that an establishment would develop a strategic posture complementary to those of its neighbors.

Results for thirteen *t* tests are reported: five with respect to subgroups, four with survivor groups, and four with cohort groups. Although the results for nine out of thirteen *t* tests are in the predicted direction, none of these results is statistically significant. Therefore, no evidence is found of an association between research institute proximity and strategic complementarity.

Additional testing: regional subsets. Additional tests of hypothesis six are performed for the California and Northeast subsets. Results of these *t* tests are reported in Appendix A, Table A-9. These findings are consistent with the *t* tests performed with respect to the total sample; while both results are in the predicted direction, neither is statistically significant.

Theoretical insights. Hypothesis six may lack support because too little time has elapsed for transaction costs to be meaningfully reduced. Development of trusting relationships with other establishments is one of the most important ways transaction costs are reduced. If many establishments exit and enter the industry in a given year, it may be difficult for managers to adequately assess their potential exchange partners. If this turnover is reflected in a significant percentage of a research institute's affiliated establishments, then the institute may not be able to build confidence among its affiliates in the manner predicted.

This result may also be affected by the nature of a research institute's relationships with its affiliates. While some institutes might encourage interaction among establishments, as predicted in Chapter Two, others might not. The need to protect proprietary information, for example, might outweigh the desire to involve additional establishments in a project. If a research institute does not encourage inter-establishment relationships, then it is unlikely that it will contribute to reduced transaction costs in its immediate region. While such an institute might serve as a conduit for information between establishments, it will not necessarily enhance feelings of trust among those establishments.

Hypothesis Seven

It is asserted in hypothesis seven that pairs of establishments nearest the same dominant firm will exhibit greater strategic isomorphism than will pairs that are not nearest the same dominant firm. Three out of thirteen *t* tests (for subgroups, survivor groups, and cohort groups) yield results in the predicted direction, but none of these three results is statistically significant. Five of the ten other *t* tests are, however, statistically significant. In other words, pairs of establishments that are *not* nearest the same dominant firm tend to be more isomorphic with one another than are pairs that *are* nearest the same dominant firm. Therefore, the only statistical support found is for a relationship opposite of that predicted in Chapter Two.

Additional testing: regional subsets. Results for the California and the Northeast subsets are reported in Appendix A, Table A-10. For the California group, the *t* test is in the predicted direction, but is not statistically significant. In contrast, the result for the Northeast is statistically significant in the direction opposite of that which is predicted. In the Northeast, establishments that are nearest the same dominant firm are less isomorphic than establishments that are not nearest the same dominant firm.

Theoretical insights. The fact that five out of five statistically significant results are in the opposite direction of that which is predicted might reflect the type of influence that dominant firms have on nearby establishments. Enright (1990) notes, for example, that Leitz encouraged startups in its immediate area in order to enhance its supplier network. When a dominant firm plays a significant role in the formation of new establishments, it is not necessarily the case that these establishments will have similar

strategic postures. The dominant firm's influence might reduce the similarity of strategic postures by encouraging the division of labor among establishments. Long-standing relationships with these suppliers might also discourage the formation of competing establishments, making it less likely that a dominant firm's neighbors will exhibit high levels of strategic isomorphism. If a dominant firm instigated an establishment's founding, it might be less likely to casually drop that establishment as a supplier. Therefore, when dominant firms engage in exchange relationships with many neighbors, and if they play a role in founding nearby establishments, the likelihood that neighbors' strategic postures will be similar might decrease. The results of this hypothesis test are so equivocal, however, that future studies are necessary to understand more fully the influence that dominant firms have on their neighbors' strategic postures (see discussion below).

It is argued in Chapter Two that dominant firms might contribute to the institutional forces present in their region. Therefore, establishments that are nearest the same dominant firm might develop similar strategic postures. Based on these results, there is no evidence to support this institutional argument. In fact, the results could indicate that dominant firms somehow dampen institutional forces that would encourage isomorphism. It is possible that dominant firms inspire other establishments to adopt certain strategic postures in spite of institutional forces, not because of them.

Hypothesis Eight

Hypothesis eight proposes that pairs of establishments nearest the same dominant firm will be more complementary to one another than will pairs that are not nearest the same dominant firm. This hypothesis is not supported. Only four of thirteen results (for

subgroups, survivors, and cohorts) are in the predicted direction, and only one of these four is statistically significant. Unlike the results for hypothesis seven, there is no pattern evident in these results.

Additional testing: regional subsets. Among the regional subsets, the results for California establishments are in the predicted direction, but not statistically significant. The results for the Northeast are in the opposite direction of that which is predicted, and are statistically significant. In other words, in the Northeast, establishments that are not nearest the same dominant firm are more strategically complementary to one another.

Theoretical insights. These results might be explained in part by the nature of relationships between dominant firms and nearby fiberoptics establishments. A dominant firm might encourage complementarity only between each nearby establishment and itself, rather than encouraging complementarity in the community as a whole. The current study does not test for this possibility.

Alternatively, dominant firms may form relationships with nearby establishments that, while they are important for both parties, do not necessarily lead to complementary product offerings in the region. Belotti (1995) notes that large firms often provide technology and expertise to small firms. Since cooperation might have the goal of inventing new products or improving existing products, such relationships could flourish without being reflected in the product offerings of establishments. Dominant firms take an interest in smaller firms for reasons other than improvement of buyer/supplier linkages.

The case is made in Chapter Two that dominant firms, to the extent that they encourage and influence interorganizational relationships, might help to reduce transaction

costs among fiberoptic establishments in their region. It may be the case, however, that dominant firms have incentives to discourage, rather than encourage, relationships among their suppliers. Resource dependence theorists (Pfeffer, 1982), for example, argue that organizations seek power over critical resources. By discouraging small suppliers from interacting with one another, the dominant firm can preserve its position of power relative to such establishments.

SUMMARY OF THEORETICAL IMPLICATIONS

Although further study is needed to determine the relative importance of strategic isomorphism and strategic complementarity in emerging higher technology industries, the results indicate that these phenomena are less dependent on geography than expected. Future studies should incorporate formal network analyses in order to determine the most plausible explanation of this finding. It is possible that strategic isomorphism and value chain complementarity are not related to the interorganizational network to the extent anticipated. Alternatively, it might be that interorganizational networks are less influenced by establishments' geographic locations than predicted.

The results for hypotheses one and three are compatible with institutional arguments, but apparently it is too soon to say whether the fiberoptics industry has developed a distinct institutional environment. It is reasonable to expect, for example, that mimetic forces would be less pronounced during the early stages of industry development. It may also be premature to say whether institutional forces in this industry vary from region to region. Additional studies are needed to better explain the effect of institutional pressures at various stages in the development in emerging higher technology industries.

Transaction costs theorists (e.g. Williamson, 1975, 1985) argue that development of mental models, reputations, and trust will make market-based transactions more viable in an industry. Results with respect to the first twenty years of the fiberoptics industry do not appear to indicate any lowering of transaction costs among geographically proximate establishments. As with institutional forces, studies of this industry in subsequent years are needed to determine whether the influence of transaction costs will become more geographically determined as the industry develops.

Finally, research institutes and dominant firms appear to have less of an effect on establishments' strategic postures than is argued in Chapter Two. As with the results for hypotheses one through four, it is possible that these entities have an effect, but that this effect is not geographically sensitive. Future studies should measure the influence of such entities more directly, rather than focusing only on the potential for influence.

If subsequent studies show that these phenomena are not geographically sensitive, then it is less likely that accounting for geographic location will enhance the predictive and explanatory value of management models. The arguments made in Chapter Two are based on the possibility that managers' choice of reference points, and therefore their choice of strategic responses, is influenced by the geographic location of their establishment (as discussed by Porac, Thomas, & Baden-Fuller, 1989). Little support for this assertion is found in these results.

SUGGESTIONS FOR FURTHER RESEARCH

Even though the results for most of the hypotheses are indeterminate, they should inform a number of useful future studies. Alterations and extensions of this study are discussed below, according to the theoretical or methodological issues they address.

Study of the Industry in Subsequent Years

Trends in the results seem to indicate that the predicted relationships are stronger among pairs of establishments that have been in the industry the longest. Therefore, additional studies incorporating subsequent years might provide greater insight into the predicted relationships. While this industry has existed for over twenty years, the high number of new entrants (even in recent years) suggests that its membership has yet to stabilize. A longer time period for the study might clarify whether, as some of the results hint, isomorphism and complementarity are more pronounced among existing establishments than among new establishments. This result would imply that location is more of a strategic influence for establishments only after they have operated in the industry for a number of years. Such a study could also clarify the extent to which establishments' choice of location is influenced by their strategic postures.

When comparing new and existing establishments, it might be useful to consider the relative stability of product offerings. Weak results for new establishments might be attributable to changes in their strategic postures in the years immediately after they are founded. The present study's three-year increments could mask changes in strategic postures that occur within the first year of operation. Therefore, this study does not

satisfactorily test the relationship, if any, between an establishment's strategic posture and its choice of location.

The Influence of Level of Analysis: Firms versus Establishments

This study's unit of analysis is the establishment. Multi-unit firms do exist in this industry, however, and the present study does not control for whether a given entity is a single unit firm or part of a multi-unit firm. While seeking economies of scope and scale, multi-unit firms often centralize such activities as sales, manufacturing, and research and development. A subunit's interrelationships with neighboring establishments might vary according to which activities are performed by that subunit and which are centralized at an alternative location. For example, a subunit that manufactures an item might be less likely to seek interrelationships with nearby establishments or research institutes than would a subunit that performs research and development activities with respect to that item.

Also, relationships among units of a multi-unit firm are less likely to vary according to distance. Many large firms facilitate links among operating units, making the exchange of resources and information among subunits relatively easy. Multi-unit firms can also facilitate links between fiberoptic and non-fiberoptic subunits. Such links might be economically beneficial to a subunit, but would not captured by this study. Therefore, multi-unit firms with significant internal exchanges of information and resources have the potential to dampen the institutional and transaction costs forces between establishments that are hypothesized to exist in Chapter Two.

