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THE DETERMINANTS OF THE GEOGRAPHICAL DISTRIBUTION OF THE FORMATION OF NEW AND SMALL TECHNOLOGY-BASED FIRMS

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Major professor

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THE DETERMINANTS OF THE GEOGRAPHICAL DISTRIBUTION OF THE FORMATION OF NEW AND SMALL TECHNOLOGY-BASED FIRMS

By

Stephen Geoffrey Graham

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ABSTRACT

THE DETERMINANTS OF THE GEOGRAPHICAL DISTRIBUTION OF THE FORMATION OF NEW AND SMALL TECHNOLOGY-BASED FIRMS

By

Stephen Geoffrey Graham

The problem addressed by this research study is to identify the factors or conditions which explain the pronounced variation in the distribution among geographical subdivisions of the U.S. of the formation of new and small technology-based firms (NSTBF). In addition, this study attempts to develop the policy implications of these factors for guiding efforts to stimulate the economic development of individual states of the U.S. and/or their geographical subdivisions.

Step-wise multiple regression was used to select the set of determinants or factors (independent variables) which best explained the number of new and small technology-based firms (NSTBF) formed in each standard Metropolitan Statistical Area of the U.S. (dependent variable). Data were obtained on the number of new firms formed. Technology-based firms were selected from these data by identifying those Standard Industrial Classifications (SIC's) which were technology-intensive. Data were developed (and arrayed) on the number of engineers and scientists (in the life and physical sciences) employed as a percentage of total employment for each SIC. Data

also were developed (and arrayed) on the ratio of research and development expense to sales for the firms in each SIC. For each array, the SIC's with data equal to or greater than a level selected on the basis of judgment were deemed technology-intensive, and the selected SIC's from the two arrays were merged.

This list of technology-intensive SIC's was purged of SIC's found to be capital intensive. The size of the average investment made by all venture capitalists was determined. Then all SIC's with firms whose net worth exceeded that average investment size were removed from the list of technology-intensive SIC's, leaving a list of SIC's defining NSTBF.

The independent variables used in the multiple regression were:

- The number of existing small and technology-based firms.
- The number of technology-intensive universities, nonprofit research institutions, and industrial firms.
- The research and development expenditures of those establishments.
- The number of earned Ph.D. and Master's degrees awarded in science and engineering.
- Federal obligations to universities and colleges for technology-based fellowships, traineeships, and training grants.

- The number of universities and colleges receiving such grants.
- The number of patents issued.
- State taxes.
- Union strength.
- Strike severity.
- Labor cost.
- Energy costs.

The results of this study show that the number of technology-intensive universities, nonprofit research institutions, and industrial firms is the principal determinant of the geographical distribution of the formation of NSTBF. A second determinant is the number of earned Ph.D. and Master's degrees in science and engineering conferred by universities and colleges. These two factors explained 76% and 2%, respectively, of the variability in the geographical distribution of the formation of NSTBF. Each of the other factors explained 1% or less of that variability.

This study has policy implications. It provides policy guidance for the promotion of economic growth in any geographical area of the U.S. It facilitates the identification of those geographical areas of the U.S. most conducive to economic stimulation. It demonstrates the ineffectiveness of certain methods of increasing the rate of formation of NSTBF presently in use. Efforts to optimize the conditions traditionally considered when attempting to attract industry to a geographical area will not increase the rate of formation of NSTBF in that area.

TABLE OF CONTENTS

page

LIST OF TABLES

page

page

CHAPTER I

INTRODUCTION

A. Summary

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B. The Venture Capital Industry

Venture capital is the equity and long-term debt financing of new and small enterprises organized to produce and to market new, unconventional, high-technology products and services having high long-run growth potential.

Rubel[1] has classified the types of financing offered by venture capital firms as follows:

Start-ups. Businesses that are still as the idea stage. According to Deloitte, Haskins and Sells, the prototype may have been developed, but operations have not begun.[2]

First-stage financing. Companies up to one year old, usually losing money, and for which profits could be one to three years in the future.

Second-stage financing. Companies generally one to three years old, which are either about to the break-even stage or are projecting profits within one year.

Third-stage financing. This is usually considered to be the last round of private financing, and at this stage the company is likely to be in the black.

Buy-out or acquisition financing. Such projects include financing the acquisition of a company to be operated as a division of another company, or financing the purchase of a business from a family that wishes to sell that business, and so forth.

The firms making venture capital available are organized in a variety of ways--as partnerships, corporations, divisions of major corporations, publicly held venture firms, venture capital funds formed within bank trust departments, divisions of investment banking firms, venture capital divisions of insurance companies, pension funds or investment advisory firms, and a variety of others.

According to Deloitte, Haskins, and Sells, the term venture capital should exclude marginal loans.[3] These are loans made under various federal and state programs. Such loans are either made directly by governmental units or by private financial institutions with a full or partial guarantee provided by a governmental unit. Many of these programs are not designed to aid new and small technology-based firms (NSTBF), and inclusion of these programs would only serve to confuse the available data on venture firms.

C. Grants Received

The cost of this research study was partially supported by two grants. One was a Faculty Research Grant received from Ferris State College, Big Rapids, Michigan. The other grant was received from the Office of Economic Research of the Small Business Administration, Washington, D.C.

CHAPTER II

REVIEW OF THE LITERATURE

Much of the research on the subject of venture capital has concluded that the lack of venture capital has been a major barrier to increased economic growth.

In 1976, the Governor of Michigan formed the Governor's Advisory Commission on the Regulation of Financial Institutions. One of the charges to the Commission was to explore financing mechanisms that might encourage the development of new high-growth enterprises in Michigan. According to the Commission, the reason for that charge was as follows:

"That Michigan's economy could benefit from active and successful entrepreneurs is not difficult to argue. Our historical economic base, durable goods manufacturing, has been moving out--moving to the "sun belt" states, which appear to offer lower labor costs. For Michigan this movement could lead to economic stagnation and increased unemployment. New sources of growth are a prerequisite to the State's economic health."[1]

The Commission concluded that the two major needs of entrepreneurs, management assistance and capital, are not being met in Michigan. It recommended "...that the state establish a new business development corporation (NBDC) charged with the objective of developing new enterprises with high growth potential which are or will be located in Michigan, in order to increase employment opportunities in the state in the long run."[2] It suggested that the NBDC's activities should include making venture capital and managerial assistance available to new enterprises in Michigan. These conclusions were based on the results of a study performed for the Commission by the accounting firm of Deloitte, Haskins, and Sells.[3]

In 1974, Brophy studied the role of finance in the development of new and small technology-based firms (NSTBF) in Michigan. His purpose was to improve "the availability of finance for technologically innovative profit-oriented ventures in Michigan."[4] Although his conclusions and recommendations were directed toward Michigan's unique problems, his general conclusions and recommendations were (1) that the rate of formation of NSTBF is greatest in places where interaction exists between research universities, nonprofit research laboratories, and private research-oriented firms; (2) that the lack of adequate local access to venture capital is one of the most serious barriers to the successful development of NSTBF; and (3) that any state can increase the rate of formation of NSTBF by creating some form of business development corporation, one of whose purposes would be to make venture capital available to NSTBF.

Chastain and DeVries[5] attempted to determine whether firms whose business is based on substantial research and development (not solely research and development) have more difficulty than general manufacturing firms in securing capital in Michigan. Specifically, the study contrasted the problems of initial financing for new R and D firms with those of new manufacturing firms and with the problems of financing expansion by older manufacturing firms.

The authors found that new R and D firms went out of state for most of their long-term debt and equity capital, while most of the new and established manufacturing firms secured their capital in-state. The study findings suggest that new R and D firms have had difficulty in establishing an understanding with the sources of capital in Michigan. The findings also suggest that, since R and D firms are characterized by high rates of growth, greater availability of capital to R and D firms could provide substantial economic benefits to Michigan.

It can be shown that NSTBF tend to be clustered in a few urban areas of the U.S.: Los Angeles, San Francisco, New York City-Northern New Jersey, Boston, Washington, D.C., and Ann Arbor, Michigan.[6] A number of researchers have suggested reasons for this clustering. Roberts[7] and Cooper[8] studied the Boston and San Francisco area clusters, respectively, and concluded that NSTBF are formed as "spin-offs" from technology-intensive universities, nonprofit research laboratories, and industrial firms which, through interaction, provide a local environment conducive to entrepreneurship and the formation of NSTBF. "Roberts and others have made the point that new and small technology-based firms usually come into existence because of some deficiency in the ability of large technology-based organizations to provide a sufficiently stimulating and rewarding entrepreneurial environment for its technologically innovative personnel. This implies that large organizations (whether industrial firms, universities, or nonprofit research laboratories) have not been, as a rule, as aggressive as possible in innovation."[9]

The interaction, referred to above by Brophy, Cooper, and Roberts, among technology-intensive universities, nonprofit research laboratories, and industrial firms has been described by Mahar and Coddington. They found that scientific complexes grow (1) from within via the "spin-off" process and (2) by attracting branch plants and research facilities. Internal growth by means of spin-offs is accelerated when there is extensive interaction among the elements of the scientific complex (universities, nonprofit research institutions, and industrial firms). "This interaction is achieved in various ways, such as consulting relationships between industry and faculty members, university-industry seminars, special courses for practicing scientists and engineers, board of directorships for faculty members, and adjunct professorships for industry and government personnel."[10]

Lamont has identified other forms of interaction among the three types of source organizations. Many spin-off firms are formed by founders coming from more than one source organization, e.g., university-industry combinations.[11] Moreover, "...university and primary industry spin-offs have in turn seeded the scientific complex by serving as source organizations for secondary spin-offs...."[12]

Shimshoni is describing interaction when he refers to the increased probability of diffusion of ideas and techniques in scientific complexes through chance encounters with knowledgeable local individuals, often through social and professional contacts.[13]

A study by the U.S. Department of Commerce found close, frequent consultations among technical people, entrepreneurs, universities, venture capital sources, and others essential to the innovative process, (i.e., interaction) to be a vitally important factor in the formation of spin-off firms.[14]

Other researchers have concluded that a dominant factor in the clustering of technology-based industry is the distribution of federal government R and D funding.[15]

According to Clark,[16] the factor which best explains this clustering is the cost of acquiring relevant technologies, which increases in direct proportion to the time required to obtain the technologies. The time required, in turn, is a function of geographical distance from the relevant technological infrastructure.

