A Critical Exploration of Sponsorship, Infrastructure, and New Organizations

David M. Flynn

ABSTRACT. This research focuses on the effects of public sponsorship, and regional infrastructure on the emergence and survival of new organizations. Propositions are tested regarding the joint effects of sponsorship and infrastructure on industrial development in a randomly selected sample of fourteen regions. The data include six measures of infrastructure, sponsorship as measured by the total dollars spent for economic development and their individual and joint effects on the number of firms and employees in "high technology" industries for the years 1965, 1970, 1975, 1980 and 1984. This preliminary analysis suggests that variation in the infrastructure and level of sponsorship within a region is related to the birth and survival of new organizations.

I. Introduction

Various analyses have been undertaken to determine the potential effects that local resources have on the birth, location, and expansion of firms. These analyses can be classified according to different perspectives. For example, certain studies attempted to determine the effects of property and other taxes on the location and expansion decision of new and existing firms (see e.g., Carlton, 1983; Charney, 1983; Chicago Fed Letter, 1988; Gyourko, 1987; Newman and Sullivan, 1988; and Schmenner, Huber, and Cook, 1987). Among the other variables considered were wage rates and other factors often classified as hedonic factors that include pollution levels, energy costs, crime and unemployment rates, the existence of hospitals, local sports teams, symphony orchestras, theatres, museums, newspapers, as well as climate variables such as temperature, rain, wind, and sun (see especially, Smith, 1983, p. 301; Blomquist *et al.*, 1988; and Boyer and Savageau, 1985).

As suggested by Blomquist *et al.* (1988) different urban locations offer different sets of wages, rents, and amenities, defined herein as infrastructure. Households then attempt to maximize well-being and firms attempt to minimize costs by their location decisions (pp. 89—90). One could also argue that firms seek to similarly maximize value or minimize their costs through their location decisions. For example, firms in high technology industries may seek a highly educated workforce and be less concerned with costs, especially taxes. Carlton (1983), for example, suggests that available technical expertise is important for highly sophisticated industries, e.g., high technology. Further it has been discovered that the availability of labor was more important than its cost in the first stage of a location decision. It was in the second stage that cost became a significant factor (Schmenner *et al.*, 1987).

These studies provide some valuable empirical evidence of the importance of infrastructure on the location decision of new or existing firms. However, there is a paucity of studies on the effect of increasing an area's attractiveness through incentives and their interaction with the existing infrastructure. These incentives, defined as sponsorship (Flynn, 1988), involve intervention by government agencies, business firms, and universities to create an environment conducive to the birth and survival of organizations. Sponsorship is a deliberate attempt to make available a significantly higher and more stable level of resources to selected firms.

The objectives of this paper are to (1) present a framework for describing types of initiatives undertaken to promote the birth of new organiza-

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Department of Management
School of Business
049 Weller Hall
Hofstra University
Hempstead, N.Y. 11550, USA

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tions, (2) pose propositions regarding the joint effects of initiatives and infrastructure on the establishment of new organizations in fourteen urban areas, and (3) provide a preliminary empirical test of the effects of both infrastructure and sponsorship on the existence and emergence of new organizations in these regions.

II. Sponsorship: concept and examples

New organizations contribute to a sense of vitality within a region. This perception is enhanced by the collaboration of public and private organizations in attempting to enhance or design an environment that is more conducive to new business formation and expansion. One could identify this process as the concept of sponsorship. Sponsorship has been previously used to describe idea champions in the innovation process (Daft and Becker, 1978) and relationships associated with business startups (Van de Ven *et al.*, 1984). Sponsorship is also readily used in the popular press, e.g., *The New York Times* and *Financial Times*, to describe the philanthropic support of artistic and cultural organizations. Herein, the concept is extended to the more general notion of a sponsored environment. Sponsorship involves planned environmental change by government agencies, business firms and universities to create new organizations and increase the likelihood of their survival. Sponsorship is a deliberate attempt to provide a significantly higher and more stable level of resources for new organizations.

Many different types of programs have been undertaken to foster startups and encourage the growth of new organizations. Activities range from universities providing physical facilities for new organizations through incubators at universities to changes in the federal or state tax structure that make a location attractive for the start-up of new organizations.

Sponsorship generally requires cooperation between the public and private sectors to be effective. Cooperative efforts are said to increase the number of startups (Premus, 1982), foster the development of high technology industries (Gruenstein, 1984), promote new regional centers of industrial activity (Brody, 1985) and aid in the revitalization of older industrial areas (Harr, 1984).

Examples of sponsorship include (consider also Premus, 1984 and Soete and Freeman, 1985 for other e.g.s):

- The University City Science Center in Philadelphia, a facility for technology oriented companies, established through the cooperation of state and city government agencies, universities and private organizations.
- Efforts at the state level, including special tax rates and subsidized mortgages, were important factors in attracting the Microelectronics and Computer Technology Corporation (MCC) and SEMATECH, two computer consortia, to Austin, Texas.
- Forty states allocated venture capital funds for direct business financing (Livingston, 1989).

In addition, the National Science Foundation (NSF) provides a form of sponsorship by funding engineering research centers at selected universities. These centers may serve as the focal point for new ideas that will contribute to the start-up of new organizations.

Underlying the current interest in sponsorship of new organizations is evidence that small organizations contribute significantly to scientific and technological innovation (U.S. Small Business Administration, 1988). Sponsorship fosters innovation directly through funding research and development and establishing incubator centers. Sponsorship provides indirect support for innovation by providing services, e.g., information networks that new organizations require for early survival. For example, small organizations are often at risk from undercapitalization, but sponsorship lowers the risk by developing links between startups and public and private venture capital organizations.

Sponsorship is also important as a means of rebuilding depressed regional areas since small firms with less than 100 employees provide the highest proportion of new jobs generated each year (U.S. Small Business Administration, 1988), even though the bulk of new employment may not come until the 4th year of the firm's existence (Phillips and Kirchhoff, 1989). Furthermore, the majority of new jobs generated by small organizations tend to be concentrated in a relatively few industries (Birch and McCracken, 1982).

Although there may be support for the notion

of sponsorship, questions are raised in a number of areas: the potential of sponsorship for long term versus short term effects (Luger, 1984), the interaction effect of sponsorship with the existing local infrastructure (Thomas, 1987; Malecki, 1984), and the relationship between patterns of cooperation and the efficient use of resources (Wiewel *et al.*, 1984). Also, there is concern over the extent to which federal and state governments should be involved in local development versus the more important role of financier (Kirlin, 1984; Nelson and Langlois, 1983). Some of these issues are addressed herein, in the attempt to provide policy guidance to governmental organizations — federal, state and local — in sponsoring new, free-standing organizations. The primary focus is to empirically establish if a region's infrastructure and the level of sponsorship has any effect, positive or negative, on the emergence of new organizations in high technology firms in particular.

III. Theoretical perspectives of sponsorship and infrastructure

A theoretical framework has been lacking to explain the phenomenon of organizational birth and death in the context of a focal environment. However, the emergence of the population ecology (Aldrich, 1979; Hannan and Freeman, 1977) and community ecology model (Astley, 1985), and the life-cycle framework (Kimberly and Miles, 1980) has provided some explanation for the emergence, growth, and decline of organizations and populations of organizations.

Ecological studies of the relationship between sponsorship, infrastructure, and the emergence of new organizations are however, relatively rare. There have been few attempts to extend organization theory to the recent efforts by private and public organizations and universities to foster new organizations. This is especially surprising in light of the important role of environmental selection in organizational theory and the deliberate attempt to increase the resource levels of environments in targeted areas, i.e., sponsorship, as it may affect the selection processes of particular organizations for survival.

A. *Theoretical perspectives of sponsorship*

The concept of sponsorship has been employed to describe a range of activities including the encouragement of new ideas and entrepreneurial behavior, and interorganizational relationships. As described earlier, sponsorship describes an environment of planned initiatives by public and private organizations at national, state, and local levels to facilitate the emergence of new organizations. Sponsorship touches on a number of important issues, discussed below, including the assumptions of selection processes in a competitive environment and arguments regarding the liability of newness and the persistence of founding characteristics over time (Stinchcombe, 1965).

1. *Population ecology*

The population ecology model of organization studies, adopted from ecological models, "explains the relationship of the organizational forms to their niches and environments, detailing the rise and fall of populations relative to specific environmental conditions and events" (Aldrich, *et al.*, 1984). Variation in organizational form within populations, along with the factors of selection and retention, are employed to analyze organizational birth and survival.

When organizations are sponsored, their environment is enriched, providing legitimacy (Stinchcombe, 1965) to their birth and early survival. This legitimacy has been shown to affect early survival in the newspaper (Carroll and Hannan, 1989a), and education software industries (Venkataram *et al.*, 1990) as well as in voluntary organizations (Singh *et al.*, 1986). However, in the later stages of the sponsored organization's life cycle, the ability to effectively compete for scarce resources is severely undermined by the previously buoyant, sponsored environment. As Brittain and Freeman (1980, p. 304) suggest, conditions that create environmental richness may very well limit the viability of some populations.