Assessment of Fiberoptic Establishments' Other Activities

One factor for which this study makes no provision is the possible influence of non-fiberoptics-related activities engaged in by some establishments. For some establishments, fiberoptic products represent only a fraction of their total product offerings. For example, Edmund Scientific sells a wide array of scientific equipment, most of which is unrelated to the fiberoptics industry. The low number of product categories per establishment (typically six in a given year, as reported in Table 3-4) might result in part from this phenomenon. If a significant number of establishments have only a tangential connection to the fiberoptics industry, then many of the institutional and transaction costs arguments used in this study might not apply. More influential institutional forces, for example, might emanate from other industries within which the establishment operates. Likewise, an establishment might transact more frequently with firms in other industries, as a result building more important long term relationships with these non-fiberoptic firms.

For these reasons, in future studies it might be beneficial to divide the sample according to establishments' other industry affiliations. Alternatively, establishments could be grouped according to which market segments they serve within the fiberoptics industry. The current approach of calculating strategic similarity and complementarity for all fiberoptic firms, regardless of which customers they tend to serve, might account for strategic interactions that, in practical reality, would never exist. By narrowing the segments studied, we can more accurately measure the likelihood that establishments will

compete or cooperate with one another. As a result, the influence, if any, of geographic location on such relationships could be more reliably tested.

Controlling for Value Chain Activity

The value chain activity(ies) an establishment performs are just as important in describing strategic posture as the product(s) it provides. Strategic isomorphism and strategic complementarity are measured by comparing the product offerings of each possible pair of establishments in a focal year. No allowance is made in this study, however, for the possibility that the predicted relationships will vary according to which value chain activities each establishment performs.

It is reasonable to expect, for example, that the predicted relationships will hold more strongly for designers and manufacturers than they will for distributors and importers. First, it is easier for distributors and importers to operate in industries other than fiberoptics, making it less likely that their institutional environment and transaction costs will be predominately determined by fiberoptic establishments. Second, to the extent that designers and manufacturers are more focused on research and development, they are more likely to seek collaborative relationships with highly similar establishments. Therefore, controlling for value chain activity has the potential to provide a more accurate test of the relationships hypothesized in Chapter Two.

Enhanced Value Chain Analysis

The approach used to study complementarity in the value chain was selected, in part, because of its simplicity. It is possible that this simplicity is masking some of the effects being measured. This study makes no allowance for possible interrelationships

among fiberoptic products. The potential for a buyer and supplier relationship is only said to exist if two establishments perform complementary activities with respect to the same product. Therefore, the study's measure of strategic complementarity understates the full potential for interrelationships among establishments. A more accurate measure of complementarity might be achieved by accounting for the fact that, for instance, a connector may be a key component of another specific fiberoptic product.

Levels of strategic isomorphism could also be understated in cases where two products are perfect substitutes for one another. In future studies, it might be possible for fiberoptic experts (for example, faculty at research institutes) to identify which products and services are complementary to (or are substitutes for) other products and services. Though less parsimonious, this might provide a more accurate test of the potential that exists for interorganizational relationships among a group of establishments or within a region.

Aggregation of Product Categories

Industry experts could also indicate which fiberoptic products are substantially similar to one another. The product categories used in this analysis are quite specific, and in some cases, perhaps, too specific. For example, establishments report making eight types of fiberoptic cable in 1994, and, for purposes of this study, each is treated as a distinct product. In some cases it might be appropriate to consider makers of different types of cable to be isomorphic. For two product categories to be merged, each would have to require similar resources, have similar suppliers and customers, and rely on substantially similar technologies.

Enhanced Indices for Strategic Isomorphism and Complementarity

In addition to the problems cited above with value chain analysis and product categories, weaknesses in the construction of the IsoScore and CompScore indices might account for some of the results' ambiguity. Both indices are more appropriately viewed as ranks, not interval/ratio data. It is not the case, for example, that a pair of establishments with an IsoScore of four is "twice as isomorphic" as a pair with an IsoScore of two. Both indices would be more informative if they rated each phenomenon without assuming a linear scale. For instance, the IsoScore could increase by a greater increment as the number of common product offerings increases.

As calculated here, the indices treat instances of each phenomenon (isomorphism or complementarity) as the same, regardless of how many products they involve. Two establishments that perform the same two value chain activities with respect to one product receive the same IsoScore as two establishments that perform the same value chain activity, but with two products.

Generalizability of these indices to other industries should also be addressed. For instance, that the complementarity index used here would likely not be a valid measure in an industry with a high degree of vertical integration. As currently calculated, the highest possible CompScore is obtained when two establishments both perform all value chain activities with respect to a given product. This implies that two such establishments have the greatest potential for buyer/supplier linkages, when actually the very fact of their vertical integration probably makes it less likely that they will become buyer and supplier to one another. Since there is not a great amount of vertical integration indicated for the

fiberoptics data, this characteristic of the index does not appear problematic in the immediate study. However, adjustments to the complementarity index are necessary before this measure can be used in industries which exhibit a significant degree of vertical integration.

Differing Conceptions of Distance

The hypothesis tests conducted above have a built-in assumption: that fifty additional miles (for example) between establishments will dampen their influence on one another by a comparable amount at all possible distances. This relationship is most likely, however, to be non-linear. There might be a more dramatic effect caused by the difference between a five mile separation and a fifty-five mile separation than caused by the difference between an 1800 mile separation and an 1850 mile separation. For this reason, it is appropriate to consider using a more coarse-grained conception of distance in future studies. Pairs of establishments could be classified according to several degrees of closeness, and then differences among these groups could be assessed. Although additional tests have been performed with respect to regional subsets in an attempt to address this issue, the regions used are relatively large. In California, for example, differences in distance might vary in significance as they do for the national sample.

It is also worth considering the issue of travel time when conducting future studies. For example, establishments in eastern Connecticut and Long Island might be twenty miles from one another as the crow flies, but are actually separated by a considerable travel time via ferry or via New York City. A Connecticut establishment might actually be "closer" to

another Connecticut establishment that is eighty miles away than it is to an establishment on Long Island.

Further Study of Research Institutes and Dominant Firms

This study addresses only a narrow set of issues when assessing how research institutes and dominant firms might affect the strategic postures of establishments. Organizations like these are likely to play a significant role in the birth and early growth of industries, and more research is needed that focuses on this role. It is quite possible that the influence of research institutes and dominant firms is not manifested in easily measurable ways until later in an industry's development.

The regional subsets suggest a possible difference in the influence of research institutes and dominant firms between the Northeast and California (hypotheses five through eight). Among regional subsets, the only statistically significant relationship found between research institute proximity and IsoScores is in California (hypothesis five). In contrast, results for both hypothesis seven and hypothesis eight are statistically significant among Northeast establishments, but not among California establishments. These results point to a possible difference in the roles and activities of institutes and dominant firms in these regions. Perhaps functions performed by dominant firms in the Northeast are performed by research institutes in California? Future studies are needed in order to properly address this question.

In order to understand the extent and nature of the influence of these entities, detailed network analyses of one or more institutes and its clients/constituents are necessary. A weakness of this study is the approach used to identify dominant firms.

While size and scope are important dimensions of dominance, future studies should test the effect of a dominant firm when it has played an important role in the industry's birth and development. It would also be worthwhile to control for the kind of products offered by dominant firms. Dominant firms, as defined in this study, might have different kinds of relationships with exchange partners according to the nature of the products and services they offer. Likewise, the extent to which a dominant firm is vertically integrated might affect the extent and nature of its relationships with other establishments.

Comparison of Survivors and Non-Survivors

In this study, no attempt is made to assess the performance implications of strategic isomorphism or complementarity. Is either of these collective strategies self-defeating? Is either one beneficial? Questions such as these need to be answered. A thorough understanding of how and why collective strategies form is far more interesting if it helps us predict which strategic postures are most favored, at which point in the industry's evolution they are most favored, and which establishments, or collectivities, are most likely to succeed or fail.

Future studies should therefore attempt to measure the effect of collective strategies on the success and survival of establishments and collectivities. One way to accomplish this would be to calculate a slightly different version of each index used in this study. Rather than calculating scores for pairs, a score could be calculated for each establishment. An establishment's isomorphic tendency, for instance, could be calculated by averaging its IsoScores relative to all other establishments in a given focal year. A regression analysis could then be performed to test whether "isomorphic tendency" is

associated with an establishment's longevity in the fiberoptics industry. This analysis would need to control for such factors as firm size and scope of product offerings.

Tests could also be performed with respect to geographically-determined collectivities. Geographic clusters, identified via cluster analysis, could be assessed in each focal year according to their levels of strategic isomorphism and complementarity. Tests could then be performed to determine whether these collective strategies are associated with the success and survival of each cluster. Possible measures of cluster success include: the percentage of establishments that survive, growth in membership for the cluster, and the extent to which product categories originating in a cluster are later offered by establishments in other clusters.

Is Density More Important than Dyadic Distances?

All tests in this study are performed with respect to distances between pairs of establishments. The general density of fiberoptic establishments in a given region may, however, be an important moderator of the relationships tested here. Population density may influence the strength of many of the forces discussed in Chapter Two. For example, a pair of establishments in a region with no other fiberoptics establishments is unlikely to experience the same sort of institutional forces as a pair in a densely populated region. The fact that both pairs are five miles apart from one another does not adequately describe the potential they have for interaction and communication because it does not account for the number of other fiberoptic establishments that are located nearby. Although dyadic relationships are the building blocks of networks (as reflected in Figure 1-1, and as

discussed by Dollinger, 1990), the density of related establishments might affect the potential for, and the nature of, dyadic relationships.

Therefore, subsequent studies might be sharpened by accounting, through cluster or network analysis, for the impact of establishment density in a given geographic region. For instance, cluster analysis could empirically assign establishments to groups and hypotheses similar to those tested here could be assessed according to whether they receive more or less support among densely-packed groups of establishments.