In 1963, Spiegelman[17] surveyed 45 precision instrument manufacturers in California, Oregon, New York, Massachusetts, and Illinois to determine which of the various possible determinants of plant location were the most important to them. "It is clear from the pattern of responses that, besides 'personal considerations,' the factors that are most important in determining location are 'availability of professional staff' and 'availability of labor of required skill or ability;' of lesser importance are proximity to educational, testing, and research facilities, and to suppliers and markets for reasons other than transport cost.

"The three factors listed as unfavorable by largest number of firms are: 'labor cost, other than professional and managerial,' 'land availability and cost,' and 'taxation.' Since most of the firms surveyed are in large metropolitan areas, where wage rates, land costs, and property taxes tend to be relatively high,...they may be regarded as the costs for obtaining the advantages of availability of labor and various services and institutions, of proximity to markets and suppliers, and of amenities that attract professional personnel."

Since Spiegelman's survey was not conducted by statistical sampling techniques, his results could not be generalized to the entire industry. However, he believed that his survey data are strongly suggestive of the location behavior of the entire industry, since all sectors of the precision instruments industry were represented.

Cooper[18] has also concluded that another essential factor accounting for clusters of NSTBF in selected areas is the existence within those clusters of pools of experienced and successful technological entrepreneurs. Such pools reduce the perceived risk associated with technological entrepreneurship.

Two directories of venture capital firms, prepared by Rubel[19] and Dominguez,[20] are available. These directories provide such information as name, location, type of venture capital firm, preference as to investment size, industry preference, stage of financing, etc.

CHAPTER III

METHOD OF RESEARCH

A. Summary

The principal hypothesis tested by this study is that it is possible to identify the determinants of the geographical distribution of the formation of new and small technology-based firms (NSTBF) at the start-up stage of financing. These firms need venture capital both at the start-up stage of financing and at later stages of financing prior to having access to the public capital markets. In this study, however, the research on the demand for venture capital is confined to the venture capital needs of NSTBF at the start-up stage of financing.

The literature on venture capital provides a rich source of factors which could explain the geographical distribution of the formation of NSTBF. A step-wise multiple regression program was used to select the set of those factors (independent variables) which best explained the geographical distribution of the formation of NSTBF (dependent variable).

B. The Dependent Variable

The dependent variable was measured by the number of NSTBF formed in 1975 in each Standard Metropolitan Statistical Area or New England County Metropolitan Area (SMSA/NECMA) of the U.S. A SMSA/NECMA is one or more counties including a major city, as defined by the Bureau of the Census of the U.S. Department of Commerce. No ready source of the number of NSTBF formed annually was (or is) available. Therefore, the data were obtained in the following manner. First, the total number of firms formed, by SMSA/NECMA, was obtained. The technology-based firms were selected from these data by identifying those Standard Industrial Classifications (SIC's) which were technology-intensive. Two methods were used to array the SIC codes by technology-intensiveness.

Under one method, the number of engineers and scientists (in the life and physical sciences) employed as a percentage of total employment was calculated for each SIC. The SIC's above the 9th decile of that array of percentages were deemed technology-intensive.

The other method involved the calculation of the ratio or research and development expense to sales ((R&D)/S) for each firm in Standard and Poor's Compustat Tape. Those data were then sorted by SIC code, and the (R&D)/S ratios were calculated for each SIC code. These ratios, by SIC code, were then arrayed. The SIC's above the 9th decile of that array of ratios were deemed technology-intensive.

The two lists of technology-intensive SIC's were merged and subjected to two different completeness tests. The technology-intensive SIC's were thus identified.

Finally, that list was purged of SIC's which represented capital-intensive industries, because the NSTBF must be small enough so that the typical venture capitalist will be able to finance them. The size of the average investment made by all venture capitalists was determined. Then all SIC's with firms whose net worth exceeded that average investment size were identified. Those SIC's were deemed capital-intensive and were removed from the list of technology-intensive SIC's. The remaining list of SIC's identified new and small technology-based firms (NSTBF).

1. Number of Firms Formed in 1975

The only source of data on the number of firms formed in a given year and classified by Standard Industrial Classification (SIC) and by geographical detail is the Dun and Bradstreet Reference Book.[1] That book contains the following information for each of some 5 to 6 million business establishments in the U.S.: state, county, city, name of firm, credit rating, a four-digit SIC code, and a one-digit code identifying the year the firm was formed, provided that year occurred within the past ten years. Dun's Marketing Services, a subsidiary of Dun and Bradstreet Corporation, sorted these 5 to 6 million firms to select those firms formed in 1975, and tabulated the number of such firms by SMSA/NECMA and by SIC.

This tabulation was designed to exclude all firms engaged in retail and wholesale trade (SIC 5000-5999). An assumption was made that, by definition, retail and wholesale trade firms cannot be NSTBF. Since they handle the more conventional products and services, they have only normal growth potential. As noted earlier, NSTBF are firms organized to produce and market new, unconventional, high-technology products and services which are expected to have relatively high growth potential. Another reason for excluding retail and wholesale trade firms was the high number of such firms--the handling of data for 167,000 of such newly formed firms was avoided. This is the difference between the 326,000 firms formed in 1975 according to the Statistical Abstract of the U.S.[2] and the 159,000 firms, exclusive of retail and wholesale firms, formed in 1975 according to the Dun's Marketing Services tabulation referred to above.

2. Technology-Intensive Firms

a. Data from the Census of Population

In addition to being new firms, NSTBF must also be technology-intensive. It was possible to array the SIC codes by technology-intensiveness by use of detailed occupation and detailed industry data in the 1970 Census of Population.[3] For each SIC category, the number of engineers and scientists (in the life and physical sciences only) employed was expressed as a percentage of the total employment (age 16 and over). See Table 2 for these data. These 155 SIC categories (groups of SIC's) were arrayed on the basis of the number of scientists and engineers as a percentage of total employment. By judgment, the seventeen, SIC categories with percentages of 6.56% and higher were deemed to be technology-intensive. See Table 3 for an array of those percentages. See Appendix Table A1 for a complete array of SIC categories by number of engineers and scientists as a percentage of total employment. Table 1 summarizes that complete array.

Table 1

Summary of Array of Number of Engineers and Scientists as Percentage of Total Employment, by SIC Category, 1970

	Percentage
Highest value	27.15
9th Decile	7.12
8th "	4.80
7th "	3.48
6th "	2.35
5th "	1.49
4th "	0.91
3rd "	0.46
2nd "	0.23
1st "	0.11
Lowest value	0.01

Table 2

Calculation of Number of Engineers and Scientists as a Percentage of Total Employment, by SIC Category, 1970

		Engineers and Scientists			
SIC Category	Total Employed	Engineers	Life and Physical Scientists	Total	Percentage of Total Employed
Total, All Industries	76,553,599	1,207,509	202,489	1,409,998	1.84%
01, 02	2,274,873	747	1,313	2,060	.09
0711-0762	141,375	95	991	1,086	.77
078	129,699	167	1,054	1,221	.94
08	53,847	1,972	822	2,794	5.19
09	36,699	244	332	576	1.57
10	91,904	2,362	2,089	4,451	4.84
11,12	136,976	1,258	259	1,517	1.11
13	271,186	13,897	11,195	25,092	9.25
14	103,858	1,325	516	1,841	1.77
15	908,330	11,716	95	11,811	1.30
16	963,692	59,860	1,329	61,189	6.35
17	1,857,392	12,481	143	12,624	.68
201	280,252	1,319	299	1,618	.58
202	158,878	837	183	1,020	.64
203	198,833	1,656	927	2,583	1.30
204	118,258	1,017	864	1,881	1.59
205	163,866	805	124	929	.57
206	69,209	462	208	670	.97
208	201,272	1,450	1,177	2,627	1.31
209	136,051	1,713	1,190	2,903	2.13
207	63,720	1,538	1,045	2,583	4.05
21	69,248	568	408	976	1.41
225	197,278	562	81	643	.33

Table 2 (continued)

226	46,353	430	228	658	1.42%
227	54,340	414	80	494	.91
221-4,228	610,294	4,386	933	5,319	.87
229	56,704	552	175	727	1.28
231-238	1,101,115	2,212	56	2,268	.21
239	118,061	500	40	540	.46
241	125,593	326	17	343	.27
242,243	334,935	1,446	94	1,540	.46
244,245,249	92,596	545	71	616	.67
25	425,269	2,679	64	2,743	.65
261-263	313,165	6,170	1,433	7,603	2.43
264,266	145,416	2,077	468	2,545	1.75
265	191,305	1,828	108	1,936	1.01
271	422,657	321	35	356	.08
272-279	768,967	2,490	297	2,787	.36
281,286	228,280	14,688	8,848	23,536	10.31
2821,2822,2824	79,660	3,816	1,859	5,675	7.12
2823	71,602	3,193	826	4,019	5.61
283	139,862	2,754	8,562	11,316	8.09
284	103,445	2,323	2,285	4,608	4.45
285	63,571	940	2,744	3,684	5.80
287	44,198	1,051	1,253	2,304	5.21
289	80,887	2,821	2,000	4,821	5.96
291	189,421	11,720	4,138	15,858	8.37
295,299	21,283	504	324	828	3.89
301-4,306	284,261	7,540	2,026	9,566	3.37
307	239,998	4,986	664	5,650	2.35
311	23,182	163	95	258	1.11
314	205,116	546	31	577	.28
313,315-317,319	54,206	248	28	276	.51
321-323	183,851	3,374	614	3,988	2.17
324,327	185,243	2,972	870	3,842	2.07
325	55,999	571	264	835	1.49

Table 2 (continued)