With regard to organizational form, the general munificience of the environmental affecting the semi-conductor industry, a high technology industry, has contributed to a diversity of organization forms (Brittain and Freeman, 1980, p. 303). A sponsored environment would be expected to also create a diversity of organizational forms within

populations because it is a munificient environment, by definition.

If, however, the pattern of resource availability over time for new resources matches the pattern of utilization of current populations, then it is very unlikely that a new organizational form will have any competitive advantages, especially considering the disadvantages posed by the liability of newness (Stinchcombe, 1965). Furthermore, from the perspective of niche theory this means that the potential new form's niche is included and subordinate to that of the existing form and is expected to fail (Brittain and Freeman, 1980, p. 320). The process of intervention by public and private organizations into communities may actually create new organizational forms through alteration of the existing ecology of the community. These new forms may be quite different from the requisite form of the relevant population, thus contributing to a lower level of later stage survival. Furthermore, as recently suggested, there is some evidence to suggest a later stage threat to survival, so called the liability of adolescence (Bruderl and Shussler, 1990).

Because the entry of new organizations increases the density of the relevant population, there is an increase in competition among firms for later stage survival. One could argue that the new sponsored organization may in fact be, illegitimate, because its incubating environment was artificially inflated with resources. As the density of the population increases, these new, sponsored firms would have a higher mortality rate versus unsponsored organizations. Sponsored organizations may have difficulty understanding survival in a high density environment where firms compete for limited resources. Greater population density has been shown to effect higher death rates due to the difficulty of competing firms procurring resources, especially new firms (Carroll and Delacroix, 1982). Very recently, however, Shan *et al.* (1991) has shown that density had a positive effect on biotechnology firms, opposite that which is predicted by ecological theory. In particular, higher population density had a negative effect on founding rates in the early years but the effects were positive in the later years. One explanation posed by these authors was that there may have been a limited supply of Ph.D.'s during the early study period, e.g., 1970's. Also plausible and complementary, is the potential effect of low legitimacy of the biotechnology field in the early study period. Therefore, although these results are potentially interesting, there is a need for a more fully specified model, as was also suggested by the authors.

Smilor and Feeser (1991) lends some support to the contention that sponsorship that is targeted to particular companies is doomed to failure because of the chaotic process of formation and subsequent survival of new firms. More importantly, they suggest that small differences in input can quickly become overwhelming differences in output (Smilor and Feeser, 1991, p. 168). Therefore, in the context of population ecology, sponsored organizations may have significantly different later stage success due to the "artificial" incubation process when extra resources are supplied in an attempt to achieve later stage organizational viability.

The population ecology work of Hannan and Freeman has recently come under serious criticism by Young (1988). She astutely points out some serious problems with the model as it has been defined and empirically tested. Even though she suggests that the theory has not contributed to the understanding of organizations (p. 23), she implies that with a more precise definition of the various concepts of birth, death, change, and inertia, their work may provide some insight into the sociology of organizations. Hannan and Freeman (1988) have answered some of the criticisms in their study of the ecology of labor unions for a period of 150 years. In this study, they support the liability of newness contention of Stinchcombe (1965) when they found a higher mortality rate for new unions versus those established through the merger of established unions. Also relevant to our discussion herein, is their finding that a high density of unions affected their disbanding rate, i.e., mortality. In other words, the local environment had a carrying capacity for some relatively fixed number of unions or more generally, organizations within a specific population and community. Population density was also shown to have a positive effect on the mortality rate of new organizations in American labor unions, Argentinean and Irish newspapers, San Francisco newspaper publishers, and American brewers (Carroll and Hannan, 1989b).

2. *Resource dependence*

The resource dependence model of organizations examines the proactive and reactive strategies organizations undertake to reduce the difficulty and variability they experience in obtaining resources (Pfeffer and Salancik, 1978). Since no organization is self-sufficient, the need to acquire resources creates dependencies between organizations. The importance and scarcity of the resources determines the extent of dependency. Interorganizational actions (e.g., joint ventures, interlocking directorates, etc.) are established as an attempt to adapt to environmental change (Pfeffer and Salancik, 1978). The focus of the resource dependence approach is different than population ecology in that the organization is looked upon as more active in attempting to adapt to the environment.

Organizations, in seeking to reduce their dependence on the environment, may attempt to develop loosely coupled systems. One of the most often recommended organizational responses is through the differentiation of the various sub-units to increase their independence both internally and externally. This differentiation necessarily implies diversification of activities to achieve loose coupling (Pfeffer and Salancik, 1978, p. 275).

The resource dependence model highlights the importance of strategies new organizations and their sponsors take to deliberately increase the level of resources available. When sponsorship takes place, the provision of resources and the conditions accompanying their acceptance increases the dependence of new organizations on the environment. However, the dependence may be characterized as benevolent since the sponsors(s) provides support for survival, especially in the short term. Sponsored organizations accept this dependence as a means of increasing their chances of survival. New organizations can make use of benevolent dependence to direct organizational energy, at least temporarily, to meet internal organizational needs. Since competitive interdependence is reduced, it is easier to focus on process or product development rather than on mapping competitive strategies for survival. Sponsorship provides resources and often acts as an intermediary to reconcile some of the incompatible demands that organizations generally face. However, there are costs associated with dependence. For example, at the interorganizational level, the linkages with the sponsoring organizations contribute to the potential for survival (Aiken and Hage, 1968). These linkages, however, may add a degree of bureaucracy that is cumbersome to a new organization. The bureaucratic element requires management control systems that are either not yet developed or require a diversion of resources to fulfill the demands associated with the sponsorship process.

Although, the resource dependence model may emphasize the use of differentiation and diversification for increased survival, "Neither the differentiation of the organization into subunits nor the diversification of activities reduces the organization's dependence on the environment" (Pfeffer and Salancik, 1978, p. 275). This also implies that undifferentiated organizations, especially new small organizations that tend to have simple structures associated with a single product or service, may be vulnerable to their dependence on the environment for resources. Therefore, an effective option available to even these undifferentiated organizations for coping with this constraint, would be through loose coupling.

Population ecology and resource dependence models have been proposed as competing perspectives for studying organization and environmental relations. More recent work points out the potentially complementary nature of the two approaches (Ulrich and Barney, 1984; Wholey and Brittain, 1986). Also, Romanelli's (1989) recent study on the minicomputer industry considered the effects of the strategic orientation of firms, i.e., generalist and specialist organizations as suggested by Brittain and Freeman (1980), on early stage mortality in the mini-computer industry. Her results support the notion that specialist organizations are more likely to survive their early years than generalists. However, as suggested by both the population ecology and resource dependence models, the mortality of young organizations is predominantly influenced by the relative abundance of resources in the environment, independent of competitive conditions (Romanelli, 1989, pp. 385—386).

In consideration of both population ecology and resource dependence models, outcomes of different types of sponsorship need to be assessed at the organizational and population levels. Spon-

sorship creates new organizations and also has effects, intended and unintended, on existing populations of organizations.

1. *Sponsorship and organizational birth*

Although stable and simple environments exist in some industries (Daft, 1983), environments appear to be evolving toward a turbulent state that involves greater complexity and instability (Aldrich *et al.*, 1984; Huber, 1984; 1990). Sponsorship is often directed toward the creation of new organizations in high technology industries that operate in turbulent environments (e.g., University Science City, Philadelphia; Microelectronics Computer Technology Corporation (MCC), Austin). Since resource acquisition is a major source of uncertainty for organizations, sponsorship provides an increased amount of available resources and lowers the level of environmental uncertainty experienced. Clearly, the expectation is that sponsorship will contribute to a higher rate of new firm births than in unsponsored environments.

2. *Sponsorship: implications for survival*

New organizations have a low probability for long term survival. This observation is supported by statistics on business failures among new organizations (U.S. Small Business Administration, 1988). Part of the tendency to fail is associated with their small size (Freeman *et al.*, 1983), competition (Aldrich, 1979), and environmental shocks (Hall, 1987).

Sponsorship, by reducing competitive disturbances and constraining organizational learning, may produce unintended consequences by aiding the survival of organizations with potential weaknesses. In the population ecology model, negative selection is discussed as a process whereby "some members of a population fail and take with them ineffective attributes, leaving a narrower set of survival-enhancing attributes" (Aldrich *et al.*, 1984). Sponsorship intervenes in this selection process so that sponsored organizations are favored regardless of the effectiveness of their attributes. Therefore, one would expect a higher rate of mortality among sponsored organizations when sponsorship either stops or is no longer effective at buffering organizations from environmental and competitive shocks.