CONCLUSION

Taken as a whole, the findings of this study indicate that the geographic proximity of pairs of establishments has less of an effect on collective strategy formation than expected. The results also suggest, however, that the potential influence of geographic proximity has not yet been fully explored and that continued study of this phenomenon has the potential to contribute to several important streams of management research.

Further study of these phenomena can help identify the relative importance of the key contingencies (see Figure 1-1) at various stages of industry development. These contingencies may also be of varying importance to establishments according to the functions they perform. Establishments that emphasize innovation, for example, might find it more pressing to adapt to institutional forces than to cope with transaction costs. Which theoretical perspectives are most useful at various stages of industry development?

Further study is also needed to help explain the impact of geographic clustering, and shared norms and values, on the development of emerging higher technology industries. While many authors have debated the most appropriate way to define strategic

groups, there has yet to be an extensive study of whether strategic groups should be defined differently at different stages of industry development. Clearly, certain establishments will be important reference points for managers when formulating firm strategy. Which criteria managers use to identify reference points, and how these criteria might evolve over time, are subjects in need of greater attention.

Finally, what other types of collective strategies influence the development of emerging higher technology industries? Future studies, for example, might compare the relative importance of intended and emergent collective strategies in such industries. While it is important to develop a clearer understanding of how collective strategies form, it is even more important to explore the range of influences that collective strategies can have on establishments, collectivities, and industries.

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APPENDICES

APPENDIX A: RESULTS OF EXPLORATORY ANALYSES

Year	U.S. Mean IsoScore	U.S. Standard Deviation	CA Mean IsoScore	CA Standard Deviation	Northeast Mean IsoScore	NE Standard Deviation
1976	0.85	1.59	1.27	2.32	0.85	1.53
1979	0.38	1.08	0.39	1.05	0.43	1.19
1982	0.46	1.32	0.32	0.90	0.55	1.57
1985	0.39	1.15	0.32	1.00	0.43	1.20
1988	0.28	0.95	0.20	0.82	0.28	0.96
1991	0.25	0.91	0.23	0.90	0.25	0.91
1994	0.22	0.85	0.20	0.80	0.24	0.89

* = significant at the 0.05 level
** = significant at the 0.01 level

Table A-1: Means and Standard Deviations for IsoScores
for the United States, California, and the Northeast

Year	U.S. Mean CompScore	U.S. Standard Deviation	CA Mean CompScore	CA Standard Deviation	Northeast Mean CompScore	NE Standard Deviation
1976	1.71	2.07	2.09	1.90	1.75	2.21
1979	0.80	1.54	0.94	1.74	0.83	1.61
1982	0.63	1.54	0.42	0.98	0.81	1.87
1985	0.44	1.18	0.37	1.04	0.48	1.26
1988	0.28	0.93	0.18	0.68	0.30	0.99
1991	0.28	0.96	0.23	0.85	0.28	0.99
1994	0.24	0.90	0.18	0.75	0.28	1.00

* = significant at the 0.05 level
** = significant at the 0.01 level

Table A-2: Means and Standard Deviations for CompScores
for the United States, California, and the Northeast

Year	U.S. Sample Size	r_s (U.S.)	CA Sample Size	r_s (CA)	Northeast Sample Size	r_s (NE)
1976	1,176	0.0353	55	0.2476	465	0.0885
1979	2,346	-0.0036	36	0.0452	1,035	0.0030
1982	12,561	-0.0215*	561	-0.0376	3,486	-0.0606**
1985	55,945	-0.0149**	3,321	-0.0105	16,471	0.0036
1988	100,128	-0.0093**	4,950	-0.0144	24,753	-0.0057
1991	166,753	-0.0055**	9,180	-0.0173	34,716	0.0059
1994	241,165	-0.0106**	12,880	-0.0169	46,056	0.0087

* = significant at the 0.05 level
** = significant at the 0.01 level

Table A-3: Spearman's Correlations for Isomorphism and Distance for the United States, California, and the Northeast

Year	U.S. Sample Size	r_s (U.S.)	CA Sample Size	r_s (CA)	Northeast Sample Size	r_s (NE)
1976	1,176	0.0643*	55	0.2468	465	0.1037*
1979	2,346	-0.0179	36	0.1595	1,035	0.0607
1982	12,561	-0.0394**	561	0.0400	3,486	-0.0837**
1985	55,945	-0.0163**	3,321	-0.0353*	16,471	-0.0045
1988	100,128	-0.0151**	4,950	-0.0002	24,753	0.0061
1991	166,753	-0.0113**	9,180	-0.0233*	34,716	0.0028
1994	241,165	-0.0159**	12,880	-0.0233**	46,056	0.0165**

* = significant at the 0.05 level
** = significant at the 0.01 level

Table A-4: Spearman's Correlations for Complementarity and Distance for the United States, California, and the Northeast

Year	Sample	Number of Estabs.	*n*	Mean IsoScore
1976	All Estabs.	49	1,176	0.85
	New Estabs.	49	1,176	0.85
	Existing Estabs.	--	--	--
1979	All Estabs.	69	2,346	0.38
	New Estabs.	51	1,275	0.25
	Existing Estabs.	18	153	0.98
1982	All Estabs.	159	12,561	0.46
	New Estabs.	117	6,786	0.49
	Existing Estabs.	42	861	0.43
1985	All Estabs.	335	55,945	0.39
	New Estabs.	224	24,976	0.31
	Existing Estabs.	111	6,105	0.61
1988	All Estabs.	448	100,128	0.28
	New Estabs.	259	33,411	0.23
	Existing Estabs.	189	17,766	0.37
1991	All Estabs.	578	166,753	0.25
	New Estabs.	273	37,128	0.18
	Existing Estabs.	305	46,360	0.32
1994	All Estabs.	695	241,165	0.22
	New Estabs.	303	45,753	0.17
	Existing Estabs.	392	76,636	0.27

Table A-5: Mean IsoScores for All Establishments, New Establishments, and Existing Establishments

Year	Sample	Number of Estabs.	*n*	Mean CompScore
1976	All Estabs.	49	1,176	1.71
	New Estabs.	49	1,176	1.71
	Existing Estabs.	--	--	--
1979	All Estabs.	69	2,346	0.80
	New Estabs.	51	1,275	0.51
	Existing Estabs.	18	153	2.07
1982	All Estabs.	159	12,561	0.63
	New Estabs.	117	6,786	0.61
	Existing Estabs.	42	861	0.72
1985	All Estabs.	335	55,945	0.44
	New Estabs.	224	24,976	0.36
	Existing Estabs.	111	6,105	0.62
1988	All Estabs.	448	100,128	0.28
	New Estabs.	259	33,411	0.26
	Existing Estabs.	189	17,766	0.34
1991	All Estabs.	578	166,753	0.28
	New Estabs.	273	37,128	0.26
	Existing Estabs.	305	46,360	0.30
1994	All Estabs.	695	241,165	0.24
	New Estabs.	303	45,753	0.21
	Existing Estabs.	392	76,636	0.28

Table A-6: Mean CompScores for All Establishments, New Establishments, and Existing Establishments

Year	Total Sample Size	r_s (All Estabs.)	New Estabs. Sample Size	r_s (New Estabs.)	Existing Estabs. Sample Size	r_s (Existing Estabs.)
1976	1,176	0.0353	1,176	0.0353	--	--
1979	2,346	-0.0036	1,275	-0.0090	153	-0.0157
1982	12,561	-0.0215*	6,786	0.0106	861	-0.1833**
1985	55,945	-0.0149**	24,976	-0.0048	6,105	-0.0478**
1988	100,128	-0.0093**	33,411	-0.0028	17,766	-0.0143
1991	166,753	-0.0055**	37,128	0.0065	46,360	-0.0125**
1994	241,165	-0.0106**	45,753	0.0002	76,636	-0.0197**

* = significant at the 0.05 level
** = significant at the 0.01 level

Table A-7: Spearman's Correlations for Isomorphism and Distance for All Establishments, New Establishments, and Existing Establishments

Year	Total Sample Size	r_s (All Estabs.)	New Estabs. Sample Size	r_s (New Estabs.)	Existing Estabs. Sample Size	r_s (Existing Estabs.)
1976	1,176	0.0643*	1,176	0.0643	--	--
1979	2,346	-0.0179	1,275	-0.0427	153	-0.0033
1982	12,561	-0.0394**	6,786	-0.0289*	861	-0.0589
1985	55,945	-0.0163**	24,976	-0.0022	6,105	-0.0275*
1988	100,128	-0.0151**	33,411	-0.0044	17,766	-0.0179*
1991	166,753	-0.0113**	37,128	-0.0034	46,360	-0.0221**
1994	241,165	-0.0159**	45,753	-0.0140**	76,636	-0.0119**

* = significant at the 0.05 level
** = significant at the 0.01 level

Table A-8: Spearman's Correlations for Complementarity and Distance for All Establishments, New Establishments, and Existing Establishments

Year	Value of RIProx	*n*	H5 Mean IsoScore	H6 Mean CompScore
1994 (CA)	0	10,070	0.190	0.172
***n* = 12,880**	1	2,810	0.234	0.195
161 Estabs.			& *	&
1994 (NE)	0	41,615	0.239	0.280
n = 46,056	1	4,441	0.240	0.292
304 Estabs.			&	&