326	41,504	762	94	856	2.06%
328,329	121,312	3,241	564	3,805	3.14
331	533,407	10,677	3,831	14,508	2.72
332	334,220	5,712	1,257	6,969	2.09
3334	141,732	4,025	773	4,798	3.39
3331-3,3339,334-336, 339	202,492	5,209	1,463	6,672	3.29
342	123,473	2,408	104	2,512	2.03
344	384,195	10,253	427	10,680	2.78
3451	76,384	1,467	100	1,567	2.05
3465,3469	140,682	2,594	80	2,674	1.90
349	375,682	8,554	744	9,298	2.47
341,343,3452,3462,3463,3466,347,348	83,138	3,500	492	3,992	4.80
351	95,179	5,896	197	6,093	6.40
352	133,977	4,662	101	4,763	3.56
353	262,766	12,930	281	13,211	5.03
354	319,049	11,860	342	12,202	3.82
3572,3574,3576,3579	131,367	7,640	372	8,012	6.10
3573	186,658	21,080	690	21,770	11.66
3599	820,933	36,141	789	36,930	4.50
355,356,358,3592	41,113	3,095	136	3,231	7.86
363	188,597	5,388	112	5,500	2.92
365,366	544,143	58,382	1,095	59,477	10.93
3699	987,208	69,546	2,344	71,890	7.28
361,362,364,367,3691-4	184,977	21,520	586	22,106	11.95
371	1,012,307	30,693	941	31,634	3.12
372	706,149	101,044	2,179	103,223	14.62
373	259,340	10,711	466	11,177	4.31
374	52,740	1,986	52	2,038	3.86

Table 2 (continued)

3792	82,851	448	10	458	.55%
375,376,3795,3799	25,483	626	12	638	2.50
381,382	118,425	10,697	453	11,150	9.42
383-385	123,793	4,771	695	5,466	4.42
386	95,657	6,859	1,403	8,262	8.64
387	27,969	623	44	667	2.38
40	636,572	4,597	157	4,754	.75
412	118,385	35		35	.03
421	955,650	1,155	39	1,194	.12
422	126,880	274	19	293	.23
44	161,890	7,655	5	7,660	4.73
45	384,294	3,504	310	3,814	.99
46	12,685	592	25	617	4.86
47	98,638	706	10	716	.73
483	130,956	7,968	210	8,178	6.24
481	899,997	34,801	167	34,968	3.89
482,489	42,710	1,534	37	1,571	3.68
491,492,493	556,750	32,225	822	33,047	5.94
496	126,553	3,122	168	3,290	2.60
494	121,331	4,329	889	5,218	4.30
495	177,421	2,092	623	2,715	1.53
497	14,280	745	126	871	6.10
60	1,006,942	885	85	970	.10
61	285,491	290	76	366	.13
62	268,817	468	79	547	.20
63,64	1,331,005	6,160	53	6,213	.47
65,66	750,529	1,655	100	1,755	.23
731	144,921	268	122	390	.27
734	166,561	233	89	322	.19
7391,7397	118,427	17,778	8,680	26,458	22.34
736	110,594	394	42	436	.39
7392	152,653	9,874	147	10,021	6.56
7372	92,762	3,501	149	3,650	3.93

Table 2 (continued)

7393	89,543	286	14	300	.34
751,752,754	137,463	196	16	212	.15
753	425,968	137	5	142	.03
762	135,905	1,337	46	1,383	1.02
763,764,769	245,556	1,061	60	1,121	.46
88	1,126,016	43	64	107	.01
701	564,426	602	22	624	.11
702-704	103,295	58	23	81	.08
721	533,482	348	31	379	.07
723	476,865	18	26	44	.01
724	169,305	43	6	49	.03
725	27,156	5	6	11	.04
729	164,346	165	23	188	.11
781,783	202,072	830	79	909	.45
793	69,538	52	8	60	.09
782,791,792,794, 799	302,092	335	158	493	.16
801,803	476,850	939	346	1,285	.27
802	221,862	307	35	342	.15
8041	18,504	64		64	.35
806	2,689,722	3,461	8,821	12,282	.46
805	509,401	173	59	232	.05
8042,8049	41,668	45	16	61	.15
807,809	288,180	2,341	5,683	8,024	2.78
81	385,676	1,802	42	1,844	.48
821	4,189,957	1,474	1,471	2,945	.07
822	1,624,559	9,505	15,884	25,389	1.56
823	117,139	105	26	131	.11
829	181,699	267	172	439	.24
824	1,524	24	29	53	3.48
84	32,922	112	498	610	1.85
866	468,961	745	34	779	.17

Table 2 (continued)

832,833,835,839	343,148	522	114	636	.19
836	39,287	44	26	70	.18
861-865,869	312,019	2,461	240	2,701	.87
891	309,162	82,642	1,289	83,931	27.15
893	281,231	2,744	59	2,803	1.00
899	193,784	12,320	13,329	25,649	13.24
43	419,133	1,069	26	1,095	.15
91-97	3,332,167	104,368	29,603	133,971	4.02
5000-5999 (Memo)					.33

Source: 1970 Census of Population, Subject Reports, Detailed Occupation by Detailed Industry, Series No. PC(2)-7C-Table 8.

Table 3

Portion of Array of Technology-Intensive SIC Categories by Number of Engineers and Scientists as a Percentage of Total Employment, 1970, 6.56% and Higher

Percentage	SIC Category	Description
27.15%	891	Engineering & architectural svs.
22.34	7391,7397	Commercial research, development & testing labs.
14.62	372	Aircraft & parts
13.24	899	Misc. professional & related svs.
11.95	361,362,364,367 3691,3694	Electrical mach'y., equip. & supplies--not specified
11.66	3573	Electronic computing equipment
10.93	365,366	Radio, television & communications equipment
10.31	281,286	Industrial chemicals
9.42	381,382	Scientific & controlling instruments
9.25	13	Crude petroleum & natural gas extraction
8.64	386	Photographic equipment & supplies
8.37	291	Petroleum refining
8.09	283	Drugs & medicines
7.86	355,356,358,3592	Mach'y.--not specified
7.28	3699	Electrical mach'y., equipment & supplies NEC
7.12	2821,2822,2824	Plastics, synthetics & resins, exc. fibers
6.56	7392	Business management & consulting svs.

Source: Appendix Table A1

b. Data from Standard and Poor's Compustat Tape

Another means used to identify technology-intensive firms was the ratio of research and development expense to sales, (R&D)/S. These data were obtained from the 1977 Standard and Poor's Compustat Tape.[4] This tape contains financial statement data on all firms whose common stock is traded on the New York and American Stock Exchanges plus about 300 additional firms of interest to researchers, investors, etc. A computer program was developed to calculate an (R&D)/S ratio for all firms combined in each SIC code. These 179 ratios were then arrayed. Again, by judgment, the seventeen SIC's with (R&D)/S ratios of .029 and higher were deemed to be technology-intensive. See Table 5 for an array of those ratios. See Appendix Table A2 for a complete array of SIC's by (R&D)/S ratios. Table 4 summarizes that array.

Table 4

Summary of Array of (R&D)/S Ratios, by SIC, 1980

	Ratio
Highest value	.084
9th Decile	.029
8th "	.020
7th "	.013
6th "	.008
5th "	.005
4th "	.003
3rd "	.002
2nd "	.000*
1st "	.000*
Lowest value	.000*

*Less than .0005

Table 5

Portion of Array of Technology-Intensive SIC's by (R&D)/S Ratios, 1980, Above 9th Decile

SIC	Description	$Millions R&D	$Millions Sales	(R&D)/S Ratio
3825	Electr meas & testing instrs	55.3	659.5	.084
3823	Industrial meas instrs	180.2	2,935.0	.061
3728	Aircraft parts & aux equip.	373.9	6,226.6	.060
3861	Photographic equip & supplies	646.6	11,595.4	.056
357	Office computing & acctg machs	1,765.9	31,261.0	.056
3573	Electronic computing equip.	569.0	10,187.9	.056
3661	Telephone & telegraph apparatus	68.3	1,249.6	.055
367	Electronic components & accessories	271.9	5,103.4	.053
283	Drugs	1,051.5	20,176.9	.052
3811	Engrg lab & research equip	84.0	2,053.2	.041
3721	Aircraft	392.5	10,344.4	.038
3841	Surg & med instrs & apparatus	247.1	6,822.8	.036
3662	Radio-TV transmitting equip & appar	221.1	6,374.4	.035
3651	Radio-TV receiving sets	533.3	17,096.2	.031
3843	Dental equip & supplies	6.4	214.3	.030
383	Optical instrs & lenses	24.6	816.8	.030
737	Computer & data processing svs	26.1	886.4	.029

Source: Appendix Table A2

The list of SIC codes based on the number of engineers and scientists as a percentage of total employment and the list of SIC codes based on (R&D)/S ratios were merged and are shown in Table 6.

c. Completeness Tests

Two means of testing the list of technology-intensive SIC's for completeness were used. Each firm listed in the 1979 Directory of the American Electronics Association[5] was classified with a 4-digit SIC code. Those SIC codes with five or more member firms accounted for two-thirds of the membership. All of those SIC's appeared on the list of technology-intensive SIC codes in Table 6.

In addition, the firms listed in the 1980 Directory of Research, Development, and Testing Facilities in Michigan prepared by the Industrial Development Division, Institute of Science and Technology, The University of Michigan,[6] were classified by 4-digit SIC code on a test basis (about one-half of the firms). Over one-half of the SIC's of these tested firms were on the list of technology-intensive SIC's. The remainder of the SIC's appeared to be not relatively technology-intensive, based on the nature of the industries involved.