Furthermore, models of organization-environment relations suggest that a higher level of organizational flexibility is necessary for adaptation to complex and unstable environments. Organizations incubated in sponsored and stable environments may be inhibited in their ability to devise effective strategies for survival beyond the period of sponsorship because of their lack of experience in coping with more uncertain environments. The literature on enactive learning indicates that the capacity to adapt depends on organizational skills learned early in organizational life (Miles and Randolph, 1980). As a function of dependence, sponsorship constrains early learning and this effect is reinforced by the structural inertia of organizations (Hannan and Freeman, 1984).

B. *The effects of infrastructure*

The notion of a sponsored environment adds another dimension to research that explored an ecological model of organizational birth rates. Pennings (1982a & b) found that certain environmental elements, i.e., the infrastructure of metropolitan areas, including occupational and industrial differentiation, size of urban areas, availability of venture capital, percentage of immigrants in the labor force and the presence of universities were positively associated with higher than expected rates of organizational birth. Furthermore, the associations were stronger in high technology industries. Other research focused on high technology firms in particular include the availability of skilled and low cost labor, a supportive tax structure, quality educational institutions, and low cost housing (Brody, 1985). Additionally, existing organizations, along with the presence of a high technology workforce, will contribute to the birth of new organizations. Premus (1982; 1984) and Carlton (1983) supported this conclusion indicating that the availability of skilled labor (e.g., percentage of workforce college educated) along with the low labor costs were most significant in influencing the location decision of high technology firms. The tax structure of a state and local community may be especially important to small expanding organizations. A fit with infrastructure is particularly important to meet the location objectives. High technology organizations require

a supply of technically trained employees and a high quality educational system. Without these elements of infrastructure, high technology start-ups will relocate to other areas in later stages of the organizational life cycle. Sponsorship that fails to consider the existing infrastructure may crowd out more effective usage of local resources. Browne (1983a) has emphasized the importance of a region's infrastructure in selecting initiatives for rebuilding communities' industrial structure. These findings should caution state and local authorities against being overly zealous in trying to create new organizations without sufficient understanding of the existing physical, industrial, and socioeconomic infrastructure.

C. *A model of the interaction of sponsorship and infrastructure*

The effect of sponsorship, infrastructure and environmental disturbances on the birth and survival of organizations is presented in Figure 1. The model describes public sponsorship at the local level, i.e., some degree of local implementation is assumed by local governmental organizations. The model illustrates changes in the relative magnitude of the three influences at different stages of the life cycle of sponsored organizations. At the time of organizational birth, sponsorship, by definition, exerts the strongest influence. Following birth, the local infrastructure becomes increasingly more important to organizational survival. This is particularly true for organizations with special infrastructure requirements, e.g., a highly skilled labor force. At stage one expansion, the effects of sponsorship and infrastructure are assumed to be about equally important. By the time second stage expansion is reached assuming that sponsorship is withdrawn, infrastructure is the major external influence on organizational survival.

The model also illustrates the role of sponsor-

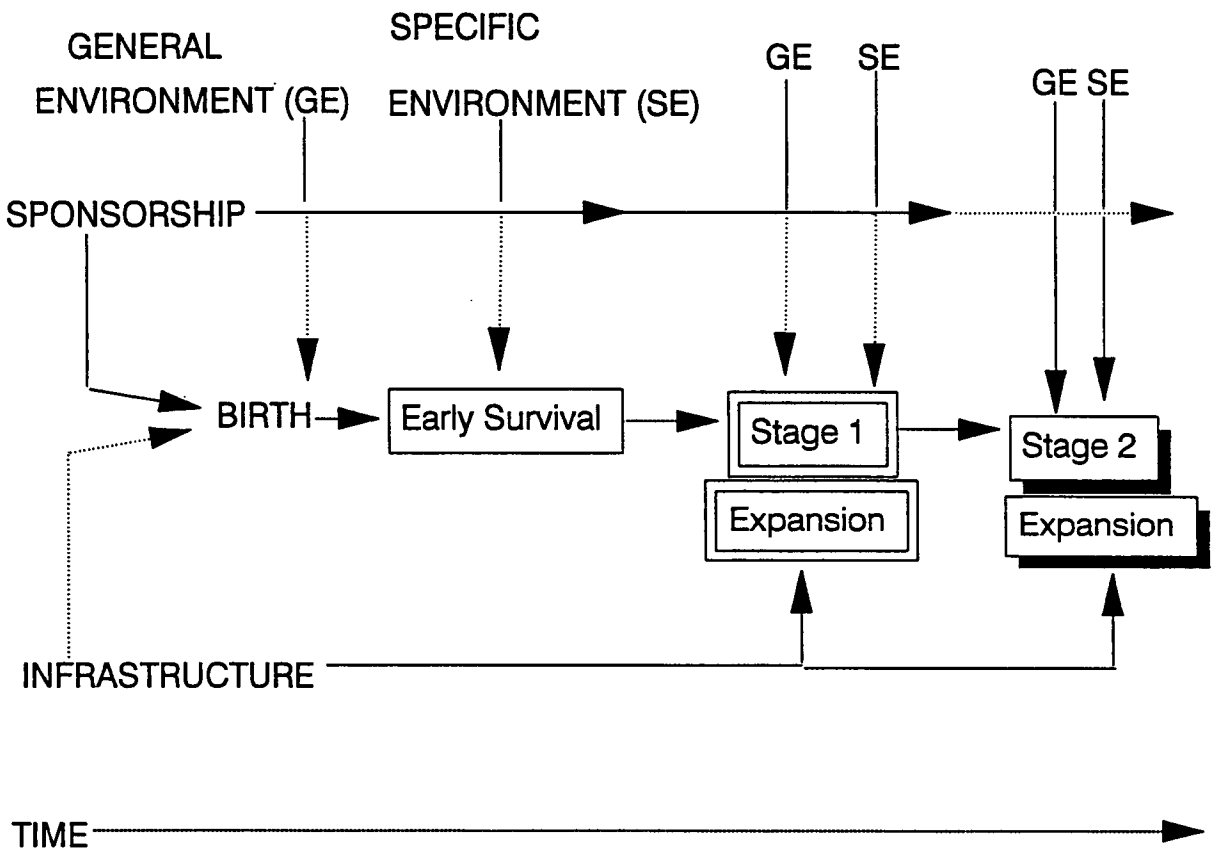

Fig. 1. The effect of environment, infrastructure, and sponsorship on organizational birth and survival

ship as a buffer against competitive and environmental disturbances over the life cycle of the organization. Sponsorship acts as a strong buffer at the time of organizational birth against both types of disturbances. The model illustrates how the buffering role of sponsorship diminishes over the life cycle of the organization. This is indicated in the model by a modest increase in the strength of environmental effects from organizational birth to stage one. By stage two, the organization is directly affected by the environment. The model shows the strong effect of the environment the organization experiences in stage 2. Disturbances from the general environment appear stronger than those of the competition because of the importance of infrastructure in the model. An appropriate fit with infrastructure, i.e., an infrastructure rich enough to meet industry requirements, will help to reduce disturbances from competition at stage two.

The ideas presented in the paper suggest that organizations incubated through sponsorship will exhibit a different pattern of survival than non-sponsored organizations. At stage one, sponsorship enables organizations to overcome the liability of newness and small size. At stage two as sponsorship is withdrawn, a higher mortality rate is expected for sponsored organizations. The strength of the relationships presented in the model indicate that the decrease in the survival rate at stage two may not be as strong if there is a good fit with infrastructure. The effectiveness of sponsorship over the longer term is a critical theoretical issue. However, the available data limit the testing of this idea in the present analysis.

IV. Methodology

As noted above, attempts to measure the relationship between infrastructure, sponsorship and the birth of new organizations have been limited. One of the primary reasons is due to the inadequacy of data available to undertake the analysis. These data are often limited in detail, e.g., distinctions for SIC members, and the years included, e.g., pre-1980 data are often not included. Some of the better data on the births and deaths of firms are available through the Office of Advocacy at the Small Business Administration, e.g., the USEEM and USELM data bases (see e.g., Phillips and Kirchhoff, 1989). However, these data do not include pre-1976 information. Therefore, data included in this analysis were taken from *County Business Patterns* and the U.S. Department of Labor, *Employment and Earnings*. Other data are taken from the *U.S. Statistical Abstracts* and other miscellaneous sources. These sources provided the data for the infrastructure variables, employee, and firm data.

The selection of the five year time frames for measuring the infrastructure, employee and firm data are posited to represent the strategic period during which the effects interaction between the infrastructure and firm births, expansions or contractions would occur. Yearly measures would not be expected to show any significant change. Furthermore, as suggested earlier, small businesses are most vulnerable to failure during the first five years of their existence. Since the analysis is considering high technology industries, i.e., firms and employees, and infrastructure factors that affect them, we are assuming, with some support from the literature, that they tend to be small firms. Small firms are considered to have fewer than 500 employees as defined by the Office of Advocacy of the Small Business Administration in the United States Federal Government. A minor note is that the 1984 year was included because the 1985 year was not available at the time of data collection.