& = result is in the predicted direction
* = significant at the 0.05 level

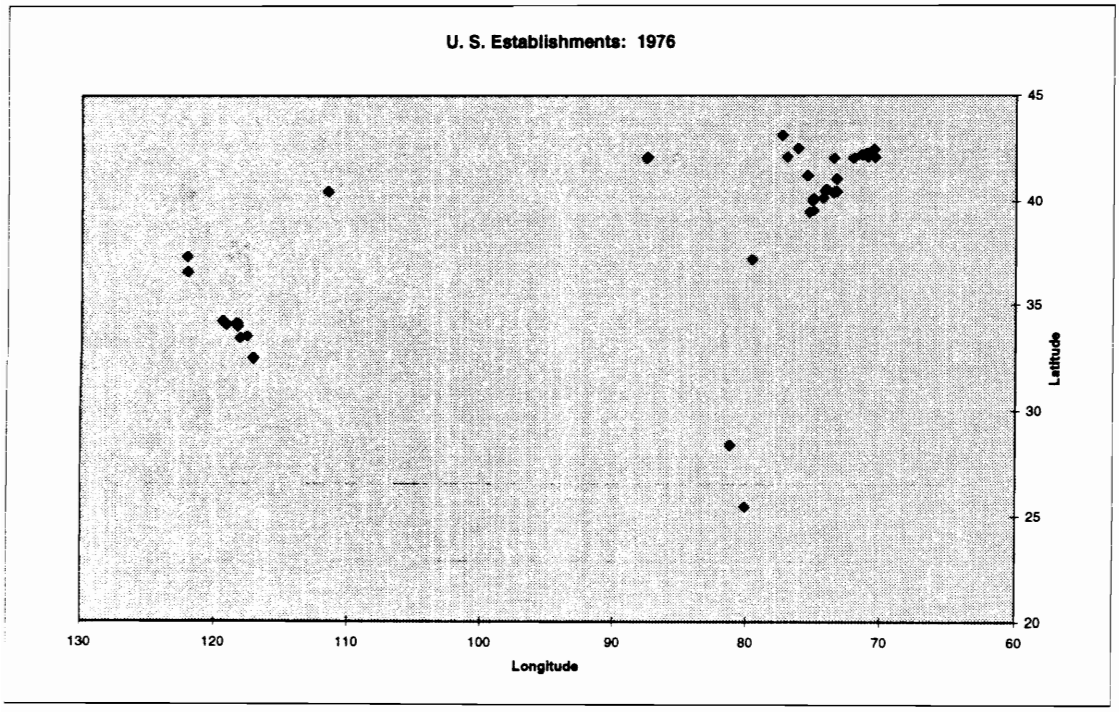
Table A-9: *t* Tests for Hypotheses Five and Six
Using California and Northeastern Sub-Samples

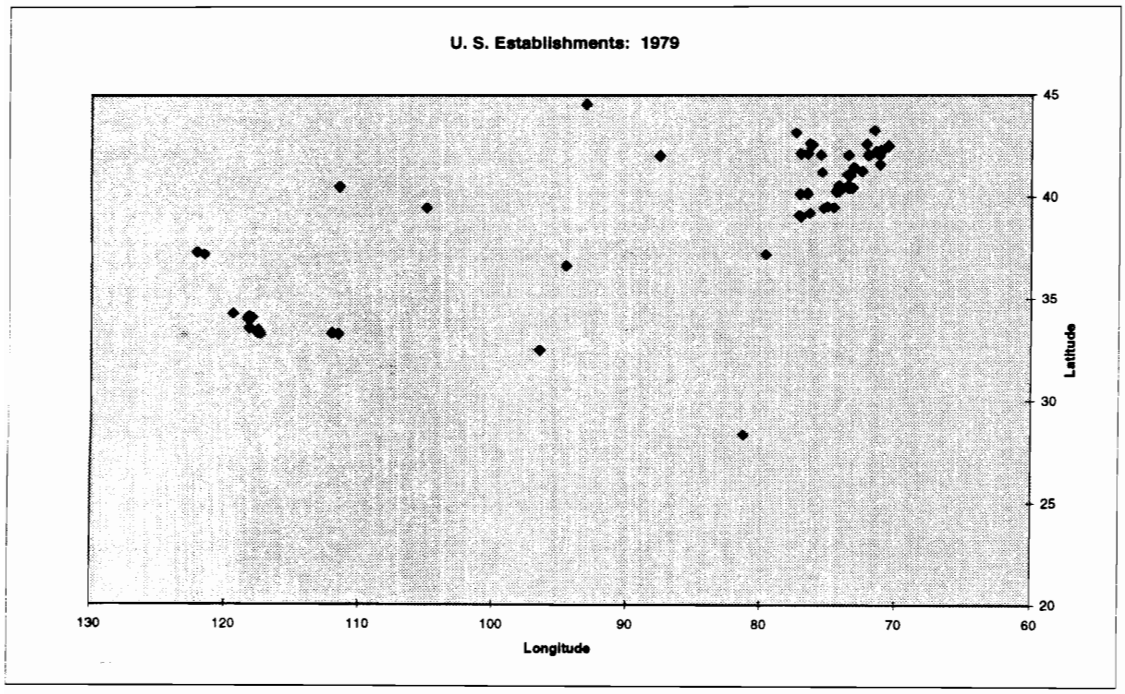
Year	Value of DFProx	*n*	H7 Mean IsoScore	H8 Mean CompScore
1994 (CA)	0	6,678	0.199	0.172
***n* = 12,880**	1	6,202	0.200	0.183
161 Estabs.			&	&
1994 (NE)	0	41,477	0.243	0.284
n = 46,056	1	4,579	0.203	0.254
304 Estabs.			**	*

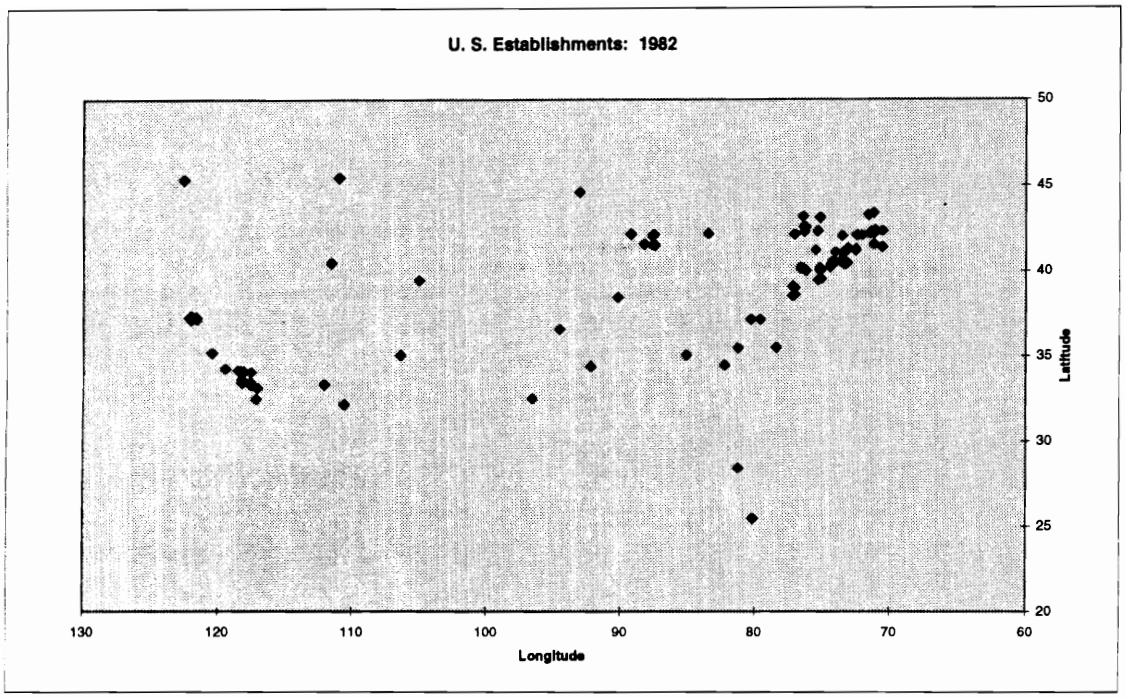
& = result is in the predicted direction
* = significant at the 0.05 level
** = significant at the 0.01 level

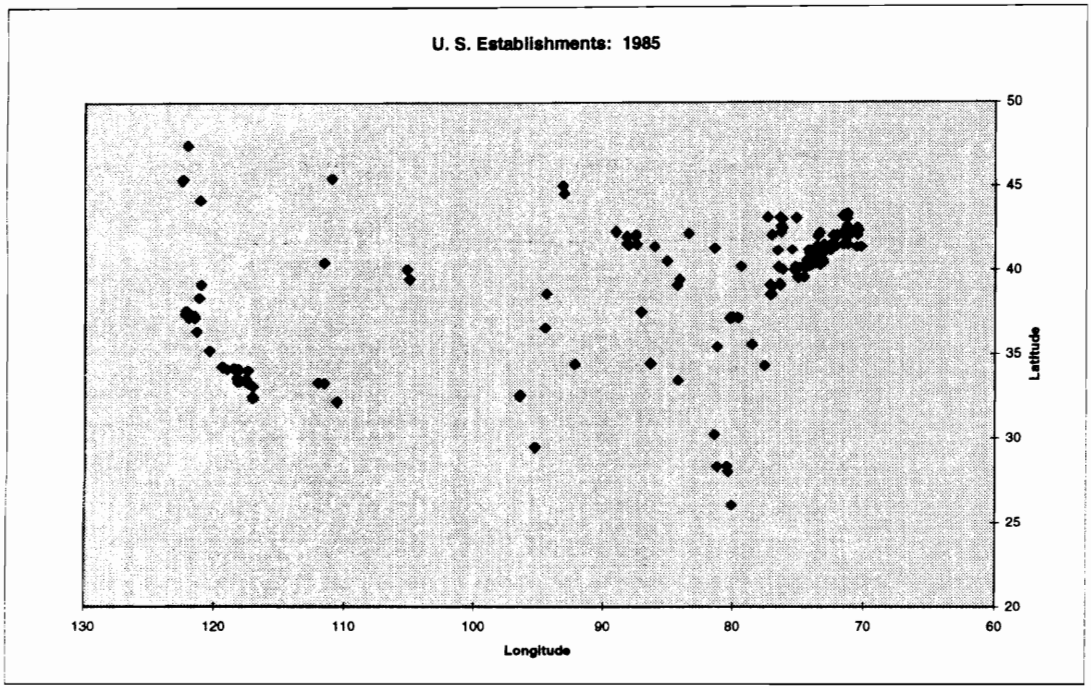
Table A-10: *t* Tests for Hypotheses Seven and Eight
Using California and Northeastern Sub-Samples