3. Capital-Intensive Firms

Although they must be technology-intensive, NSTBF must not be capital-intensive. In other words, they must

Table 6

Technology-Intensive and Capital-Intensive SIC's

Technology-Intensive SIC's (1)	No. of Small Firms (2)	Technology-Intensive SIC's (1)	No. of Small Firms (2)
		3641	4
1311	120	3643	7
1321	0 X	3644	3
1381	36	3645	10
1382	9	3646	5
1389	55	3647	1
2812	1	3648	0 X
2813	1	3651	5
2816	2	3652	4
2819	5	3661	5
2821	16	3662	38
2822	2	3671	0 X
2824	0 X	3672	0 X
2831	1	3673	1
2833	6	3674	17
2834	13	3675	0 X
2861	2	3676	0 X
2865	1	3677	4
2869	5	3678	0 X
2911	5	3679	60
3551	15	3691	3
3552	8	3692	1
3553	7	3693	2
3554	7	3694	2
3555	8	3699	6
3559	21	3721	2
3561	12	3724	4
3562	1	3728	14
3563	5	3811	14
3564	7	3822	6
3565	3	3823	7
3566	12	3824	3
3567	11	3825	10
3568	3	3829	4
3569	18	3832	6
3572	0 X	3841	5
3573	19	3843	4
3574	2	3861	10
3576	1	7372	12
3579	3	7374	20

Table 6 (continued)

3581	1	7379	5
3582	1	7391	17
3585	17	7392	56
3586	0 X	7397	10
3589	12	8911	129
3592	2	8999	4
3612	5		
3613	8		
3621	5		
3622	7		
3623	5		
3624	2		
3629	9		

X - Capital-Intensive industry

(1) - Merger of SIC's above 9th decile on the number of engineers and scientists as a percentage of total employment (Table 3) and on list of SIC's based on (R&D)/S ratios (Table 5).

(2) - Number of firms classified in this SIC only and with a net worth between $500,000 and $1,000,000 in 1980. Source: Dun & Bradstreet, Inc., Million Dollar Directory, Vol. II, 1980, New York, N.Y.

be small enough so that the typical venture capitalist will be able to finance them. Data for fiscal year 1976 on average investment size was secured from Rubel's Guide to Venture Capital Firms.[7] Of the 352 venture capital firms for which such data were available, about 90% of them invested less than $1 million per investment. The average investment size was approximately $600,000. Volume II of the Million Dollar Directory for 1980 published by Dun and Bradstreet[8] lists alphabetically all firms with a net worth between $500,000 and $1,000,000. This Directory is also arranged by 4-digit SIC code. The number of firms in that Directory (limited by this researcher to firms classified in one SIC code only) in each SIC on the list of technology-intensive SIC's was tabulated. These data are shown in Table 6. Each technology-intensive SIC having no firms with a net worth between $500,000 and $1,000,000 was deemed to include no small firms. Based on the type of industry which each such SIC represents, it was reasonable to conclude that each such SIC consisted only of firms with a net worth greater than $1,000,000. These SIC codes were removed from the list of technology-intensive SIC codes. The result was a list of SIC codes which identified NSTBF (see Table 7).

The Dun's Marketing Services tabulation of all firms formed in 1975, by SMSA/NECMA and by SIC was purged of all firms in SIC's other than those which identified NSTBF. The resulting number of NSTBF by SMSA/NECMA for 1975 is shown in Table 8.

It should be noted that the 11,159 NSTBF formed in 1975 represent only about 3% of the 326,000 firms formed in that year, as shown by the reconciliation in Table 9.

C. The Independent Variables

In multiple regression, the confidence interval about the expected value of the projected dependent variable must be reasonably narrow. To accomplish this, the number of observations must be at least ten times the number of independent variables, as a rule of thumb. Since I have identified twelve independent variables (factors or determinants of the geographical distribution of NSTBF), the number of observations must be at least 120. Therefore, data for each factor was obtained for each of the 266 Standard Metropolitan Statistical Areas or New England County Metropolitan Areas (SMSA/NECMA's) in the U.S.

For each of the factors selected for use as an independent variable in the test of the hypothesis there is provided below: (1) the nature of that factor, (2) the rationale for its selection, and (3) a description of the type of data obtained to measure it.

* * * * *

Table 7

List of SIC Codes Which Identify Firms as Being NSTBF

1311	Crude petroleum & nat gas
1381	Drilling oil & gas wells
1382	Oil & gas field explor svs
1389	Oil & gas field svs NEC
2812	Alkalies & chlorine
2813	Industrial gases
2816	Inorganic pigments
2819	Indust inorg chems NEC
2821	Plastic materials, etc.
2822	Synthetic rubber
2831	Biological prods
2833	Medicinal chems & botan prods
2834	Pharmaceutical preps
2861	Gum & wood chems
2865	Cyclic crudes & interms dyes etc.
2869	Indust organic chems NEC
2911	Petroleum refining
3551	Food prods machy
3552	Textile machy
3553	Woodworking machy
3554	Paper industries machy
3555	Printing trades machy & equip
3559	Special industry machy NEC
3561	Pumps & pumping equip
3562	Ball & roller bearings
3563	Air & gas compressors
3564	Blowers & exhaust & vent fans
3565	Industrial patterns
3566	Speed changers indust high speed drives

3567	Industrial process furnaces & ovens
3568	Mechl power transmission equip NEC
3569	Gen indust machy & equip NEC
3573	Electronic computing equip
3574	Calc & acctg machines exc el comp equip
3576	Scales & balances exc laboratory
3579	Office machines NEC
3581	Automatic merchandising machines
3582	Comml laundry dry clng & pressing machines
3585	Air cond warm air heating & refrigeration equip
3589	Service industry machines NEC
3592	Carburetors pistons rings valves
3612	Power distrib & spec transformers
3613	Switchgear & switchbd apparatus
3621	Motors & generators
3622	Industrial controls
3623	Welding apparatus, electric
3624	Carbon & graphite prods
3629	Electrical indust appls NEC
3641	Electric lamps
3643	Current carrying wiring devices
3644	Noncurr carrying wiring devices
3645	Resid elect lighting fixtures
3646	Comml industl & institl elect lighting fixtures
3647	Vehicular lighting equip
3651	Radio TV receiving sets

Table 7 (continued)

3652	Phono records & prerecorded magnetic tape
3661	Telephone & telegr apparatus
3662	Radio TV transmitting equip
3673	Transm indust & spec elect tubes
3674	Semiconductors & related devices
3677	Electronic coils transformer etc.
3679	Electronic components NEC
3691	Storage batteries
3692	Primary batteries, dry & wet
3693	X-ray apparatus & tubes
3694	Electrical equip for internal combustion engines
3699	Electrical machy equip NEC
3721	Aircraft
3724	Aircraft engines & eng parts
3728	Aircraft parts & aux equip NEC
3811	Engrg lab scient & res instruments
3822	Automatic controls
3823	Industrial instruments
3824	Totalizing fluid meters and counting devices
3825	Instruments for testing & meas electricity
3829	Meas & controlling devices NEC
3832	Optical instruments & lenses
3841	Surg & med instruments & apparatus
3843	Dental equip. & supplies
3861	Photographic equip & supplies
7372	Computer programming & oth softwear svs
7374	Data processing svs
7379	Computer related svs NEC
7391	Research & development laboratories
7392	Mgt consulting & pub rels svs
7397	Commercial testing laboratories
8911	Engrg archit & surveying svs
8999	Services NEC

NEC--Not elsewhere classified

Source: Table 6

Table 8

Number of NSTBF Formed in 1975, by SMSA/NECMA

SMSA/NECMA	No.	SMSA/NECMA	No.
Abilene TX	32	Bloomington IN	5
Akron OH	33	Bloomington-Normal IL	3
Albany GA	3	Boise ID	4
Albany-Schenectady-Troy NY	27	Boston-Lowell-Brockton-Lawrence-Haverhill MA	256
Albuquerque NM	33	Bradenton FL	17
Alexandria LA	3	Bridgeport-Stamford-Norwalk-Danbury CT	108
Allentown-Bethlehem-Easton PA-NJ	17	Brownsville-Harlingen-Sanbenito TX	7
Altoona PA	1	Bryan-College Station TX	6
Amarillo TX	7	Buffalo NY	27
Anaheim-Santa Ana-Garden Grove CA	264	Burlington NC	4
Anderson IN	3	Canton OH	9
Ann Arbor MI	27	Cedar Rapids IA	5
Anniston AL	4	Champaign-Urbana-Rantoul IL	11
Appleton-Oshkosh WI	5	Charleston-North Charleston SC	8
Asheville NC	6	Charleston WV	7
Atlanta GA	179	Charlotte-Gastonia NC	24
Atlantic City NJ	5	Chattanooga TN-GA	6
Augusta GA-SC	4	Chicago IL	579
Austin TX	45	Cincinnati OH-KY-IN	67
Bakersfield CA	37	Cleveland OH	127
Baltimore MD	120	Colorado Springs CO	9
Baton Rouge LA	18	Columbia MO	6
Battle Creek MI	2	Columbia SC	9
Bay City MI	1	Columbus OH	62
Beaumont-Port Arthur-Orange TX	7	Corpus Christi TX	29
Billings MT	3	Dallas-Fort Worth TX	322
Biloxi-Gulfport MS	4	Davenport-Rock Island-Moline IA-IL	7
Binghamton NY-PA	4		
Birmingham AL	26		

Table 8 (continued)

Dayton OH	42	Greenville-Spartanburg SC	22
Daytona Beach FL	24	Hamilton-Middletown OH	5
Decatur IL	1	Harrisburg PA	15
Denver-Boulder CO	180	Hartford-New Britain-Bristol CT	33
Des Moines IA	12	Honolulu HI	34
Detroit MI	200	Houston TX	375
Dubuque IA	1	Huntington-Ashland WV-KY-OH	6
Duluth-Superior MN-WI	6	Huntsville AL	11
Eau Claire WI	1	Indianapolis IN	64
El Paso TX	13	Jackson MI	6
Elmira NY	2	Jackson MS	12
Erie PA	9	Jacksonville FL	30
Eugene-Springfield OR	3	Janesville-Beloit WI	3
Evansville IN-KY	12	Jersey City NJ	29
Fayetteville NC	3	Johnson City-Kingsport-Briston TN-VA	2
Fayetteville-Springdale AR	3	Johnstown PA	2
Flint MI	1	Kalamazoo-Portage MI	7
Florence AL	7	Kansas City MO-KS	86
Fort Collins CO	9	Kenosha WI	5
Fort Lauderdale-Hollywood FL	70	Killeen-Temple TX	2
Fort Myers FL	27	Knoxville TN	19
Fort Smith AR-OK	3	Kokomo IN	2
Fort Wayne IN	12	La Crosse WI	1
Fresno CA	22	Lafayette LA	28
Gainsville FL	21	Lafayette-West Lafayette IN	5
Galveston-Texas City TX	10	Lake Charles LA	8
Gary-Hammond-East Chicago IN	9	Lakeland-Winter Haven FL	17
Grand Forks ND-MN	1	Lancaster PA	12
Grand Rapids MI	30	Lansing-East Lansing MI	13
Great Falls MT	2	Laredo TX	8
Greeley CO	5	Las Vegas NV	17
Green Bay WI	6	Lawrence KS	7
Greensboro-Winston-Salem-High Point NC	21	Lawton OK	3