Information for the sponsorship variable included the U.S. Department of Commerce (1988), Bartsch *et al.* (1988), and the National Association of State Development Agencies (1986). Additional information was provided by the Commerce Departments of the fourteen states. The theoretical foundation provided above would suggest the importance of a longitudinal analysis of the sponsorship variable. However, as stated earlier, the data on this variable have not been collected over time by any of the state or Federal agencies associated with economic data collection and analysis. Therefore, the empirical testing of the effect of sponsorship is grossly limited. However, a preliminary analysis has been undertaken to enlighten the one the potential significance of sponsorship.

The choice of the fourteen regions was achieved through a random selection from the Rand McNally's *Places Rated Almanac* (see Boyer

and Savageau, 1985). The only criterium used was that the city had to be rated in the top 100 of the 329 urban areas included in the sample. Selected sample characteristics are included in Appendix I and II. Appendix I includes the relative ranking of the fourteen regions for the infrastructure variables. Appendix II lists the relative rank of each region for the number of firms in the high technology industries included in this study. These data served as the basis for the summary Table IV.

A. *Propositions and results*

The following propositions are presented as a preliminary framework for analysis of the data. These propositions were developed in consideration of the theoretical material discussed above and the available data.

1. *Propositions*

Proposition 1: a) Infrastructure is related to the number of existing firms in high technology industries; and b) infrastructure is related to the number of employees in high technology industries.

Proposition 2: a) Infrastructure is related to the change in the number of firms over two periods in high technology industries; and b) infrastructure is related to the change in the number of employees over two periods in high technology industries.

Proposition 3: Regions with a rich versus a weak infrastructure will have to maintain a higher relative position for the number of firms in high technology over the five time periods. The following values for the infrastructure variables are defined as rich versus weak relative to the fourteen regions (Premus, 1982 & 1984): (Number in parentheses indicates the relative rank of the variable in the research conducted by Premus (1982, p. 23; 1984, p. 49). The variable may represent a close substitute and not the exact variable because of data inavailability.)

1) low relative hourly cost of manufacturing labor (rank of 2);
2) high relative per pupil expenditure on education (rank of 4);
3) high relative number of persons over 25 with four or more years of college education (rank of 1);
4) low relative taxes per capita (rank of 3);
5) high relative income per capita (rank of 7); and
6) low relative cost of housing per capita (rank of 5 & 9).

Proposition 4: Regions with high levels of sponsorship will exhibit higher relative number of firms over time than regions with low levels of sponsorship. This will be evident in the high relative dollars spent by the state for regional economic development and the high relative number of firms in high technology industries.

Proposition 5: The existence of a rich infrastructure and a high level of sponsorship, the higher the relative number of organizations in high technology manufacturing and service industries.

2. *Results*

Proposition #1a & #1b is tested by the significance of the Pearson correlation coefficients (P) for the high technology manufacturing and service industries with the factors representing the six infrastructure variables for each of the five periods. The factor analysis for the aggregate infrastructure variables, i.e., fourteen region values, resulted in two factor solution in four of the five periods with one varimax rotation using Kaiser normalization (see Table I). The fourth period (1980) resulted in a three factor solution. The emergence of per capita tax costs on a single factor may account for the three versus two factor solution. It is difficult to generalize what the factors actually may mean over the five periods. However, it is interesting to note that the per pupil education expenditure generally loads on the other factor from the variable measuring the number of people with 4 or more years of college (standardized for population).

Table II includes the Pearson correlation coefficients for the infrastructure factors and the firm and employee data.

It is evident from the above data that there is preliminary, albeit partial, support for the Proposition #1a & #1b. Specifically, significant correlations exist between infrastructure, and the employee and firm data. However, consideration must be given for both industry, period, and the employee or firm data. Not all high technology industries and not all periods indicate a significant relationship between infrastructure and the number of firms or employees in high technology industries. However, a previous analysis that excluded the employee data minimized the significance of the infrastructure to the existence of firms and employees in high technology industries (Flynn, 1988).

The following data in Table III are presented as a test for Proposition #2a & #2b that the infrastructure variables for period T-1 are related

TABLE I
Factor analysis for infrastructure variables over the 5 periods

Period 1 (1965)	Factor 1	Factor 2	
Per Pupil Expenditure For Education (PPUPEXP)	0.92	0.00	
Housing Costs (HOUPOP)	−0.07	0.98	
Hourly Cost of Labor (COSTLAB)	0.68	−0.39	
Tax Costs, Per Capita (TAXSTRU)	0.39	−0.37	
Income, Per Capita (PERCAP)	0.96	0.04	
Number of People with 4 or more Years of College (COLPOP)	−0.02	0.99	
Eigenvalue	2.81	1.86	
Percent of Variance Explained	46.9	31.1	
Period 2 (1970)	**Factor 1**	**Factor 2**	
Per Pupil Expenditure for Education (PPUPEXP)	0.51	0.52	
Housing Cost (HOUPOP)	0.94	−0.11	
Hourly Cost of Labor (COSTLAB)	−0.21	0.81	
Tax Costs, Per Capita (TAXSTRU)	−0.45	0.51	
Income, Per Capita (PERCAP)	0.10	0.91	
Number of People with 4 or more Years of College (COLPOP)	0.96	−0.02	
Eigenvalue	2.42	1.97	
Percent of Variance Explained	40.3	32.9	
Period 3 (1975)	**Factor 1**	**Factor 2**	
Per Pupil Expenditure for Education (PPUPEXP)	0.87	−0.27	
Housing Cost (HOUPOP)	−0.33	0.89	
Hourly Cost of Labor (COSTLAB)	0.83	−0.25	
Tax Costs, Per Capita (TAXSTRU)	−0.03	−0.57	
Income, Per Capita (PERCAP)	0.87	0.11	
Number of People with 4 or more Years of College (COLPOP)	−0.17	0.93	
Eigenvalue	3.06	1.46	
Percent of Variance Explained	51.1	24.5	
Period 4 (1980)	**Factor 1**	**Factor 2**	**Factor 3**
Per Pupil Expenditure for Education (PPUPEXP)	−0.05	0.88	0.33
Housing Cost (HOUPOP)	0.95	−0.22	−0.01
Hourly Cost of Labor (COSTLAB)	−0.54	−0.19	0.76
Tax Costs, Per Capita (TAXSTRU)	−0.25	0.83	−0.12
Income, per Capita (PERCAP)	0.24	0.29	0.91
Number of People with 4 or more Years of College (COLPOP)	0.98	−0.14	0.02
Eigenvalue	2.62	1.64	1.26
Percent of Variance Explained	43.7	27.4	21.2
Period 5 (1984)	**Factor 1**	**Factor 2**	
Per Pupil Expenditure for Education (PPUPEXP)	−0.31	0.75	
Housing Cost (HOUPOP)	0.97	−0.09	
Hourly Cost of Labor (COSTLAB)	−0.00	0.60	
Tax Costs, Per Capita (TAXSTRU)	−0.55	0.50	
Income, Per Capita (PERCAP)	0.25	0.88	
Number of People with 4 or more Years of College (COLPOP)	0.95	0.16	
Eigenvalue	2.45	1.88	
Percent of Variance Explained	40.9	31.4	

TABLE II
Pearson Correlation Coefficients for Infrastructure Factors with Firm and Employee Values in Fourteen Regions in Aggregate
(significance level of variables in parentheses)

Period 1 (1965) Infrastructure Factors with Firm Data (Period 1) in High Technology Industries, Manufacturing & Services.**

Manufacturing

	Drugs	Ordac	Compmc	Elec	Missl	Transp	Instru
Factor 1	(0.22)	(0.08)*	(0.06)*	---	---	(0.05)*	
Factor 2	(0.19)	(0.12)	(0.06)*	---	---	(0.10)*	

Services

	Services	DataPr	BusSer	Consul
Factor 1	(0.07)*	---	(0.07)*	(0.08)*
Factor 2	(0.05)*	---	(0.04)*	(0.05)*

Period 1 (1965) Infranstructure Factors with Employee Data (Period 1) in High Technology Industries, Manufacturing & Services.

Manufacturing

	Drugs	Ordac	Compmc	Elec	Missl	Transp	Instru
Factor 1	(0.40	(0.38)	(0.49)	(0.01)*	---	---	(0.34)
Factor 2	(0.12)	(0.24)	(0.26)	(0.17)	---	---	(0.10)*

Services

	Services	DataPr	BurSer	Consul
Factor 1	(0.04)*	---	(0.08)*	(0.11)
Factor 2	(0.05)*	---	(0.06)	(0.04)

** The high technology industries included in this analysis are listed below.

Manufacturing
Drugs (SIC: 283)
Ordnance & Accessories (SIC: 348) (ORDAC)
Office Computers & Accessories (SIC: 357) (COMPMC)
Electrical & Electrical Machinery (SIC: 36) (ELEC)
Guided Misseles, Space Vehicles & Parts (SIC: 376) (MISSL)
Miscellaneous Transportation Equipment (SIC: 379) (TRANSP)
Instruments & Related Products (SIC: 38) (INSTRU)

Services
Services (all)
Business Services (SIC: 73) (BUSSERV)
Data Processing (SIC: 737) (DATAPR)
Consulting & Public Relations (SIC: 739) (CONSUL)

Period 2 (1970) Infrastructure Factors with Firm Data (Period 2) in High Technology Industries, Manufacturing & Services.