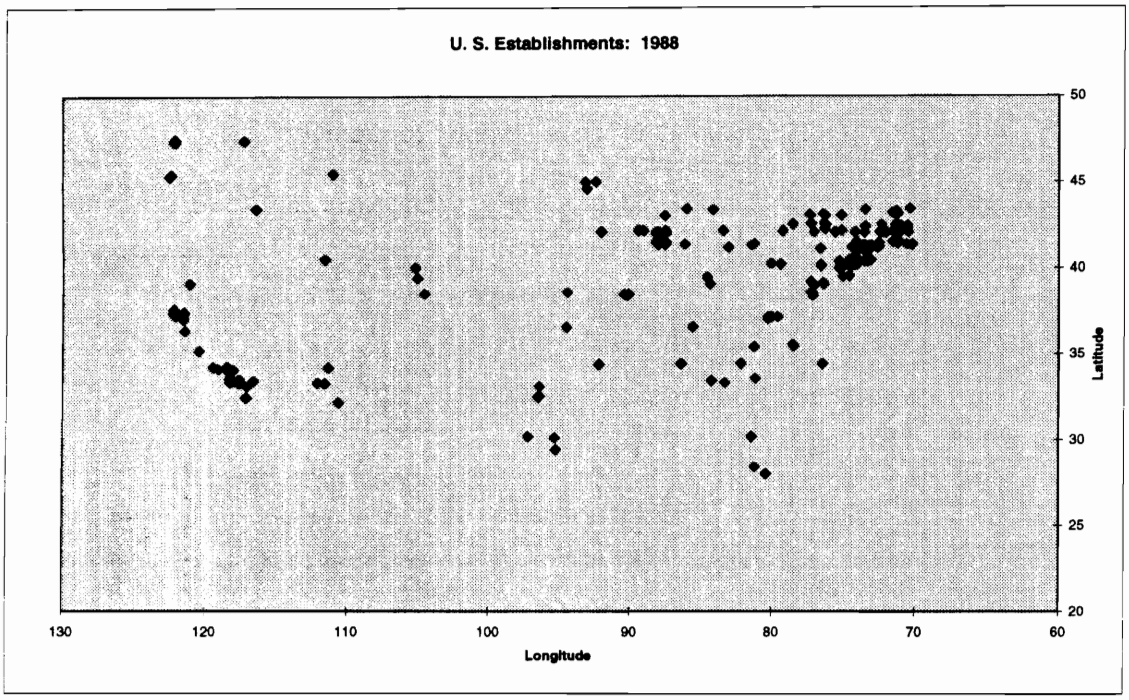
APPENDIX B: ESTABLISHMENT LOCATION PLOTS (BY YEAR)