Table 8 (continued)

Lewiston-Auburn ME	2
Lexington-Fayette KY	15
Lima OH	2
Lincoln NE	8
Little Rock-North Little Rock AR	11
Long Branch-Asbury Park NJ	36
Longview TX	8
Lorain-Elyria OH	7
Los Angeles-Long Beach CA	634
Louisville KY-IN	41
Lubbock TX	11
Lynchburg VA	4
Macon GA	1
Madison WI	6
Manchester-Nashua NH	17
Mansfield OH	2
McAllen-Pharr-Edinburg TX	6
Melbourne-Titusville-Cocoa FL	30
Memphis TN-AR-MS	35
Miami FL	115
Midland TX	38
Milwaukee WI	65
Minneapolis-St. Paul MN-WI	185
Mobile AL	13
Modesto CA	10
Monroe LA	15
Montgomery AL	9
Muncie IN	3
Muskegon-Norton Shores-Muskegon Heights MI	6
Nashville-Davidson TN	39
Nassau-Suffolk NY	168
New Bedford-Fall River MA	7
New Brunswick-Perth Amboy-Sayreville NJ	39
New Haven-West Haven-Waterbury-Meriden CT	31
New London-Norwich CT	8
New Orleans LA	59
New York NY-NJ	790
Newark NJ	301
Newport News-Hampton VA	6
Norfolk-Virginia Beach-Portsmouth VA-NC	21
Northeast Pennsylvania	22
Odessa TX	29
Oklahoma City OK	124
Omaha NE-IA	26
Orlando FL	169
Owensboro KY	5
Oxnard-Simi Valley-Ventura CA	51
Panama City FL	6
Parkersvurg-Marietta WV-OH	5
Pascagoula-Moss Point MS	3
Paterson-Clifton-Passaic NJ	49
Pensacola FL	15
Peoria IL	13
Petersburg-Colonia Heights-Hopewell VA	2
Philadelphia PA-NJ	300
Phoenix AZ	162
Pittsburgh PA	87
Pittsfield MA	1
Portland ME	1
Portland OR-WA	89
Poughkeepsie NY	6

Table 8 (continued)

Providence-Warwick-Pawtucket RI	32	Savannah GA	9
Provo-Orem UT	8	Seattle-Everett WA	373
Pueblo CO	3	Sherman-Denison TX	1
Racine WI	4	Shreveport LA	26
Raleigh-Durham NC	37	Sioux City IA-NE	1
Rapid City SD	1	Sioux Falls SD	5
Reading PA	7	South Bend IN	15
Reno NV	13	Spokane WA	41
Richland-Kennewick WA	24	Springfield IL	6
Richmond VA	29	Springfield-Chicopee-Holyoke MA	14
Riverside-San Bernardino-Ontario CA	42	Springfield MO	4
Roanoke VA	6	Springfield OH	2
Rochester NY	41	Steubenville-Wierton OH-WV	2
Rockford IL	6	Stockton CA	10
Sacramento CA	45	Syracuse NY	25
Saginaw MI	8	Tacoma WA	64
St. Cloud MN	6	Tallahassee FL	15
St. Joseph MO	3	Tampa-St. Petersburg FL	217
St. Louis MO-IL	111	Terre Haute IN	3
Salem OR	8	Texarkana TX Texarkana AR	3
Salinas-Seaside-Monterey CA	15	Toledo OH-MI	21
Salt Lake City-Ogden UT	83	Topeka KS	6
San Angelo TX	4	Trenton NJ	33
San Antonio TX	55	Tucson AZ	55
San Diego CA	147	Tulsa OK	78
San Francisco-Oakland CA	293	Tuscaloosa AL	1
San Jose CA	234	Tyler TX	9
Santa Barbara-Santa Maria-Lompoc CA	22	Utica-Rome NY	6
Santa Cruz CA	10	Vallejo-Fairfield-Napa CA	6
Santa Rosa CA	13	Vineland-Millville-Bridgeton NJ	2
Sarasota FL	31	Waco TX	3

Table 8 (continued)

Washington DC-MD-VA	312	Wilmington NC	2
Waterloo-Cedar Falls IA	2	Worcester-Fitchburg-Leominster MA	15
West Palm Beach-Boca Raton FL	33	Yakima WA	16
Wichita KS	40	York PA	12
Wichita Falls TX	24	Youngstown-Warren OH	15
Wilmington DE-NJ-MD	21		

Sources: Dun's Marketing Services tabulation of all firms formed in 1975, by SMSA/NECMA and by SIC. Table 7.

Table 9

Reconciliation of Number of NSTBF Formed with Total Number of Firms Formed, 1975

	No. of Firms (1,000)	Percent of Total
Total formations	326	100
Less: Retail and wholesale formations	167	51
Formations covered by Dun's Marketing Services tabulation	159	49
Less: Non-NSTBF portion	148	46
Portion comprising NSTBF	11	3

FACTOR: ESTBF--Existence of a pool of experienced and successful technological entrepreneurs, i.e., existing small and technology-based firms.

RATIONALE: Lamont[9] found that as an area develops a successful cluster of NSTBF (primary spin-offs from incubator organizations), secondary spin-offs occur from the NSTBF themselves, in effect accelerating the rate of development. Cooper[10] found that each successful new firm provides an example for others who may follow. In an environment including successful NSTBF as well as the incubator organizations, prospective entrepreneurs may perceive the risks to be relatively low and the rewards relatively high, because they find it relatively easy to learn about what is involved in starting a NSTBF.

DATA: The number of small and technology-based firms in existence in 1975 in each SMSA/NECMA of the U.S. was obtained in the following manner. All of the data from the 1975 County Business Patterns, published by the Bureau of the Census of the U.S. Department of Commerce,[11] was purchased in tape form from National Planning Data Corporation, Ithica NY. These data provided the number of existing establishments in 1975 by county and by SIC. A computer program was developed to select from these data the number of establishments in each SMSA/NECMA having the same SIC codes as those used to define NSTBF (see Table 7 in section B3 of Chapter III). These data also are shown in Appendix Table A4.

* * * * *

FACTOR: R&DNO--The number of technology-intensive universities, nonprofit research laboratories, and industrial firms.

RATIONALE: Roberts[12] and Cooper[13] studied the factors which caused new and small technology-based firms (NSTBF) to form in the Boston and San Francisco areas, respectively. They both found that NSTBF are formed as "spin-offs" from technology-intensive universities, nonprofit research laboratories, and industrial firms. Such firms provide an environment in which technically-trained employees perceive entrepreneurial opportunities to transfer technology to NSTBF.

Clark[14] concluded that NSTBF are formed near scientific complexes in order to minimize the cost of acquiring relevant technologies.

DATA: Data were gathered on the distribution by SMSA/NECMA of the number of technology-intensive universities, nonprofit research institutions, and industrial firms.

Data on the number of technology-intensive universities were obtained from the results of the National Science Foundation's (NSF) Survey of Scientific and Engineering

Expenditures at Universities and Colleges for fiscal year 1978.[15] The data were derived from 320 institutions with doctorate programs in the sciences and/or engineering. According to the NSF, doctorate-granting institutions are an excellent indicator of research and development (R&D) activities in academia as a whole, since 98 percent of all R&D spending in academia has occurred in these institutions.[16] A list of science and engineering fields used by NSF in its annual surveys of academic science is furnished as Appendix Table A3.

Data on the number of technology-intensive nonprofit research institutions were obtained from the results of the NSF's Survey of Federal Support to Universities, Colleges, and Selected Nonprofit Institutions for the fiscal year 1977.[17] The relevant portion of this survey covered the 213 nonprofit institutions which received a minimum of $300,000 in total federal obligations for research and development during fiscal year 1977 or $100,000 from any one agency.

Data on the number of technology-intensive industrial firms was obtained from the 1977 Compustat Tape described in section B2b of Chapter III above. Data on all of the 877 firms with R&D expenditures, in that tape, were used in this study.

The above data were sorted by SMSA/NECMA, and are shown in Appendix Table A4.

* * * * *

FACTOR: R&DMIL--Expenditures on research and development by technology-intensive universities, nonprofit institutions, and industrial firms.

RATIONALE: As noted above, NSTBF are likely to be "spin-offs" from technology-intensive universities, nonprofit research laboratories, and industrial firms. Therefore, it seems reasonable that the rate of formation of NSTBF may be related to the intensity of efforts to promote and encourage technology-based activity. One means of doing so is through expenditures for R&D at such incubator organizations.

DATA: Data were gathered on the R&D expenditures of universities, nonprofit research institutes, and industrial firms for the same periods and from the same sources used to develop data for factor R&DNO above. These data were sorted by SMSA/NECMA and are also shown in Appendix Table A4.

* * * * *

FACTOR: DEGREES--Production of technically trained university graduates.

RATIONALE: Universities are one of the incubators of "spin-off" NSTBF.[18] It appears reasonable that a direct relationship may exist between the number of technically trained graduates of universities and the rate of formation of NSTBF.