Manufacturing

	Drugs	Ordac	Compmc	Elec	Missl	Transp	Instru
Factor 1	(0.22)	(0.15)	(0.09)*	(0.05)*	---	(0.16)	(0.03)*
Factor 2	(0.18)	(0.16)	(0.27)	(0.03)*	---	(0.18)	(0.03)*

Services

	Services	DataPr	BusSer	Consul
Factor 1	(0.03)*	---	(0.01)*	(0.03)*
Factor 2	(0.05)*	---	(0.16)	(0.12)

* Level of Significance at least 0.10

Table II (Continued)

Period 2 (1970) Infrastructure Factors with Employee Data (Period 2) in High Technology Industries, Manfuacturing & Services.

Manufacturing

	Drugs	Ordac	Compmc	Elec	Missl	Transp	Instru
Factor 1	(0.21)	(0.43)	(0.06)*	(0.40)	---	(0.00)*	(0.21)
Factor 2	(0.11)	(0.25)	(0.38)	(0.00)*	---	(0.04)*	(0.03)*

Services

	Services	DataPr	BusSer	Consul
Factor 1	(0.05)*	---	(0.06)*	(0.05)*
Factor 2	(0.04)*	---	(0.15)	(0.13)

Period 3 (1975) Infrastructure Factors with Firm Data (Period 3) in High Technology Industries, Manufacturing & Services.

Manufacturing

	Drugs	Ordac	CompMc	Elec	Missl	Transp	Instru
Factor 1	(0.24)	(0.41)	(0.36)	(0.28)	(0.45)	(0.24)	(0.29)
Factor 2	(0.24)	(0.07)*	(0.07)*	(0.03)*	(0.43)	(0.32)	(0.03)*

Services

	Services	DataPr	BusSer	Consul
Factor 1	(0.16)	(0.43)	(0.26)	(0.37)
Factor 2	(0.01)*	(0.02)*	(0.000)*	(0.02)*

Period 3 (1975) Infrastructure Factors with Employee Data (Period 3) in High Technology Industries, Manufacturing & Services.

Manufacturing

	Drugs	Ordac	Compmc	Elec	Missl	Transp	Instru
Factor 1	(0.07)*	(0.48)	(0.33)	(0.18)	(0.08)*	(0.45)	(0.28)
Factor 2	(0.18)	(0.38)	(0.26)	(0.49)	(0.05)*	(0.03)*	(0.18)

Services

	Services	DataPr	BusSer	Consul
Factor 1	(0.16)	(0.40)	(0.26)	(0.39)
Factor 2	(0.04)*	(0.26)	(0.04)*	(0.04)*

Period 4 (1980) Infrastructure Factors with Firm Data (Period 4) in High Technology Industries Manufacturing & Services.

Manufacturing

	Drugs	Ordac	Compmc	Elec	Missl	Transp	Instru
Factor 1	(0.35)	---	(0.27)	(0.32)	(0.14)	(0.04)*	(0.33)
Factor 2	(0.007)	---	(0.00)*	(0.00)*	(0.35)	(0.45)	(0.03)*
Factor 3	(0.17)	---	(0.43)	(0.42)	(0.02)*	(0.08)*	(0.40)

Services

	Services	DataPr	BusSer	Consul
Factor 1	(0.07)*	(0.32)	(0.04)*	(0.17)
Factor 2	(0.01)*	(0.001)*	(0.01)*	(0.004)*
Factor 3	(0.25)	(0.42)	(0.44)	(0.45)

* Level of Significance at least 0.10

Table II (Continued)

Period 4 (1980) Infrastructure Factors with Employee Data (Period 4) in High Technology Industries, Manufacturing & Services.

Manufacturing

	Drugs	Ordac	CompMc	Elec	Missl	Transp	Instru
Factor 1	(0.05)*	(0.49)	(0.32)	(0.08)*	(0.01)*	(0.07)*	(0.42)
Factor 2	(0.30)	(0.31)	(0.04)*	(0.01)*	(0.42)	(0.30)	(0.00)*
Factor 3	(0.05)*	(0.43)	(0.13)	(0.21)	(0.00)*	(0.09)*	(0.29)

Services

	Services	DataPr	BusSer	Consul
Factor 1	(0.30)	(0.32)	(0.45)	(0.45)
Factor 2	(0.00)*	(0.00)*	(0.00)*	(0.00)*
Factor 3	(0.16)	(0.47)	(0.33)	(0.45)

Period 5 (1984) Infrastructure Factors with Firm Data (Period 5) in High Technology Industries, Manufacturing & Services.

Manufacturing

	Drugs	Ordac	CompMc	Elec	Missl	Transp	Instru
Factor 1	(0.41)	(0.25)	(0.16)	(0.10)*	--	(0.09)*	(0.27)
Factor 2	(0.16)	(0.36)	(0.05)*	(0.01)*	—	(0.08)*	(0.11)

Services

	Services	DataPr	BusSer	Consul
Factor 1	(0.03)*	(0.34)	(0.07)*	(0.11)
Factor 2	(0.08)*	(0.26)	(0.19)	(0.23)

Period 5 (1984) Infrastructure Factors with Employee Data (Period 5) in High Technology Industries, Manufacturing & Services.

Manufacturing

	Drugs	Ordac	CompMc	Elec	Missl	Transp	Instru
Factor 1	(0.07)*	(0.39)	(0.26)	(0.02)*	(0.04)*	(0.30)	(0.41)
Factor 2	(0.18)	(0.16)	(0.02)*	(0.03)*	(0.27)	(0.09)*	(0.01)*

Services

	Services	DataPr	BusSer	Consul
Factor 1	(0.36)	(0.41)	(0.34)	(0.30)
Factor 2	(0.00)*	(0.03)*	(0.01)*	(0.00)*

* Level of Significance at least 0.10

to the subsequent periods net change in firms or employees, respectively. One could tentatively suggest that this measure for net change indicates the births and deaths in forms over the previous four or five year period. However, the data included in the data base do not distinguish for organizational size.

There is some support for the proposition that the net change in firm births and deaths is affected by the infrastructure of the previous period, especially if employee data are included. The significant correlations tend to be in the later periods, i.e., 1970—1975, 1975—1980, & 1980—1984 for a few manufacturing and service industries. The following results for inter-regional differences in infrastructure and firm data may provide some insight to the above results.

The remaining Propositions 3, 4, and 5 are measured by the relative ranking of the number of firms, infrastructure factors in aggregate and dollars allocated for sponsorship and amount of university funding from Federal sources. These data are summarized in Table IV.

The data in columns A1—A2 and B are

TABLE III

Pearson Correlation Coefficients For Infrastructure and the Net Change in Firm Values for Fourteen Regions in Aggregate (significance level of variables in parentheses)

Period 1 (1965) Infrastructure Factors with Firm Data (Period 2-1) in High Technology Industries, Manufacturing & Services.

Manufacturing

	Drugs	Ordac	Compmc	Elec	Missl	Transp	Instru
Factor 1	(0.13)	(0.42)	(0.40)	(0.16)	---	---	(0.13)
Factor 2	(0.12)	(0.48)	(0.20)	(0.26)	---	---	(0.29)

Services

	Services	DataPr	BusSer	Consul
Factor 1	(0.13)	---	(0.44)	(0.20)
Factor 2	(0.29)	---	(0.14)	(0.14)

Period 1 (1965) Infrastructure Factors with Employee Data (Period 2.1) in High Technology Industries, Manufacturing & Services.

Manufacturing

	Drugs	Ordac	Compmc	Elec	Missl	Transp	Instru
Factor 1	(0.20)	(0.26)	(0.41)	(0.30)	---	---	(0.08)*
Factor 2	(0.41)	(0.36)	(0.35)	(0.09)*	---	---	(0.48)

Services

	Services	DataPr	BusSer	Consul
Factor 1	(0.05)*	---	(0.21)	(0.20)
Factor 2	(0.14)	---	(0.10)*	(0.12)

Period 2 (1970) Infrastructure Factors with Firm Data (Period 3-2) in High Technology Industries, Manufacturing & Services.

Manufacturing

	Drugs	Ordac	CompMc	Elec	Missl	Transp	Instru
Factor 1	(0.13)	(0.42)	(0.27)	(0.10)*	---	(0.10)*	(0.19)
Factor 2	(0.21)	(0.43)	(0.34)	(0.20)	---	(0.18)	(0.12)

Services

	Services	DataPr	BusSer	Consul
Factor 1	(0.27)	---	(0.26)	(0.23)
Factor 2	(0.43)	---	(0.42)	(0.21)

Period 2 (1970) Infrastructure Factors with Employee Data (Period 3-2) in High Technology Industries, Manufacturing & Services.