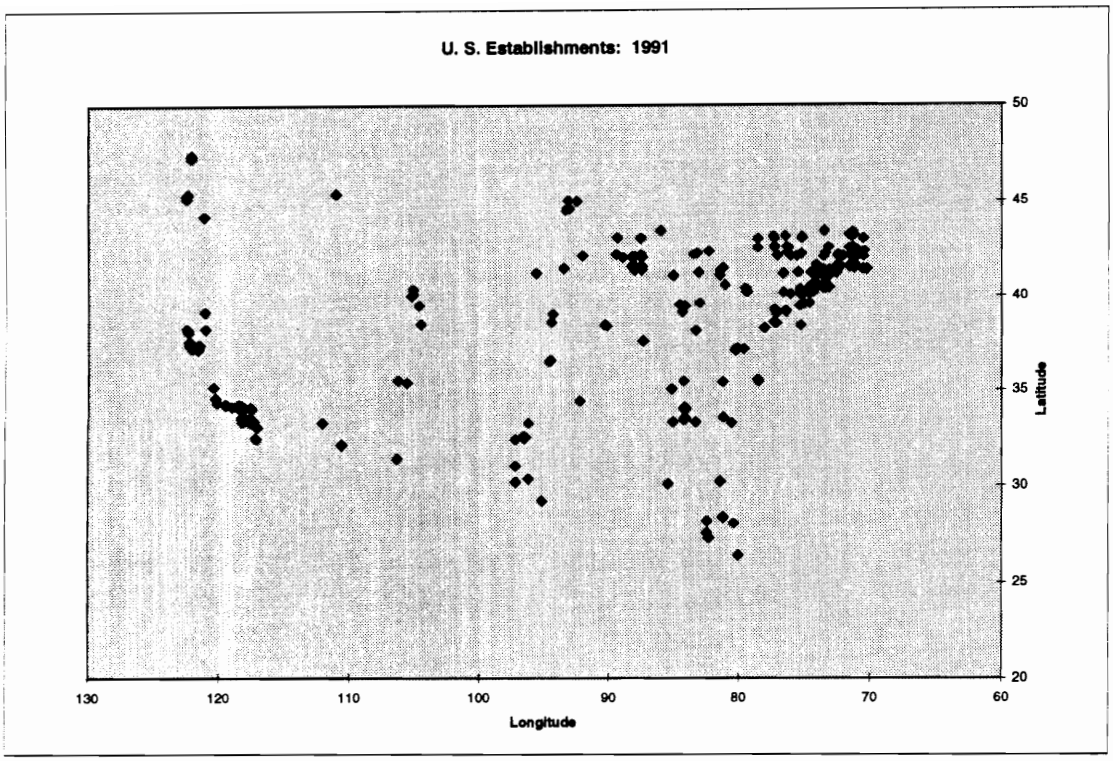


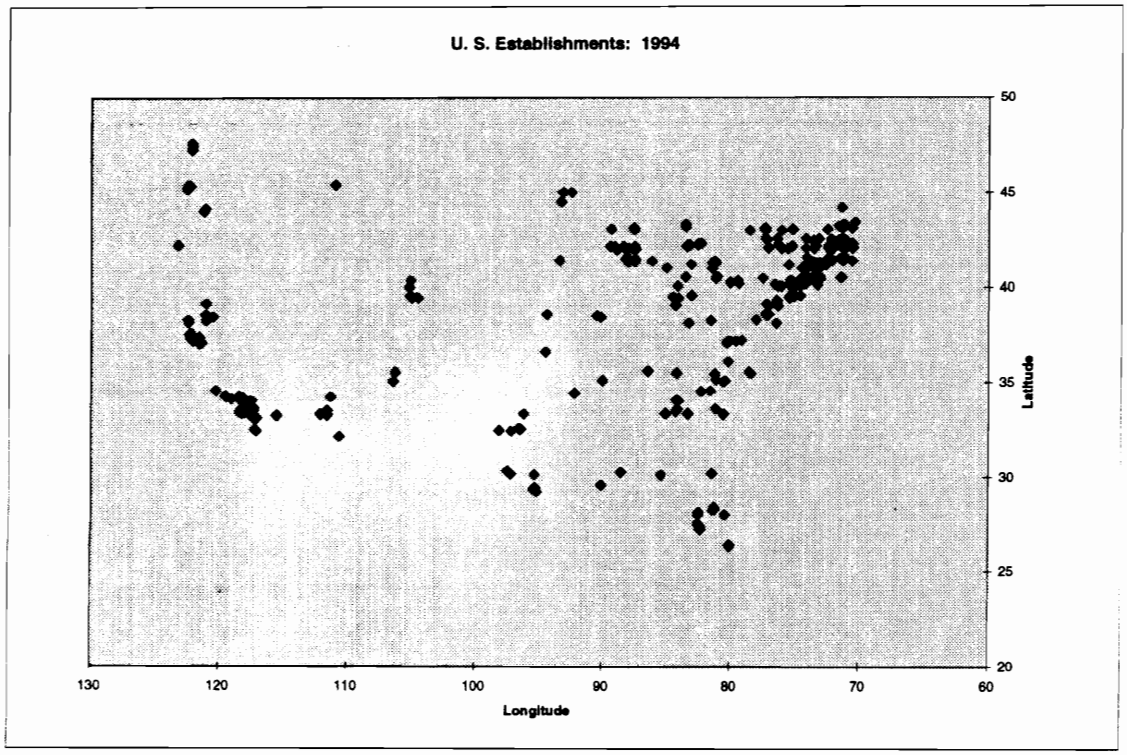

U. S. Establishments: 1979
45
40
35
30
25
20
Latitude
130
120
110
100
90
80
70
60
Longitude


U. S. Establishments: 1982
50
45
40
35
30
25
20
Latitude
130
120
110
100
90
80
70
60
Longitude

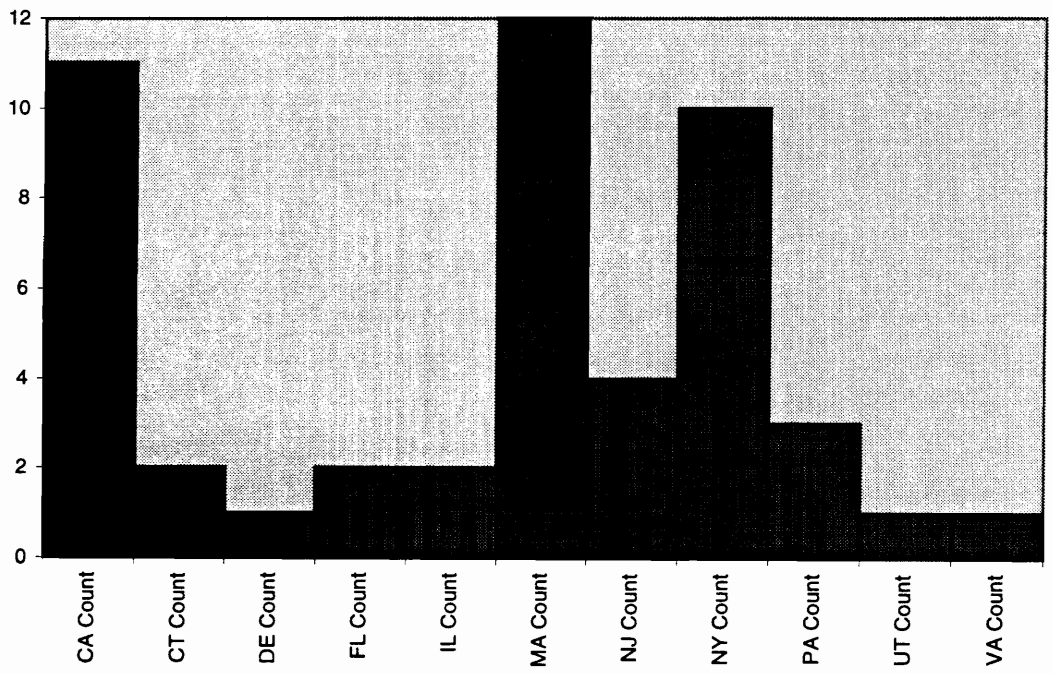

U. S. Establishments: 1985
50
45
40
35
30
25
20
Latitude
130
120
110
100
90
80
70
60
Longitude


U. S. Establishments: 1988
50
45
40
35
30
25
20
Latitude
130
120
110
100
90
80
70
60
Longitude


U. S. Establishments: 1991
50
45
40
35
30
25
20
Latitude
130
120
110
100
90
80
70
60
Longitude


U. S. Establishments: 1994
50
45
40
35
30
25
20
Latitude
130
120
110
100
90
80
70
60
Longitude

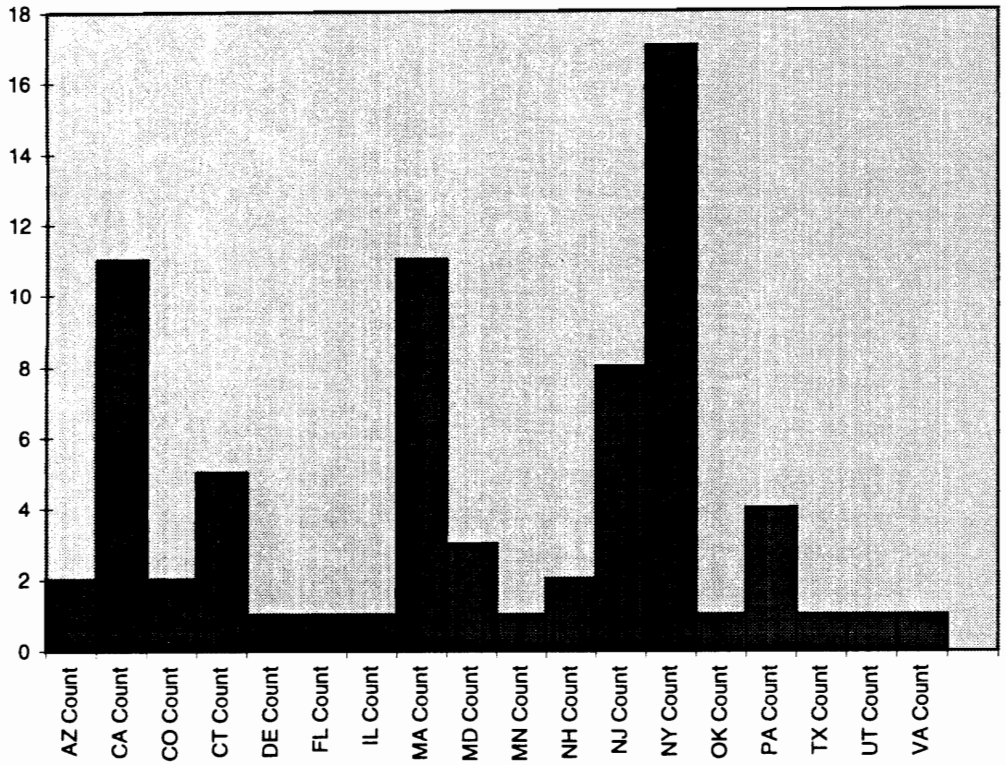
APPENDIX C: ESTABLISHMENT FREQUENCY CHARTS (BY STATE, BY YEAR)



CA Count	11
CT Count	2
DE Count	1
FL Count	2
IL Count	2
MA Count	12

NJ Count	4
NY Count	10
PA Count	3
UT Count	1
VA Count	1

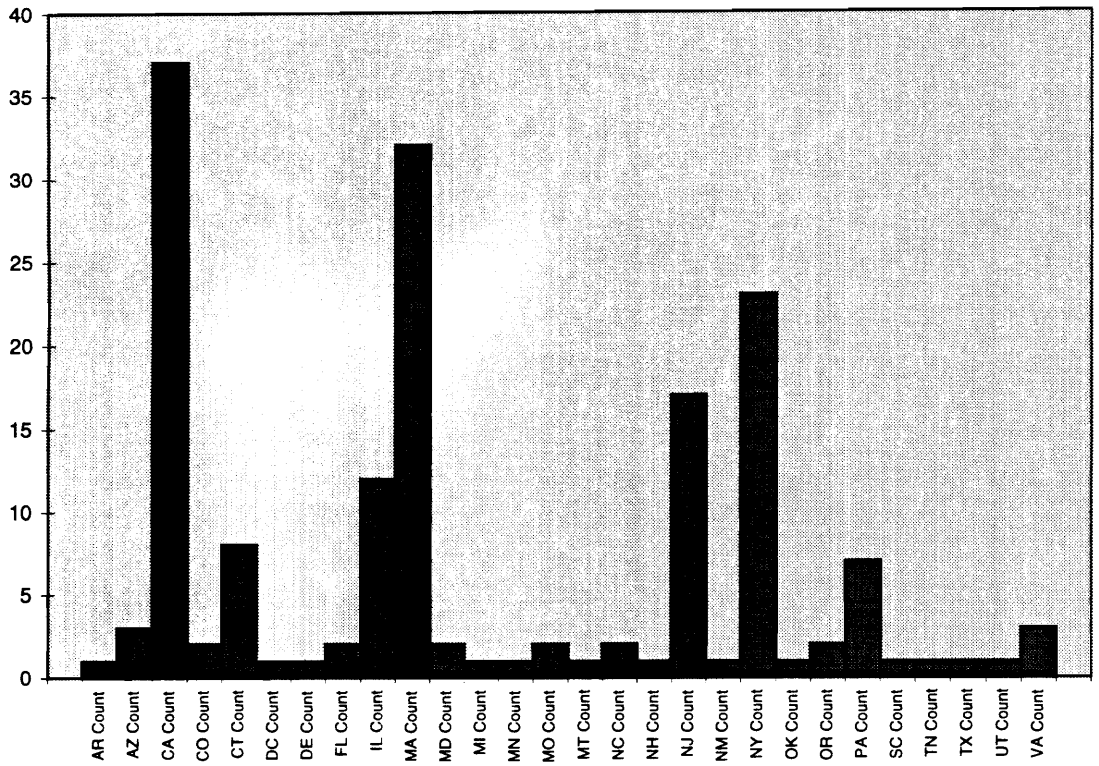
Number of Establishments by state: 1979



AZ Count	2
CA Count	11
CO Count	2
CT Count	5
DE Count	1
FL Count	1
IL Count	1
MA Count	11
MD Count	3

MN Count	1
NH Count	2
NJ Count	8
NY Count	17
OK Count	1
PA Count	4
TX Count	1
UT Count	1
VA Count	1

Number of Establishments by state: 1982

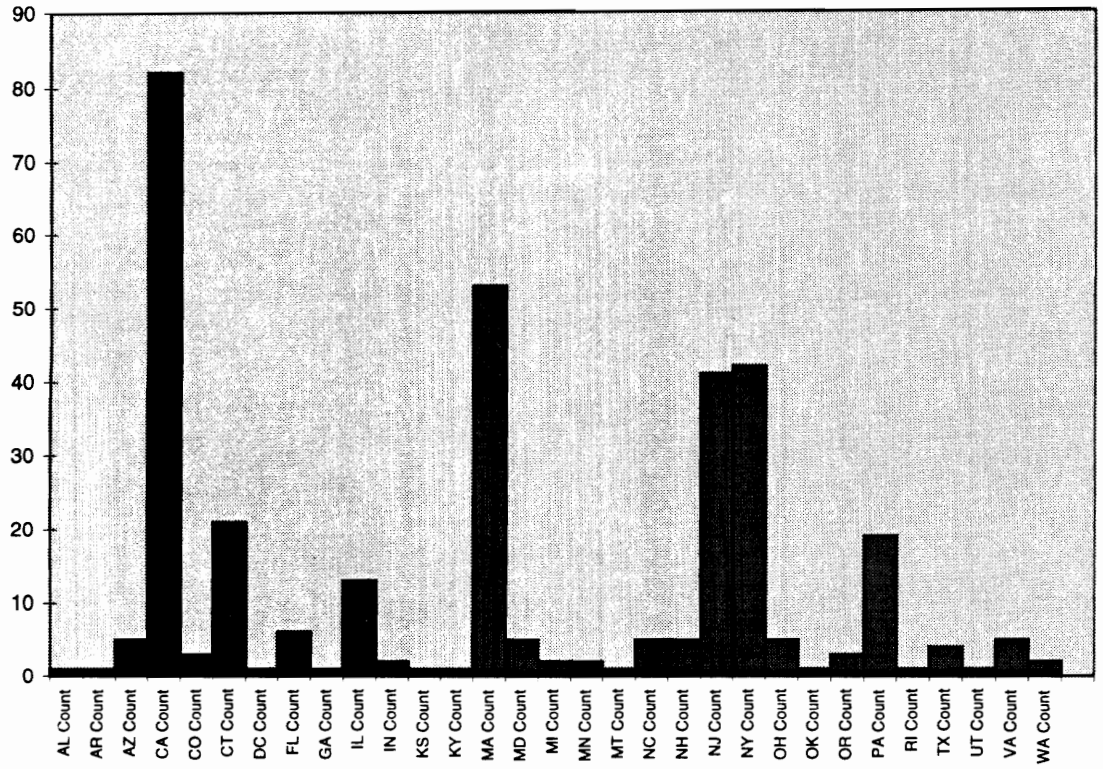


AR Count	1
AZ Count	3
CA Count	37
CO Count	2
CT Count	8
DC Count	1
DE Count	1
FL Count	2
IL Count	12
MA Count	32