DATA: Data were obtained from the NSF on the number of earned Ph.D. and Master's degrees in science and engineering conferred by universities and colleges in 1974-1975.[19] These data were sorted by SMSA/NECMA and are shown in Appendix Table A4.

* * * * *

FACTORS: FEDOBMIL and FEDOBNO--Intensity of promotion and encouragement of technology-based activity by means of federal obligations to universities and colleges for fellowships, traineeships, and training grants. Factor FEDOBMIL is measured in terms of the dollar amount of federal support. Factor FEDOBNO is measured in terms of the number of universities receiving these funds.

RATIONALE: The rationale for these factors is similar to that for factor R&DMIL. Factors FEDOBMIL and FEDOBNO provide data on additional means of promoting and encouraging technology-based activity.

DATA: Data were obtained from the National Science Foundation on federal obligations to the 100 universities and colleges which received the largest amounts of funds for this purpose and which accounted for $180.8 million of the $201.3 million total obligations for this purpose in fiscal 1975.[20] These data, sorted by SMSA/NECMA, are also shown in Appendix Table A4.

* * * * *

FACTOR: PATENTS--The rate of introduction of new products.

RATIONALE: This factor may provide an indication of the technology-intensiveness of geographical areas. Technology-intensive geographical areas may be effective incubators of primary "spin-offs" in the form of NSTBF.

DATA: The only available data on this factor is the number of patents issued. Furthermore, these data are only available by state. Where an SMSA/NECMA comprised more than one state, the number of patents issued for each of the states involved was averaged. The number of patents issued by state in 1975 was obtained from the Patent and Trademark Office of the U.S. Department of Commerce.[21] These data, sorted by SMSA/NECMA, are shown in Appendix Table A7.

* * * * *

FACTORS: TAXES, STRSEV, UNSTR, LABCOST, and ENERGY--Factors traditionally taken into consideration when selecting the geographical area of the U.S. in which to establish a new business.

RATIONALE: The costs of the factors of production and the attractiveness of the business climate in general may be significant explanatory factors in the location decisions of NSTBF, just as they are for any new business.

DATA: Data were obtainable for a number of the factors which should be considered by the entrepreneur when selecting a location at which to form a new business.

Factor: TAXES--Data were obtained from the All State Tax Handbook 1980[22] on the following taxes for each state: unemployment insurance tax, business income tax, property tax, capital values and franchise taxes, and the state personal income tax. Using the DuPont system of financial analysis, and reasonable assumptions, the financial statements of a typical NTBF at December 31, 1979 and for the year then ended were projected as follows:

($000)

	Balance Sheet			Income Statement	
Assets	$1,000	Debt	$ 0	Sales	$4,000
		Net worth	1,000	Expenses	3,750
	$1,000		$1,000	Taxable Income	$ 250

Assumptions:

(1) The following financial ratios were used:

Rate of return on net worth	X	Net Worth / Total Assets	=	Rate of return on investment	=	Profit margin on sales	X	Total asset turnover
.25	X	1	=	.25	=	.0625	X	4

(2) A relatively high expected rate of return on net worth and the inability to obtain debt financing are characteristic of NSTBF. See section B of Chapter I above.

(3) The net worth at formation of the NSTBF in 1975 was assumed to be $600,000. As discussed in section A3 of Chapter III above, the size of the average investment made by venture capital firms in fiscal year 1976 was $600,000. This investment was assumed to be equity financing in view of the high risk level.

(4) The venture capitalist was assumed to have based his estimates of taxes on projected financial statements as of December 31, 1979 and for the year then ended and on forecasts of tax rates as of December 31, 1979.

(5) The payroll of the NSTBF was assumed to be 70% of sales, or $2,800,000.

The unemployment tax was assumed to have been levied on the first $6,000 of wages per employee. Since average annual earnings per employee was assumed to be $18,000, the taxable payroll was one-third ($6,000/$18,000) of $2,800,000, or about $1,000,000. The absolute high experience rates were applied to the taxable payroll.

State corporation income tax rates were applied to the assumed taxable income of $250,000.

The first step in estimating the property tax was to obtain the percentage at which the assumed $1,000,000 of property was assessed. The composite average rate of assessment in each state was multiplied by the assumed $1,000,000 of property value. That product was multiplied by the composite average property tax rate in each state to get the estimated property tax which would be paid by this NSTBF in each state.

For capital values tax purposes the net worth of the NSTBF was assumed to consist of the following at December 31, 1979:

Common stock (par)	$ 250,000
Paid-in capital	250,000
Retained earnings	500,000
	$1,000,000

The rates for each state were applied to the appropriate segments of net worth, as specified by law.

The state personal income tax was based on an assumed eventual taxable income of $50,000 for an entrepreneur. The rates for a joint return were used. For simplicity, it was assumed that the entrepreneur had no capital gains or losses and no interest or dividend income.

A summary by state of these five taxes on the hypothetical NSTBF described above and on its entrepreneur is provided in Appendix Table A5. The total taxes by state were converted to a SMSA/NECMA basis. Where a

SMSA/NECMA was located in more than one state, a simple average of the total taxes in each of the states involved was used.

Factor: UNSTR--Union strength was measured in terms of the 1974-1976 average of labor union membership as a percentage of nonagricultural employment. The data were obtained from the Statistical Abstract of the U.S.[23] State data were converted to SMSA/NECMA data. Where a SMSA/NECMA was located in more than one state, a simple average of the values for each state involved was obtained.

Factor: STRSEV--Strike severity was measured in terms of the average annual number of days idle per 100 union members during the 1974-76 period. Data by state on the number of days idle and on total union membership were obtained from the Statistical Abstract of the U.S.[24] State data were converted into SMSA/NECMA data. Where a SMSA/NECMA was located in more than one state, a simple average of the data for the states involved was obtained.

Factor: LABCOST--Labor cost. This factor was measured by data on average weekly earnings by state for 1975. The source was the Statistical Abstract of the U.S.[25] State data were converted to SMSA/NECMA data. Where a SMSA/NECMA was located in more than one state, the data for each state involved were averaged.

Factor: ENERGY--Energy costs were measured by data by state on cents per million BTU for each of the three types of fuel used by electric utility plants in July, 1980: coal, oil, and gas. These data were obtained from the U.S. Department of Energy.[26] An unweighted average of the costs of these three fuels was calculated for each state. However, one or two of the three forms of energy (coal, oil, and gas) were not used by electric utility plants in some states. Where cost data for a particular fuel were available for at least 2/3 of the states in a geographic region of the U.S., the regional average cost of that fuel was used to estimate the cost for that fuel in the states in that region with missing data.

Appendix Table A6 presents a summary by SMSA/NECMA of the data on the following factors: states taxes, union strength, strike severity, labor cost, and energy costs.

* * * * *

Data on the number of NSTBF formed in 1975 (the dependent variable) were available for 256 of the 266 SMSA/NECMA's. No NSTBF were formed in 1975 in the following SMSA/NECMA's:

Anchorage AK
Clarksville-Hopkinsville TN-KY
Columbus GA-AL
Fargo-Moorhead ND-MN
Gadsden AL
Kankakee IL
Pine Bluff AR
Rochester MN
Wheeling WV-OH
Williamsport PA

Data for some SMSA/NECMA's were missing for most of the independent variables. As shown in Table 10 below, except for factors FEDOBMIL and FEDOBNO, data on each of the independent variables were available for a high proportion of the 256 SMSA/NECMA's covered by the dependent variable. Although data for factors FEDOBMIL and FEDOBNO were available for only 64 or 25% of these 256 SMSA/NECMA's those data included 89.8% of the $201 million of federal obligations for fellowships, traineeships, and training grants incurred in fiscal year 1975.

In order to perform a step-wise multiple regression using all 256 of the available observations on the dependent variable, estimates of missing observations were made where necessary for each of the independent variables. Each of those variables was regressed on the dependent variable. Each resulting regression equation was used to calculate the missing observations for the particular independent variable. The step-wise multiple regression was then run using 256 observations on each variable.

A multiple t-test also was used to test the hypothesis of this study. The continuous variable used to measure the dependent variable in this study, the number of NSTBF formed in 1975, was replaced by two different pairs of categorical variables. One pair of categorical variables was developed on the basis of the median number of NSTBF formed in each SMSA/NECMA, being 11 firms. One category comprised SMSA/NECMA's with 0 - 11 NSTBF. The other category comprised SMSA/NECMA's with 12 or more NSTBF. The several measures developed on each SMSA/NECMA were the same factors used as independent variables in the test of the hypothesis of this study by means of stepwise multiple regression.

The other pair of categorical variables was developed on the basis of the median value of the percentage of the total number of firms formed in 1975 represented by NSTBF, which was 6.02%. One category comprised SMSA/NECMA's for which this percentage amounted to no more than 6.02%. The other category comprised SMSA/NECMA's for which this percentage was greater than 6.02%. The same independent variables were used as for the first pair of categorical variables.

Multiple t-tests were applied separately to each pair of categorical variables. For each pair, the null hypothesis tested was that the means of the two population categories, using all of the independent variables, were equal. The equality of the means of the two population categories was also tested using single independent variables only.

Table 10

Extent of Available Data on Independent Variables

Abbreviation		SMSA/NECMA's No.	SMSA/NECMA's % of total
ESTBF	- Number of existing small and technology-based firms	254	99.2
R&DNO	- Number of technology-intensive universities, nonprofit research institutions, and industrial firms	155	60.5
R&DMIL	- Research and development expenditures of those establishments	155	60.5
DEGREES	- Number of earned Ph.D. and Master's degrees awarded in science and engineering	180	70.3
FEDOBMIL	- Federal obligations to universities and colleges for technology-based fellowships, traineeships, and training grants	64	25.0
FEDOBNO	- Number of universities and colleges receiving such grants	64	25.0
PATENTS	- Number of patents issued	256	100.0
TAXES	- State taxes	256	100.0
UNSTR	- Union strength	255	99.6
STRSEV	- Strike severity	255	99.6
LABCOST	- Labor cost	251	98.0
ENERGY	- Energy costs	255	99.6

CHAPTER IV

FINDINGS AND CONCLUSIONS

The hypothesis tested by this study is that some set of factors (independent variables) described in Chapter III-C above determines the number of new and small technology-based firms (NSTBF) formed in 1975 (dependent variable).