Manufacturing

	Drugs	Ordac	CompMc	Elec	Missl	Transp	Instru
Factor 1	(0.07)*	---	(0.13)	(0.13)	---	(0.04)*	(0.21)
Factor 2	(0.24)	---	(0.07)*	(0.02)*	---	(0.26)	(0.03)*

Services

	Services	DataPr	BusSer	Consul
Factor 1	(0.34)	---	(0.25)	(0.22)
Factor 2	(0.20)	---	(0.48)	(0.22)

* Level of Significance at least 0.10

Table III (Continued)

Period 3 (1975) Infrastructure Factors with Firm Data (Period 4-3) in High Technology Industries, Manufacturing & Services

Manufacturing							
	Drugs	Ordac	CompMc	Elec	Missl	Transp	Instru
Factor 1	(0.46)	—	(0.13)	(0.14)	(0.18)	(0.39)	(0.29)
Factor 2	(0.04)*	—	(0.39)	(0.30)	(0.31)	(0.12)	(0.18)

Services				
	Services	DataPr	BusSer	Consul
Factor 1	(0.29)	(0.44)	(0.37)	(0.26)
Factor 2	(0.47)	(0.09)*	(0.02)*	(0.02)*

Period 3 (1975) Infrastructure Factors with Employee Data (Period 4-3) in High Technology Industries, Manufacturing & Services.

Manufacturing							
	Drugs	Ordac	CompMc	Elec	Missl	Transp	Instru
Factor 1	(0.50)	—	(0.46)	(0.27)	(0.20)	(0.33)	(0.32)
Factor 2	(0.01)*	—	(0.18)	(0.08)*	(0.01)*	(0.01)*	(0.20)

Services				
	Services	DataPr	BusSer	Consul
Factor 1	(0.30)	(0.30)	(0.41)	(0.34)
Factor 2	(0.44)	(0.28)	(0.46)	(0.46)

Period 4 (1980) Infrastructure Factors with Firm Data (Period 5-4) in High Technology Industries, Manufacturing & Services.

Manufacturing							
	Drugs	Ordac	CompMc	Elec	Missl	Transp	Instru
Factor 1	(0.30)	—	(0.44)	(0.01)*	—	(0.18)	(0.40)
Factor 2	(0.36)	—	(0.004)*	(0.31)	—	(0.43)	(0.000)*
Factor 3	(0.18)	—	(0.42)	(0.14)	—	(0.03)*	(0.37)

Services				
	Services	DataPr	BusSer	Consul
Factor 1	(0.03)*	(0.05)*	(0.008)*	(0.03)*
Factor 2	(0.17)	(0.33)	(0.45)	(0.42)
Factor 3	(0.15)	(0.18)	(0.46)	(0.46)

Period 4 (1980) Infrastructure Factors with Employee Data (Period 5-4) in High Technology Industries, Manufacturing & Services.

Manufacturing							
	Drugs	Ordac	CompMc	Elec	Missl	Transp	Instru
Factor 1	(0.12)	(0.29)	(0.29)	(0.38)	(0.29)	(0.30)	(0.20)
Factor 2	(0.37)	(0.29)	(0.09)	(0.31)	(0.13)	(0.20)	(0.30)
Factor 3	(0.12)	(0.48)	(0.28)	(0.18)	(0.22)	(0.35)	(0.07)*

Services				
	Services	DataPr	BusSer	Consul
Factor 1	(0.14)	(0.20)	(0.09)*	(0.11)
Factor 2	(0.00)*	(0.02)*	(0.23)	(0.30)
Factor 3	(0.37)	(0.19)	(0.46)	(0.06)*

* Level of Significance at least 0.10

TABLE IV
Summary of Relative Rankings for High Technology Firms, Employees, Infrastructure, Sponsorship, and University Factors

Relative	Firm[1]	Employee Infrastructure[2]		Sponsorship[3]	University[4]
	A(1)	A(2)	B	C	D
Anaheim	27 (9&10)	54 (2)	288 (1)	297 (9)	1.10 (2)
Atlanta	35 (6)	53 (3)	217 (10)	154 (11)	0.28 (6)
Austin	27 (9&10)	42 (10)	242 (5)	952.9 (4)	0.24 (7)
Birmingham	26 (11&12)	32 (13)	148.5 (13)	1235 (3)	0.14 (8)
Boston	83 (1)	47 (7&8)	261 (2)	534 (6)	1.54 (1)
Cincinnatti	35 (5)	44 (9)	247 (4)	1554.5 (2)	0.10 (10)
Charlotte	28 (8)	36 (12)	213 (12)	402.2 (8)	(14)
Detroit	55 (3)	48 (6)	252.5 (3)	163.8 (10)	0.33 (5)
Honolulu	16 (14)	27 (14)	220 (9)	2.2 (14)	0.11 (9)
Minneapolis	48 (4)	47 (7&8)	240 (6)	951 (5)	0.38 (4)
New Orleans	25 (13)	49 (5)	170.5 (14)	43 (13)	(14)
Philadelphia	56 (2)	56 (1)	233 (7)	1974 (1)	0.75 (3)
Portland	34 (7)	39 (11)	214.5 (11)	73 (12)	(14)
Wichita	26 (11&12)	27 (14)	225 (8)	494 (7)	(14)

[1] Firm value based on award of 1 for having firms listed and 2 for being first in the particular period. These values are then summed over the five periods. Rank for all four factors is based on scale of 1—14, i.e. best to worst.
[2] Infrastructure based on ranking of each region over the five periods as included in Appendix # 1.
[3] Sponsorship measured by total spend for state economic development in millions of dollars.
[4] University variable measured by Federal Obligations for research and development to the 100 universities receiving the largest amounts in billions of dollars.

regarded as a test for the significance of infrastructure to the relative ranking of the fourteen regions for the number of firms in the different high technology industries. Although Anaheim has the richest infrastructure, i.e., relative rank of 1, it only ranked 9-10th in firm rankings with Austin. However, Boston which had the second riches infrastructure, has the highest relative rank for the firm data. Detroit ranked third in both infrastructure and firm data. Cincinnati ranked fourth in infrastructure and fifth for firm data. Some consistency between the firm and infrastructure data also include Birmingham and Minneapolis. When we consider the relative ranking of employee data in the same high technology industries, the results are somewhat different. Anaheim, Birmingham, Charlotte, Minneapolis, and Portland emerge as areas in which the relative rankings of infrastructure and employee data are similar (i.e., + or − 2 ranks). These examples suggest that their is some support for Proposition # 3, that a rich infrastructure will facilitate the existence of high technology firms.

Proposition # 4 is measured by the relative ranking of sponsorship, measured in millions of dollars allocated for industrial revenue bonds, direct loans, development corporations, industrial training and venture capital (Column C). These rankings are compared with the firm rankings in Column A1. Evidence to support this proposition include Philadelphia, Minneapolis, Charlotte, Anaheim, New Orleans and Honolulu. When we consider the data in Column A2, even fewer regions show these relationships. These regions are Honolulu, Philadelphia and Portland. Although not all regions show some consistency between sponsorship and the existence of high technology employees and firms, there is some evidence to support the proposition that sponsorship may be important.

The final Proposition # 5, that there is a relationship between a rich infrastructure, a high level of dollars allocated for sponsorship and the

stence of high technology includes the relative rankings in Columns B, C, and A1—A2, respectively. There is little evidence that supports this proposition. Minneapolis and New Orleans are the only regions that have relatively equivalent rank-

ings for all four variables. New Orleans does however, have a significantly higher ranking in number of employees in the high technology regions.

A final measure includes the potential role university funding from Federal sources may have in spawning high technology firms. Mitton (1990) has suggested that institutional effects, e.g., university research centers, are important to the "begetting" process in the biotechnology industry in the San Diego area. These effects were hypothesized to be more significant in the early years of firm formation. In the later years, the spawned firms take over as the prime mover for further formation of new firms. Although little research into this issue is available, it is expected that universities serve a critical role as "incubators" of new products and processes. Recently, Louis *et al.* (1989, p. 128) found evidence that communities where universities received larger grants had more significant levels of entrepreneurial activity than those receiving smaller grants. Such grants could be seen as a form of general sponsorship, reducing inconsistencies between the community infrastructure and the need of new firms for an environment with technical and scientific research to provide necessary vitality. Furthermore, the U.S. Department of Education has recently reported that other than tuition, Federal monies account for the largest source of revenue for doctoral degree-granting universities.

Although an operational means for measuring the university variable is problematic, data are aggregated from the National Science Foundation's (NSF) Bulletin Board (an on-line data service), and the Resources, Community, and Economic Development Division of the United States General Accounting Office. Data were gleaned from the NSF for Federal obligations to universities within a fifty mile radius of the relevant region for the 1979—1984 period. These data are not available on the university level prior to the 1979 period.