MD Count	2
MI Count	1
MN Count	1
MO Count	2
MT Count	1
NC Count	2
NH Count	1
NJ Count	17
NM Count	1
NY Count	23

OK Count	1
OR Count	2
PA Count	7
SC Count	1
TN Count	1
TX Count	1
UT Count	1
VA Count	3

Number of Establishments by state: 1985

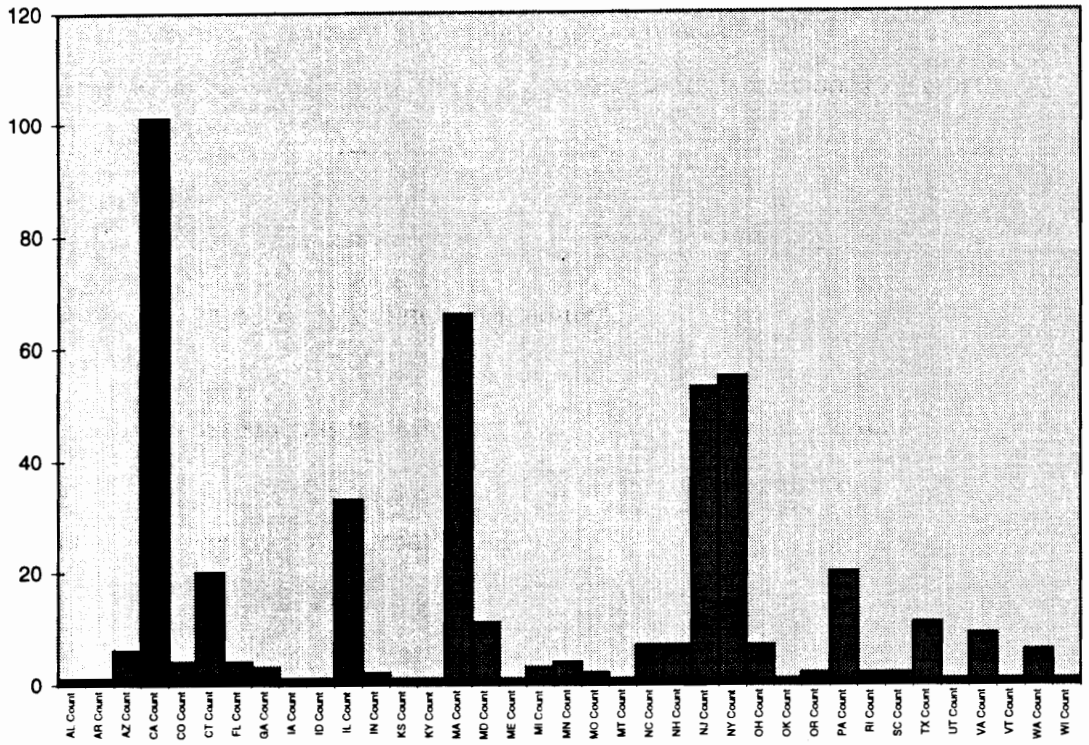


AL Count	1
AR Count	1
AZ Count	5
CA Count	82
CO Count	3
CT Count	21
DC Count	1
FL Count	6
GA Count	1
IL Count	13
IN Count	2

KS Count	1
KY Count	1
MA Count	53
MD Count	5
MI Count	2
MN Count	2
MT Count	1
NC Count	5
NH Count	5
NJ Count	41

NY Count	42
OH Count	5
OK Count	1
OR Count	3
PA Count	19
RI Count	1
TX Count	4
UT Count	1
VA Count	5
WA Count	2

Number of Establishments by state: 1988

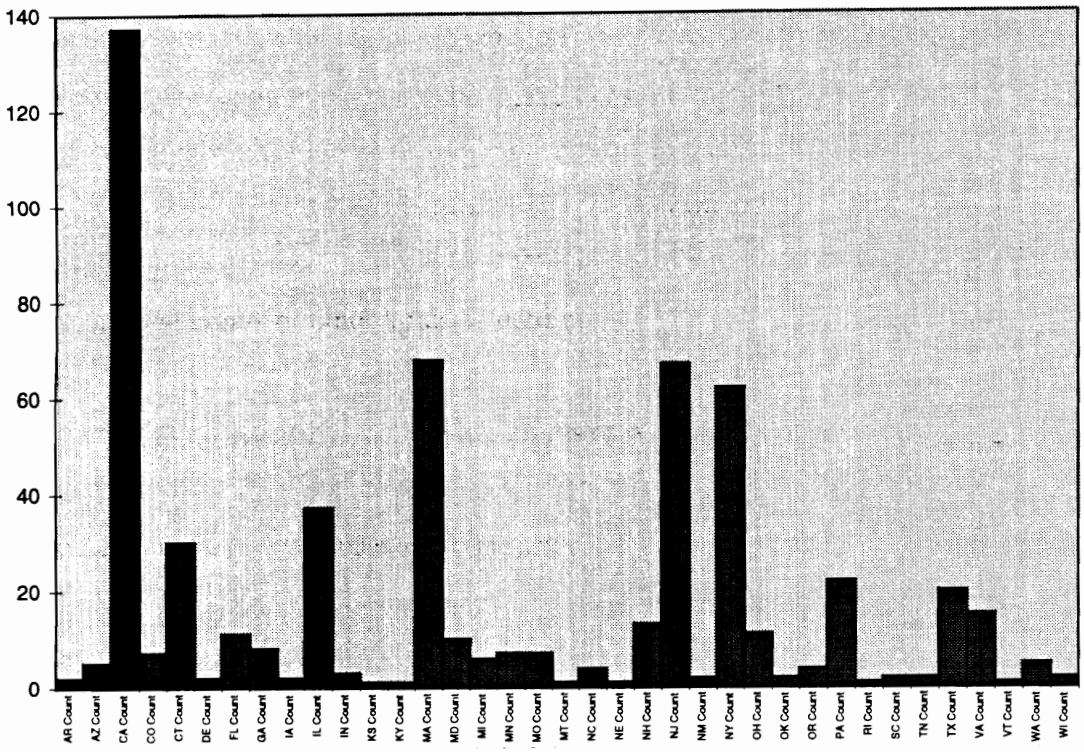


AL Count	1
AR Count	1
AZ Count	6
CA Count	101
CO Count	4
CT Count	20
FL Count	4
GA Count	3
IA Count	1
ID Count	1
IL Count	33
IN Count	2
KS Count	1

KY Count	1
MA Count	66
MD Count	11
ME Count	1
MI Count	3
MN Count	4
MO Count	2
MT Count	1
NC Count	7
NH Count	7
NJ Count	53
NY Count	55

OH Count	7
OK Count	1
OR Count	2
PA Count	20
RI Count	2
SC Count	2
TX Count	11
UT Count	1
VA Count	9
VT Count	1
WA Count	6
WI Count	1

Number of Establishments by state: 1991

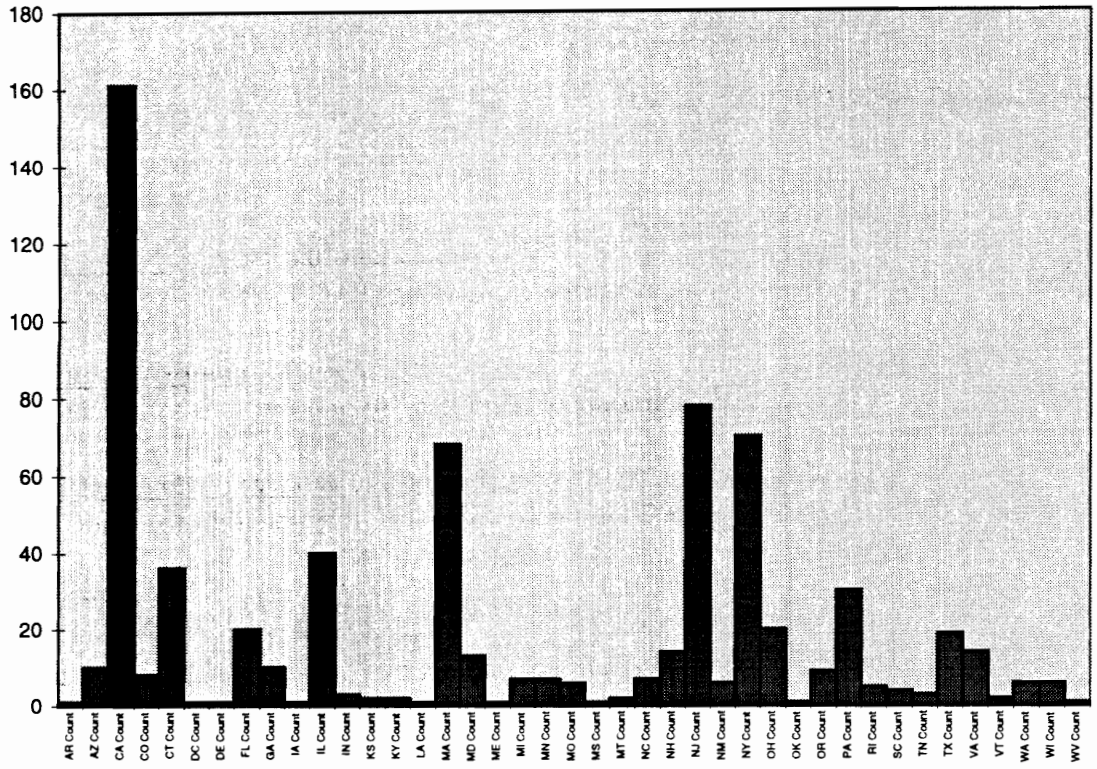


AR Count	2
AZ Count	5
CA Count	137
CO Count	7
CT Count	30
DE Count	2
FL Count	11
GA Count	8
IA Count	2
IL Count	37
IN Count	3
KS Count	1
KY Count	1