A. Observed Associations

One by-product of the step-wise multiple regression program used to test the hypothesis was a set of correlation coefficients between the dependent variable and each of the independent variables, as shown in Table 11.

A number of conclusions can be drawn from these data. First, substantial positive correlation exists between the dependent variable and measures of activities associated with the process of technological innovation (ESTBF, R&DNO, R&DMIL, DEGREES, FEDOBMIL, and FEDOBNO). The low correlation between the dependent variable and the number of patents issued is an exception and remains unexplained.

Second, little correlation exists between the dependent variable and factors traditionally taken into consideration

Table 11

Correlation Coefficient Between Dependent Variable (NSTBF) and Each Independent Variable

Abbreviation	Independent Variable	Correlation with NSTBF
ESTBF	Number of existing small and technology-based firms	.89
R&DNO	Number of technology-intensive universities, nonprofit research institutions, and industrial firms	.87
DEGREES	Number of earned Ph.D. and Master's degrees awarded in science and engineering	.80
FEDOBMIL	Federal obligations to universities and colleges for technology-based fellowships, traineeships, and training grants	.66
FEDOBNO	Number of universities and colleges receiving such grants	.76
R&DMIL	Research and development expenditures of R&DNO	.65
PATENTS	Number of patents issued	.23
TAXES	State taxes	.03
UNSTR	Union of strength	.07
STRSEV	Strike severity	-.14
LABCOST	Labor cost	.07
ENERGY	Energy costs	.13

when selecting the geographical area of the U.S. in which to establish a new business (TAXES, UNSTR, STRSEV, LABCOST, and ENERGY).

These two conclusions appear to provide statistical support for the conclusions of an earlier researcher, Spiegelman (see endnote 17 of Chapter II). He found that the most important factors determining the location decisions reported by 45 firms in the precision instruments industry in five states across the U.S. were "availability of professional staff," "availability of labor of required skill or ability," and, of lesser importance, "proximity to educational, testing and research facilities, and to suppliers and markets for reasons other than transport costs." He also found that most of these firms located in large metropolitan areas in spite of the high wage rates, land costs, and taxes in those areas, because the favorable factors were present in those areas.

B. Step-Wise Multiple Regressions

The initial step-wise multiple regression of the data of this study revealed that ESTBF explained 80% of the variability of NSTBF. In other words, the coefficient of determination (multiple R^2) was .7997. The increase in multiple R^2 for each of the other independent variables was insignificant, being less than .01 except for R&DNO which was .0112 and R&DMIL which was .0123. This researcher hypothesized that the reason for this finding is that <u>all</u>

small and technology-based firms, whether new ones or existing ones, prosper under the same favorable conditions. If this hypothesis is true, then separate step-wise multiple regressions of NSTBF and ESTBF on the remaining independent variables should produce similar results. They did produce similar results, as shown in Tables 12 and 13.

Table 12

Independent Variables Which Explain Variability of NSTBF and ESTBF, Separately

Independent Variables	Increase in Multiple R^2 If the Dependent Variable Is: NSTBF	ESTBF
R&DNO	.76	.86
DEGREES	.02	.02
TAXES	.01	less than .01
OTHER	less than .01 each	less than .01 each

These results show that the principal determinant of the geographical distribution of the formation of NSTBF is the number of technology-intensive universities, non-profit research institutions, and industrial firms in a SMSA/NECMA. This factor explained 76% and 86%, respectively, of the variability in the dependent variables, NSTBF and ESTBF. A second determinant, which explained an additional 2% in each case, is the number of earned Ph.D. and Master's degrees in science and engineering conferred by universities and colleges in a SMSA/NECMA. Each of the other factors explained 1% or less of the variability in the dependent variables.

Table 13

Correlation Coefficient Between Each Dependent Variable (NSTBF and ESTBF) and Each Independent Variable

Abbreviation	Independent Variable	Correlation With NSTBF	Correlation With ESTBF
R&DNO	Number of technology-intensive universities, non-profit research institutions, and industrial firms	.87	.93
DEGREES	Number of earned Ph.D. and Master's degrees awarded in science and engineering	.80	.85
FEDOBMIL	Federal obligations to universities and colleges for technology-based fellowships, traineeships, and training grants	.66	.69
FEDOBNO	Number of universities and colleges receiving FEDOBMIL	.76	.78
R&DMIL	R&D expenditures of R&DNO	.65	.78
PATENTS	Number of patents issued	.23	.23
TAXES	State taxes	.03	.13
UNSTR	Union strength	.07	.13
STRSEV	Strike severity	-.14	-.17
LABCOST	Labor cost	.07	.06
ENERGY	Energy costs	.13	.13

The resulting regression equations are given below. Whether NSTBF or ESTBF is used as the dependent variable, the coefficients of both dependent variables (R&DNO and DEGREES) are significant. Multiple R is substantial and positive for each regression equation.

$$NSTBF = 5.39 + \underset{(\pm 0.41)}{5.09}\ R\&DNO + \underset{(\pm 0.03)}{0.11}\ DEGREES + e$$

$$\text{Multiple } R = .88$$

$$ESTBF = 17.55 + \underset{(\pm 1.22)}{22.16}\ R\&DNO + \underset{(\pm 0.07)}{0.46}\ DEGREES + e$$

$$\text{Multiple } R = .94$$

The present finding that the number of technology-intensive universities, nonprofit research institutions, and industrial firms (R&DNO) is the principal determinant of the geographical distribution of the formation of NSTBF supports the findings of certain earlier researchers. Those findings are described in section C of Chapter III as part of the rationale for using R&DNO as an independent variable to test the major hypothesis of this study. In their studies of the Boston and San Francisco areas, respectively, Roberts and Cooper (see endnotes 12 and 13 to Chapter III, respectively) both found that NSTBF are formed as "spin-offs" from technology-intensive universities, nonprofit research laboratories, and industrial firms. Such firms provide an environment in which technically-trained employees perceive entrepreneurial opportunities to transfer technology to NSTBF. The present research study provides empirical evidence that the greater the number of technology-intensive establishments of all kinds in any given SMSA/NECMA the greater will be the expected number of entrepreneurial opportunities that will be perceived and exploited.

An analysis of variance based on regressing the dependent variable (NSTBF) on the two independent variables which explain more than 1% of the variance in NSTBF (R&DNO and DEGREES) resulted in an F ratio of 427.77 which was greater than the table F ratio of 99.5 at the 1% significance level. Therefore, there is a less than 1% probability that these results could have occurred by chance. Thus the research hypothesis may be deemed to have been supported.

An additional analysis of variance, this time based on regressing the dependent variable, ESTBF, on the two independent variables each of which explains more than 1% of the variance in ESTBF, R&DNO and DEGREES, results in an F ratio of 918.14 which also is greater than the table F ratio of 99.5 at the 1% significance level. Again, there is a less than 1% probability that these results could have occurred by chance. These results provide further evidence to support the research hypothesis.

The same conclusions can be drawn from the data in Table 13 as from the data in Table 11. All small and technology-based firms, whether new ones (NSTBF) or existing ones (ESTBF), prosper under the same favorable conditions (R&DNO, DEGREES, FEDOBMIL, FEDOBNO, AND R&DMIL). As before, none of the remaining variables show substantial correlation with NSTBF or ESTBF.

C. Multivariate t-Tests

An additional method used to test the major hypothesis of this study was the multivariate t-test. The sample of 256 observations was split into two samples by converting the dependent variable (NSTBF) from a continuous variable into a categorical variable based upon a median split of the number of NSTBF. The two categories were 0-11 NSTBF and 12 or more NSTBF.

The null hypothesis tested was that the means of the two population categories, using all of the independent variables, were equal. As in the earlier tests, the independent variables were: R&DNO, DEGREES, FEDOBMIL, FEDOBNO, R&DMIL, PATENTS, TAXES, UNSTR, STRSEV, LABCOST, and ENERGY. The null hypothesis was rejected because the probability (two-tailed) of equality of these means was less than .005, as shown in Table 14. To interpret the results in another way, the calculated F value was 4.8 versus a table value of 2.2 at the .01 significance level. Therefore, the two populations have different means, since the probability that this difference could occur by chance is insignificant.

The next step was to test the difference between the means of the two population categories on the basis of each of the independent variables. Table 14 shows the probability (two-tailed) of equality of these means. The null hypothesis of equality of means of the two populations based on single independent variables must be rejected for all of those variables serving as measures of activities associated with the process of technological innovation (R&DNO, DEGREES, FEDOBMIL, FEDOBNO, and R&DMIL), since there is less than a five hundreths of one percent chance of equality of means. The null hypothesis must be accepted for those variables measuring the factors traditionally taken into account when selecting the location for a new business (TAXES, UNSTR, STRSEV, LABCOST, and ENERGY) if a significance level of one percent is used.

In summary, the results of these multivariate t-tests reinforce the conclusions based upon observed associations and step-wise multiple regression.

Another multivariate t-test was performed by converting the dependent variable (NSTBF) from a continuous variable into a categorical variable based upon a median split of NSTBF as a percentage of total firms formed. The two categories were 0 to 6.02%, and greater than 6.02%. Table 15 shows the results of this test. They are almost identical and thus provide further support for the major hypothesis of this study.