The data presented in Column D in Table IV suggest that university funding may have some relationship to the prominence of certain areas in the high technology arena. In particular, there is some commonality between the relative rank of firms in Column A and the university funding data in Column D. For example, Atlanta, Boston, Detroit, and Philadelphia rank closely on these two factors (Columns A1 and D). A notable exception is Anaheim with the rank of 11 & 12, and 2 on the firm and university measures, respectively. However, when we include the number of employees as the measure for high technology the results are consistent with the expectation that universities contribute to employment in high technology industries in Anaheim, Cincinnati, Detroit, and Philadelphia.

Although no causality is suggested, there may be some support for the critical role of universities in high technology firm formation and survival. More rigorous data analyses need to be undertaken as better data are procurred from institutions such as the NSF.

In summary, there are data to support the idea that either a rich infrastructure or high relative dollars allocated for sponsorship will support the existence of high technology manufacturing and service firms. Also, there is some evidence that suggests infrastructure will effect a net change in the number of firms in the subsequent period as measured in Proposition #2a & #2b. Further analyses are necessary to more rigorously test the Propositions. This would be facilitated by access to a more detailed data base, especially including sponsorship data over all five periods, i.e., 1965—1984.

Implications

Preliminary analysis of the existing data base suggests that either a rich infrastructure or high relative dollars allocated for sponsorship will support the existence of high technology manufacturing and service firms. However, further analyses are necessary to more rigorously test the propositions. This would be facilitated by access to better data.

The preliminary analysis suggests, however, that sponsorship: (1) support the initial development of industries compatible with the local infrastructure; (2) enrich the local infrastructure through direct and indirect support; and, (3) require firms to include mechanisms for organizational learning to overcome the effects of benevolent dependence resulting from sponsorship.

The matching of the local infrastructure with industry requirements may be problematic given

the dynamic aspects of most emerging technologies. However, there are various typologies for classifying organizational technology (Perrow, 1967; Scott, 1981; Thompson, 1967) and organizational environments (Dess and Beard, 1984). This suggests a means for sponsoring organizations to identify technologies that are compatible with the local infrastructure. For example, the infrastructure necessary to support biotechnology research requires a highly educated workforce supported through a local university with graduate programs to maintain the necessary level of basic and applied research.

Although the university was included as a part of the empirical analysis, it does not represent a "best" measure. It is recommended that a region specific analysis be undertaken to assess the contribution of the university to the formation of firms and the expansion of employment. The university is an important element of the local infrastructure and as a vehicle of sponsorship. The university serves critical roles as a part of the local infrastructure and also, as a vehicle of sponsorship, i.e., through the use of Federal grants and contracts and industry sponsored research.

As noted earlier, state and local planners have been favorably biased toward high-technology industries to promote rapid employment growth. However, Browne (1983b) has shown that there may be more employment opportunities in other industries. For example, business services often grow at a higher rate than the populations of high technology firms they support.

Sponsorship can enrich the local infrastructure by various programs aimed at increasing the attractiveness of a region for organizational births and survival through increased educational funding, technical training for displaced workers, and technical and managerial assistance to innovative firms, and improving the quality of life.

Public policy formulation and implementation for sponsorship appears to be more effective at a local versus the state or federal level as indicated by research on decentralization of sponsorship (Joglekar and Hamburg, 1983a & b). Similarly, Kirlin (1984) and Nelson and Langlois (1983) concluded that governmental policy aimed at increasing the innovative output of organizations is more effective with low levels of control, i.e., decentralization. Controlling for level of resources, local sponsorship is the most effective in meeting local needs. However, the initial impact of local sponsorship cannot be maintained if environmental disturbances are considerable. This suggests that multiple sources of sponsorship, i.e., cooperative efforts with decentralization of implementation will be effective over the longer term.

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Appendix I. Rankings of Regions by Infrastructure Variables over Five Periods

Hourly Cost of Manufacturing Labor: COSTLAB
(Mean Rank: lowest to highest)

	1965	1970	1975	1980	1984
Anaheim	13	12	6	5	11
Atlanta	3	1	3	3	5
Austin	2	3	2	2	2
Birmingham	10	6	9.5	6	3
Boston	5	8	5	4	7
Cincinnatti	8	10	7	10	13
Charlotte	1	2	1	1	1
Detroit	14	14	13	13	14
Honolulu	4	4	14	14	4
Minneapolis	11	11	9.5	9	9.5
New Orleans	6	5	4	8	9.5
Philadelphia	7	9	8	7	6
Portland	12	13	11	12	12
Wichita	9	7	12	11	8

State Per Pupil Educational Expenditure: PPUPEXP
(Mean Rank: lowest to highest)

	1965	1970	1975	1980	1984
Anaheim	13	14	8	12	4
Atlanta	3	1	1	7	2
Austin	4	2	3	1	5
Birmingham	1	3	2	3	1
Boston	11	5	6	14	12
Cincinnatti	7	7	7	6	7.5
Charlotte	2	6	5	2	6
Detroit	10	13	14	9.5	7.5
Honolulu	9	8	9	5	14
Minneapolis	6	11	10	8	10
New Orleans	5	4	4	4	3
Philadelphia	12	10	13	13	11
Portland	14	9	11	9.5	13
Wichita	8	12	12	11	9

Persons over Age 25 with Four or more Years of College divided by Population: COLPOP
(Mean Rank: lowest to highest)

	1965	1970	1975	1980	1984
Anaheim	14	14	14	14	14
Atlanta	6	5	7	8	8
Austin	12	13	13	13	13
Birmingham	3	4	4	3	3
Boston	9	9	9	9	9
Cincinnatti	11	11	11	11	10
Charlotte	8	8	8	7	7
Detroit	10	10	10	10	11
Honolulu	1	1	1	1	1
Minneapolis	7	7	6	6	6
New Orleans	5	6	5	5	5
Philadelphia	13	12	12	12	12
Portland	2	2	3	4	4
Wichita	4	3	2	2	2

Appendix I (Continued)

Taxes Paid Per Capita: TAXSTRU
(Mean Rank: lowest to highest)

	1965	1970	1975	1980	1984
Anaheim	3	4	3	1	4
Atlanta	6	1	9	10	9
Austin	2	2	2	3	2
Birmingham	4	3	8	8	3
Boston	14	14	14	14	14
Cincinnatti	10	10	11.5	12	10
Charlotte	5	6	5	4	5
Detroit	12	12	11.5	11	12
Honolulu	11	11	10	7	8
Minneapolis	8	7	6	5	6
New Orleans	9	9	7	9	11
Philadelphia	13	13	13	13	13
Portland	7	8	4	6	7
Wichita	1	5	1	2	1

Income Per Capita: PERCAP
(Mean Rank: lowest to highest)

	1965	1970	1975	1980	1984
Anaheim	14	13	13	14	14
Atlanta	4	1	4	4	4
Austin	5	5	5	6	9
Birmingham	1	2	1	1	1
Boston	13	12	12	10	13
Cincinnatti	10	10	7	8	7
Charlotte	2	3	2	2	2
Detroit	12	11	11	12	8
Honolulu	11	14	14	13	12
Minneapolis	6	8	8	7	11
New Orleans	3	4	3	3	3
Philadelphia	8	9	9	5	6
Portland	9	6	6	9	5
Wichita	7	7	10	11	10

Cost of Single Family Home Per Capita: HOUPOP
(lowest to the highest)

	1965	1970	1975	1980	1984
Anaheim	13	13	12	13	13
Atlanta	1	1	6	6	9
Austin	14	14	14	14	14
Birmingham	10	10	13	9	7
Boston	6	6	2	3	1
Cincinnatti	11	11	10	10	10
Charlotte	12	12	11	12	12
Detroit	4	4	3	2	2
Honolulu	7	7	7	8	3
Minneapolis	3	3	4	4	6
New Orleans	8	8	8	7	8
Philadelphia	2	2	1	1	4
Portland	5	5	5	5	5
Wichita	9	9	9	11	11

Appendix II. Firm Data for Counties in High Technology Industries over Five Periods [Source: County Business Patterns 1965, 1970, 1980, & 1984]

Manufacturing
Drugs (SIC: 283)
(Mean Rank: ranked lowest to highest)

	1965	1970	1975	1980	1984
Atlanta	1	2	1	1.5	8
Boston				8	6
Cincinatti	3	3	4	5.5	4.5
Charlotte				1.5	1
Detroit	4	4	5	4	3
Minneapolis			2.5	3	2
Philadelphia	5	5	6	7	7
Portland	2	1	2.5	5.5	4.5

Summary Statistics for Each Period

	1965	1970	1975	1980	1984
Number of Regions	5	5	6	8	8
Mean	15.4	11.8	8.8	7.6	14.1
Std. Dev.	11.5	8.9	4.4	3.8	16.9
Minimum	6	4	5	3	3
Maximum	15	25	17	13	55