MA Count	68
MD Count	10
MI Count	6
MN Count	7
MO Count	7
MT Count	1
NC Count	4
NE Count	1
NH Count	13
NJ Count	67
NM Count	2
NY Count	62
OH Count	11

OK Count	2
OR Count	4
PA Count	22
RI Count	1
SC Count	2
TN Count	2
TX Count	20
VA Count	15
VT Count	1
WA Count	5
WI Count	2

Number of Establishments by state: 1994



AR Count	1
AZ Count	10
CA Count	161
CO Count	8
CT Count	36
DC Count	1
DE Count	1
FL Count	20
GA Count	10
IA Count	1
IL Count	40

IN Count	3
KS Count	2
KY Count	2
LA Count	1
MA Count	68
MD Count	13
ME Count	1
MI Count	7
MN Count	7
MO Count	6

MS Count	1
MT Count	2
NC Count	7
NH Count	14
NJ Count	78
NM Count	6
NY Count	70
OH Count	20
OK Count	1
OR Count	9

PA Count	30
RI Count	5
SC Count	4
TN Count	3
TX Count	19
VA Count	14
VT Count	2
WA Count	6
WI Count	6
WV Count	1

APPENDIX D: RESEARCH INSTITUTE SURVEY INSTRUMENTS

Organization: _____ Contact: _____

Phone: Role/Title: _____

Address: Phone: _____

Date Contacted

DEMOGRAPHIC INFO:

Year Founded: _____

Other locations?: _____ Total Staff: ____

# of labs: ____ # of faculty: ____

# of clients: ____ # of grad students: ____

Annual budget: $_____

CURRICULUM INFO

Fiberoptics-related courses (yes/no)? ____ If yes, # of courses offered per year: ____

Technical courses (yes/no)? ____ If yes, # offered ____

Undergrad courses (yes/no)? ____ If yes, # offered ____

Masters courses (yes/no)? ____ If yes, # offered ____

Ph.D. courses (yes/no)? ____ If yes, # offered ____

Night courses offered? ____ If yes, # of night courses: ____

Training courses/professional development offered? ____ If yes, # of seminars: ____

Would you be willing to send us a course listing? ____

RESEARCH INFO

Does your organization perform fiberoptics-related research? ____

If so, is this research ever done in conjunction with firms in industry? ____

Does your organization pursue patents? ____ If yes, how many does it have? ____

Do your researchers ever offer consultation services to industry (yes/no)? ____

If so, how often: 100% of the time ____ 75% of the time ____
50% of the time ____ 25% of the time ____ Less than 25% ____

Do you provide grants or other kinds of funding? ____

Do you actively assist firms in obtaining grants or other kinds of funding ? ____

What other services do you provide to industry?

CONCLUDING QUESTIONS

Do you actively work to structure cooperative agreements among firms?

Do you make introductions among firms (or individuals within firms) who have mutual or complementary skills or interests?

Do you have promotional literature/press releases? ____
Would you be willing to send us some? ____

Do you have an annual report? ____ Would you send us a copy? ____

Do you have a formal client list? ____ Would you be willing to share it with us? ____

RESEARCH INSTITUTE SURVEY-IN-BRIEF

Name: _____ Contact: _____

Phone _____ Email _____

Fiberoptics research? Yes No

Courses offered? Yes No

Notes:

APPENDIX E: CURRICULUM VITAE

William B. Lamb

6295 Old Canton Road, #9B
Jackson, MS 39211-2933
Home Phone: (601) 957-3337

Office Phone: (601) 974-1262
Office Facsimile: (601) 974-1260
Email: lambwb@okra.millsaps.edu

Education:

University of Virginia, Charlottesville, VA.
Bachelor of Arts in Anthropology, 1986.

University of Virginia, Charlottesville, VA.
Master of Education in Instructional Technology, 1988.

Virginia Polytechnic Institute and State University, Blacksburg, VA.
Doctor of Philosophy in Business (Pending, December 1997).

Publications:

Wokutch, R. E., Lamb, W. B., and Kumar, R. The Stockmarket Impact of the End of South African Sanctions. Executive Citizen, April, 1997.

Lamb, W. B. Managing the Effects of Social Investing. Mississippi Business Journal, July 8, 1996.

Lamb, W. B., Wokutch, R. E., and Kumar, R. 1995. The Financial Impact of the End to South African Sanctions: An Event History Analysis. In D. P. Moore (Ed.), Academy of Management Best Papers Proceedings: 391-395.

Bezold, M. P., and Lamb, W. B. The SIM Researcher's Responsibility: Objective Observer or Active Advocate? Proceedings of the annual conference of the International Association of Business and Society, Hilton Head, SC, March 17-20, 1994.

Lamb, W. B. Measuring Corporate Social Performance. Proceedings of the annual conference of the International Association of Business and Society, Hilton Head, SC,
March 17-20, 1994.

Conference Presentations:

Wade, P. P., and Lamb, W. B. Women and the Learning Organization. Associated Colleges of the South Women's Studies Conference, Jackson, MS, October 24-26, 1997.

Lamb, W. B., Wokutch, R. E., and Kumar, R. The Financial Impact of the End to South African Sanctions: An Event History Analysis. Academy of Management Meetings, Vancouver, BC, August 6-9, 1995.

Lamb, W. B. Why Firms Collaborate: The Impact of Environmental Munificence and Dynamism. Presented at the Organizational Studies Doctoral Student Conference, Seattle, WA, September 30-October 2, 1994.

Bezold, M. P., and Lamb, W. B. The SIM Researcher's Responsibility: Objective Observer or Active Advocate? Presented at the annual conference of the International Association for Business and Society, Hilton Head, SC, March 17-20, 1994.

Lamb, W. B. Measuring Corporate Social Performance. Presented at the annual conference of the International Association for Business and Society, Hilton Head, SC,
March 17-20, 1994.

Invited Presentations, Caucuses, Discussion Sessions

Lamb, W. B., Wokutch, R. E., and Kumar, R. The Financial Impact of the End to South African Sanctions: An Event History Analysis. An invited presentation at Elon College's event entitled "South Africa in Context: Celebrating Transformation," Elon College, North Carolina, April 21, 1997.

Lamb, W. B., and Bezold, M. P. The Internet and the Social Issues Researcher: A Discussion of the Possibilities. Discussion session at the annual conference of the International Association for Business and Society, Sandestin, FL, March 6-9, 1997.

Bezold, M. P., and Lamb, W. B. Crisis Management: Strategic Implications of Social Activism (Caucus). Academy of Management Meetings, Vancouver, BC, August 6-9, 1995.

Works in Progress:

Wokutch, R. E., Lamb, W. B., and Kumar, R. Social/Ethical Investing and the South African Boycott: An Event Study Analysis of the Stock Market Consequences of the End of Sanctions. Being submitted to the Academy of Management Journal, Winter, 1997-98.

Teaching Experience:

Millsaps College, Jackson, MS.
Strategic Management. (Spring 1998)
Introduction to Management. (Fall 1996, Fall 1997)
Management Skills (MBA). (Fall, 1996)
People in the Organization (MBA). (Spring, 1997)
Introduction to Business Ethics (MBA). (Spring, 1997)
Lessons in Leadership. (Spring 1998)

Virginia Tech, Blacksburg, VA.
Business Policy and Strategy. Twelve sections (Spring 1992-Spring 1995).
Administrative Theory and Practice (Summer 1994).
Social Issues in Management (Fall 1994).
Small Business Institute (SBI) Course (Fall 1995).

Arthur Andersen & Co., S.C., St. Charles, IL.
Various courses and workshops for educational staff (Fall 1988-Summer 1991).

Work Experience:

Millsaps College, Else School of Management, Jackson, MS.
Assistant Professor of Management (August 1996-Present).

Virginia Tech, Department of Management, Blacksburg, VA.
Research Assistant (August 1991-July 1992).
Instructor (January 1992-May 1995).
Director, Small Business Institute (August 1995-July 1996).

Arthur Andersen & Co., S.C., International/Specialty Tax Division, St. Charles, IL.
Senior/Instructional Designer (October 1988-August 1991).
Consultant/Part-time employee (August 1991-June 1996).

Ritz Camera, Charlottesville, VA.
Store Manager (August 1987-October 1988).

WUVA, Inc., Charlottesville, VA.
Executive Vice President and General Manager (March, 1986-March, 1987).

Service:

- United Way of the Capital Area, Jackson, MS. Community Investment Group member, "Abused and At-Risk." (April 1997-Present)
- Reviewer, Social Issues in Management Division, Academy of Management Meetings. (February 1997)
- Ad hoc Reviewer, International Journal of Organizational Analysis. (December 1996)
- President, Management Ph.D. Association, Virginia Tech Department of Management. (September 1992-September 1994)

Committee Memberships:

- Scholarships and Fellowships Committee, Millsaps College. (August 1997-Present)
- Educational Technology Task Force, Millsaps College. (November 1996-August 1997)
- Virginia Tech Intellectual Property Committee. (September 1994-May 1995)
- Management Graduate Curriculum Committee, Virginia Tech Department of Management. (September 1992-September 1994)

Honors/Awards:

- Inducted into Beta Gamma Sigma (National Business Honorary) (April, 1996).
- Academy of Management Entrepreneurship Doctoral Consortium (August, 1995).
- Academy of Management Business Policy and Strategy Doctoral Consortium (August, 1994).
- Recipient of the Jack Hoover Memorial Award for Teaching Excellence (April, 1994).
- Awarded two "XL" Awards at Arthur Andersen & Co. for cost reductions of over 65% as a project leader. Cost reductions totaled over $800,000 (January 1990 and August 1990).
- Awarded the Intern Supervisor Award at Arthur Andersen & Co. for outstanding supervision and mentoring of a summer intern (September, 1990).

Affiliations:

- Academy of Management
- Strategic Management Society
- Society for Business Ethics
- International Association for Business & Society
- Southern Management Association