Ordac. & Accessories (SIC: 348)
(Mean Rank: ranked lowest to highest)

	1965	1970	1975	1980	1984
Birmingham	3	2			
Boston	4.5	4	5	1	1.5
Cincinatti	2	1	3		
Charlotte	1				
Detroit	7	5	4		
Minneapolis			1.5	2	3
Philadelphia	6	6	1.5		
Portland	4.5	3			1.5

Summary Statistics for Each Period

	1965	1970	1975	1980	1984
Number of Regions	7	6	5	2	3
Mean	14.8	14.5	3.8	1.5	1.3
Std. Dev.	11.4	9.3	3.5	0.7	0.5
Minimum	3	5	1	1	1
Maximum	33	28	9	2	2

Office Computers & Accessories (SIC: 357)
(Mean Rank: ranked lowest to highest)

Appendix II (Continued)

	1965	1970	1975	1980	1984
Anaheim		1.5	3	5	6
Atlanta			5	5	3
Austin		1.5	3	5	6
Boston	4	7	9	10	10
Cincinatti	1	3.5	6	7	6
Charlotte				3	4
Detroit	3	5	7	8	8
Minneapolis	2	6	8	9	9
Philadelphia		3.5	3	2	1.5
Wichita			1	1	1.5

Summary Statistics for Each Period

	1965	1970	1975	1980	1984
Number of Regions	4	7	9	10	10
Mean	10.5	15	12.3	13.9	15.9
Std. Dev.	5.4	19.2	17.2	18.5	23.8
Minimum	5	2	2	2	3
Maximum	18	56	55	62	80

Electrical & Electrical Machinery (SIC: 36)
(Mean Rank: ranked lowest to highest)

	1965	1970	1975	1980	1984
Anaheim	2.5	3.5	4.5	4.5	6.5
Atlanta	6	7	6	6	5
Austin	2.5	3.5	4.5	4.5	6.5
Birmingham	4	5	3	7.5	4
Boston	12	13	13	14	14
Cincinatti	8	9	9	10	10
Charlotte	5	6	7	7.5	8
Detroit	10	11	10	11	11
Honolulu				3	2
Minneapolis	9	10	12	13	13
New Orleans		2	1.5	2	1
Philadelphia	11	12	11	12	12
Portland	7	8	8	9	9
Wichita	1	1	1.5	1	3

Summary Statistics for Each Period

	1965	1970	1975	1980	1984
Number of Regions	12	13	13	14	14
Mean	57.2	64.9	61.3	60.4	63.0
Std. Dev.	64.1	76.3	69.5	74.0	73.5
Minimum	6	9	14	1	8
Maximum	188	266	261	284	288

Guided Missles, Space Vehicles & Parts (SIC: 376)
(Mean Rank: ranked lowest to highest)

Appendix II (Continued)

	1965	1970	1975	1980	1984
Boston			1.5	1.5	
Cincinatti			1.5	1.5	
New Orleans			3.5	3	1
Philadelphia			3.5	4	2

Summary Statistics for Each Period

	1965	1970	1975	1980	1984
Number of Regions			4	4	2
Mean			1.5	1.7	1.5
Std. Dev.			0.5	0.9	0.7
Minimum			1	1	1
Maximum			2	3	2

Miscellaneous Transportation Equipment (SIC: 379)
(Mean Rank: ranked lowest to highest)

Atlanta				1.5	1
Boston			1.5	3.5	
Charlotte		1			
Detroit		2.5	4	6	3
Minneapolis	5	3	5	2	
Philadelphia	2.5	1.5	3.5		
Portland	4	1.5	1.5		

Summary Statistics for Each Period

	1965	1970	1975	1980	1984
Number of Regions		5	4	6	3
Mean		5.8	3.7	3.1	5
Std. Dev.		3.6	0.9	2.2	4
Minimum		1	3	1	1
Maximum		11	5	7	9

Instruments & Related Products (SIC: 38)
(Mean Rank: ranked lowest to highest)

	1965	1970	1975	1980	1984
Anaheim	5	3.5	5.5	6.5	9.5
Atlanta	5	5	7	4.5	6
Austin	5	3.5	5.5	6.5	9.5
Birmingham	1.5	1.5	1	1	4
Boston	11	13	13	13	7
Cincinnatti	8	9	9	9	11
Charlotte	1.5	1.5	3	4.5	5
Detroit	10	10	10	10	12
Honolulu					2
Minneapolis	9	11	11	12	14
New Orleans		6	2	2	1

Appendix II (Continued)

Philadelphia	12	12	12	11	13
Portland	7	8	8	8	8
Wichita	3	7	4	3	3

Summary Statistics for Each Period

	1965	1970	1975	1980	1984
Number of Regions	12	13	13	13	14
Mean	30.5	32.0	41.5	42.3	28.75
Std. Dev.	30.5	33.7	49.5	51.0	20.9
Minimum	5	7	9	7	9
Maximum	97	111	187	196	80

Services
(Mean Rank: ranked lowest to highest)

	1965	1970	1975	1980	1984
Anaheim	1.5	1.5	2.5	2.5	3.5
Atlanta	9	10	9	10	10
Austin	1.5	1.5	2.5	2.5	3.5
Birmingham	6	6	5	5	6
Boston	12	12	12	12	14
Cincinnatti	10	9	10	9	9
Charlotte	3	4	4	4	2
Detroit	14	14	14	14	13
Honolulu	5	5	7	7	7
Minneapolis	11	11	11	11	11
New Orleans	7	7	6	5	5
Philadelphia	13	13	13	13	12
Portland	8	8	8	8	8
Wichita	4	3	1	1	1

Summary Statistics for Each Period

	1965	1970	1975	1980	1984
Number of Regions	14	14	14	14	14
Mean	4583.0	4695.5	4959.9	5469.3	5868.3
Std. Dev.	3408.9	3064.5	2633.8	2482.0	2775.5
Minimum	1746	1958	2219	2561	2666
Maximum	13317.0	11851	10932	10387	11350

Business Services (SIC: 73)
(Mean Rank: ranked lowest to highest)

	1965	1970	1975	1980	1984
Anaheim	1.5	2	3	3	5
Atlanta	10	10	10	12	12
Austin	1.5	2	2	1	1

Appendix II (Continued)

Birmingham	4	4	4	4	3
Boston	11	11	11	13	14
Cincinnatti	8	9	9	9	9
Charlotte	5	5	5	6	6
Detroit	14	14	14	11	11
Honolulu	6	6	7	7	7
Minneapolis	12	12	12	14	13
New Orleans	7	7	6	5	4
Philadelphia	13	13	13	10	10
Portland	9	8	8	8	8
Wichita	3	2	1	2	2

Summary Statistics for Each Period

	1965	1970	1975	1980	1984
Number of Regions	14	14	14	14	14
Mean	437.7	541.2	682.0	821.1	932.2
Std. Dev.	315.9	339.4	359.8	434.9	567.1
Minimum	148	210	270	219	334
Maximum	1181	1218	1232	1571	2372

Data Processing (SIC: 737)
(Mean Rank: ranked lowest to highest)

	1965*	1970*	1975	1980	1984
Anaheim			3.5	5	7.5
Atlanta			12	12	12
Austin			3.5	5	7.5
Birmingham			6	2	3
Boston			14	14	14
Cincinnatti			8	11	10
Charlotte			7	5	3
Detroit			10	10	11
Honolulu			5	7	5
Minneapolis			13	13	13
New Orleans			2	1	1
Philadelphia			11	8	6
Portland			9	9	9
Wichita			1	3	3

Summary Statistics for Each Period

	1965	1970	1975	1980	1984
Number of Regions			14	14	14
Mean			42.8	81.1	106
Std. Dev.			34.0	65.9	123
Minimum			10	28	29
Maximum			139	276	512

Consulting & Public Relations (SIC: 739)
(Mean Rank: ranked lowest to highest)

Appendix II (Continued)

	1965	1970	1975	1980	1984
Anaheim	2.5	5	5.5	4	7.5
Atlanta	10	10	11	12	12
Austin	2.5	5	5.5	4	7.5
Birmingham	1	2	3	2	3
Boston	12	13	14	14	14
Cincinnatti	9	9	9	9	10
Charlotte	5	5	4	4	3
Detroit	14	12	10	10	11
Honolulu	6	7.5	8	7	5
Minneapolis	11	11	13	13	13
New Orleans	8	3	2	6	1
Philadelphia	13	14	12	11	6
Portland	7	7.5	7	8	9
Wichita	4	1	1	1	3

Summary Statistics for Each Period

	1965	1970	1975	1980	1984
Number of Regions	14	14	14	14	
Mean	69.5	119.2	105.9	143.0	200.0
Std. Dev.	52.1	79.4	69.0	94.9	238.5
Minimum	23	42	33	45	46
Maximum	194	265	248	345	984