Table 14

Multivariate t-Test--Probability (Two-Tailed) of Equality of Means of Populations Based on All Independent Variables and on Single Independent Variables and Median Split of Number of NSTBF

Abbreviation	Independent Variable	Probability of Equality
-	All	less than .0005
R&DNO	Number of technology-intensive universities, non-profit research institutions, and industrial firms	less than .0005
DEGREES	Number of earned Ph.D. and Master's degrees awarded in science and engineering	less than .0005
FEDOBMIL	Federal obligations to universities and colleges for technology-based fellowships, traineeships, and training grants	less than .0005
FEDOBNO	Number of universities and colleges receiving FEDOBMIL	.003
R&DMIL	R&D expenditures of R&DNO	less than .0005
PATENTS	Number of patents issued	.010
TAXES	State taxes	.520
UNSTR	Union strength	.847
STRSEV	Strike severity	.038
LABCOST	Labor cost	.827
ENERGY	Energy costs	.273

Table 15

Multivariate t-Test--Probability (Two-Tailed) of Equality of Population Means Based on All Independent Variables and on Single Independent Variables and a Median Split of NSTBF as Percentage of Total Firms Formed

Abbreviation	Independent Variable	Probability of Equality
-	All	less than .0005
R&DNO	Number of technology-intensive universities, non-profit research institutions, and industrial firms	less than .0005
DEGREES	Number of earned Ph.D. and Master's degrees awarded in science and engineering	less than .0005
FEDOBMIL	Federal obligations to universities and colleges for technology-based fellowships, traineeships, and training grants	less than .0005
FEDOBNO	Number of universities and colleges receiving FEDOBMIL	.001
R&DMIL	R&D expenditures of R&DNO	.001
PATENTS	Number of patents issued	.232
TAXES	State taxes	.194
UNSTR	Union strength	.813
STRSEV	Strike severity	.895
LABCOST	Labor cost	.231
ENERGY	Energy costs	.897

D. Influence of Population

In drawing conclusions from the test of the hypothesis of this study, consideration was given to the possibility that the size of SMSA/NECMA's may have induced artificially strong relationships between measures of the geographical distribution of the formation of NSTBF and measures of its determinants. To test this possibility it was hypothesized (1) that the geographical distribution of the formation of NSTBF is determined by factors other than population, and (2) that those factors are highly correlated with the size of geographical areas measured in terms of population. If these hypotheses were supported by tests, then that evidence would support the conclusion that the regression relationship between the geographical distribution of the formation of NSTBF and its determinants is not artificially strong, but in fact is truly strong.

Table 16 shows the correlation coefficients between population and each of the variables used to test the hypothesis of this study. Population is highly correlated with each of the factors which are highly correlated with the geographical distribution of the formation of NSTBF: R&DNO, DEGREES, FEDOBMIL, FEDOBNO, and R&DMIL. This finding is reasonable, since it is reasonable to believe that these types of innovative activity take place in urban centers having relatively high population density, rather than in remote areas.

Table 16

Correlation Coefficient Between Each Independent Variable and Both Population and NSTBF

Abbreviation	Independent Variable	Correlation with NSTBF (Table 13)	Correlation with Population
R&DNO	Number of technology-intensive universities, nonprofit research institutions, and industrial firms	.87	.90
DEGREES	Number of earned Ph.D. and Master's degrees awarded in science and engineering	.80	.83
FEDOBMIL	Federal obligations to universities and colleges for technology-based fellowships, traineeships, and training grants	.66	.68
FEDOBNO	Number of universities and colleges receiving FEDOBMIL	.76	.75
R&DMIL	R&D expenditures of R&DNO	.65	.74
PATENTS	Number of patents issued	.23	.26
TAXES	State taxes	.03	.12
UNSTR	Union strength	.07	.15
STRSEV	Strike severity	-.14	-.18
LABCOST	Labor cost	.07	.09
ENERGY	Energy costs	.13	.18

Population is not correlated with any of the factors which are not correlated with the geographical distribution of the formation of NSTBF. This finding is also reasonable, since there is no reason to expect any systematic relationship between population and the factors traditionally considered when selecting a location for a new business.

These results support the conclusion that the relationship between the geographical distribution of the formation of NSTBF and its determinants are not artificially strong, but in fact are truly strong.

E. No Shortage of Venture Capital

Much of the research on the subject of venture capital has concluded that the lack of venture capital has been a major barrier to increased economic growth. The (Michigan) Governor's Advisory Commission on the Regulation of Financial Institutions,[1] Brophy,[2] and Chastain and DeVries[3] all have reached that conclusion.

In theory, however, there can be no shortage of venture capital. In a free market, at some price, capital flows to where it is needed. Sharpe's Capital Asset Pricing Model,[4] a major contribution to the theory of finance, holds that in equilibrium there is a direct and linear relationship between the expected rate of return on any asset and its systematic risk as measured by beta. Whatever the level of risk associated with a new and small technology-based firm (NSTBF), there is a corresponding expected rate of return. That expected rate of return will equal or exceed the rate of return required by some venture capitalist somewhere in order to compensate him for taking the risk involved in that NSTBF.

According to a recent article in the Grand Rapids Press, based on a New York Times News Service report, there is more venture capital money available now than there are opportunities for investment. One factor has been the reduction in the capital gains tax in 1978 to a maximum rate of 28% from 49%. "Another factor...is that the public's hunger for technology stocks has made it easy for young companies to go public at high price-earnings ratios, virtually insuring that a venture capital company will recoup its investment quickly. Also, equity in a young company is considered one of the few investments that can outrun inflation."[5]

Evidence exists that there are plenty of risk-takers--more than is generally suspected. As an example, consider the history of Viatron Computer System Corp. common stock. It initially sold at $15 per share in 1969. The stock soared to a high of $61. In 1971 it fell to $1 and the company filed under the bankruptcy act. The company raised the money it needed from the public (risk-takers), but then made bad mistakes and went under.[6]

Another example is furnished by an article in the September, 1975 issue of Fortune, "A Thinking Man's Guide to Losing at the Track."[7] That article describes a study which provides evidence that people are basically risk-takers. By studying the odds of 1,000 races at the moment the horses started off and the winnings of those horses the article concludes that one can win by betting the favorites, since so many people bet on the long shots.

Some entrepreneurs may face a self-imposed barrier to available venture capital, because they may be reluctant to share the equity in their firm with venture capitalists. This hypothesis appears to be testable and should be the subject of further research.

CHAPTER V

POLICY IMPLICATIONS AND RECOMMENDATIONS

A. Summary

This study has identified the determinants of the geographical distribution of the formation of NSTBF. It has the following implications. It provides policy guidance for the promotion of economic growth in any geographical area of the U.S. It facilitates the identification of those geographical areas of the U.S. most conducive to economic stimulation. It demonstrates the ineffectiveness of certain methods of increasing the rate of formation of NSTBF presently in use.

B. Policy Guidance for the Promotion of Economic Growth

This study has shown that 76% of the variability in the geographical distribution of the formation of new and small technology-based firms (NSTBF) is explained by the number of technology-intensive universities, nonprofit research institutions, and industrial firms (R&DNO) in any given geographical area of the U.S. Therefore, to improve the level of economic activity in any Standard Metropolitan Statistical Area or New England County

Metropolitan Area (SMSA/NECMA) of the U.S. by increasing the rate of formation of NSTBF, the most important policy guideline is to maximize R&DNO. The interaction between these different types of establishments in any given SMSA/NECMA provides a local environment conducive to entrepreneurship and the formation of NSTBF.

Another 2% of the variability in the geographical distribution of the formation of NSTBF is explained by the number of earned Ph.D. and Master's degrees in the life and physical sciences and in engineering conferred by universities and colleges (DEGREES). Accordingly, the next most important policy guideline is to maximize DEGREES.

Three other factors, in addition to R&DNO and DEGREES, were shown to have high positive correlation with the geographical distribution of the formation of NSTBF and therefore also should be maximized to the extent practicable:

- Federal obligations to universities and colleges for technology-based fellowships, traineeships, and training grants (FEDOBMIL).
- The number of universities and colleges receiving FEDOBMIL (FEDOBNO).
- R&D expenditures of R&DNO (R&DMIL).

C. Geographical Areas Most Conducive to Economic Stimulation

This study has shown that the existence of technology-intensive universities, nonprofit research organizations, and industrial firms is by far the most important determinant of the geographical distribution of the formation of NSTBF in any given geographical area of the U.S. The rate of formation of NSTBF is greatest in places where interaction exists between these three types of establishments. Therefore, those geographical areas most likely to generate NSTBF would be those having the highest number of all three types of establishments. The least promising areas would be those with no establishments in any of the three categories.

1. The State of Michigan

As of December 31, 1980, the state of Michigan had the highest annual rate of unemployment in the country--12.6%. (Indiana and Alaska tied for second place with 9.6%.)[1] Fortunately, Michigan appears to contain at least three SMSA's which are conducive to economic stimulation, namely, Ann Arbor, Detroit, and Lansing-East Lansing. Since each of these SMSA's has a large university which is technology-intensive, one of the policy conditions described in B above has been met. As shown in Tables 17 and 18, those three technology-intensive universities are: University of Michigan (Ann Arbor), Wayne State

Table 17

Number of Technology-Intensive Universities, Nonprofit Research Institutions, and Industrial Firms in Michigan, by SMSA, Circa 1977

SMSA	Total	Univs.	Nonprofit Research Insts.	Industrial Firms
Ann Arbor	3	1	1	1
Detroit	22	1	1	20
Lansing-E. Lansing	1	1		
Battle Creek	1			1
Bay City	1			1
Flint				
Grand Rapids	3			3
Jackson				
Kalamazoo-Portage	4		1	3
Muskegon				
Saginaw				

Table 18

R&D Expenditures of Technology-Intensive Universities, Nonprofit Research Institutions, and Industrial Firms in Michigan, by SMSA, Circa 1977 ($Mil.)

SMSA	Total	Univs.	Nonprofit Research Insts.	Industrial Firms
Ann Arbor	$ 95.1	$86.9	$7.4	$ .8
Detroit	3,235.3	20.3	2.0	3,213.0
Lansing-E. Lansing	55.4	55.4		
Battle Creek	7.7			7.7
Bay City	203.3			203.3
Flint				
Grand Rapids	3.0			3.0
Jackson				
Kalamazoo-Portage	103.0		*	103.0
Muskegon				
Saginaw				

* $18,000

University (Detroit), and Michigan State University (Lansing-East Lansing). However, both the Ann Arbor and Lansing SMSA's have virtually no technology-intensive nonprofit research institutions and industrial firms. Although the Detroit SMSA has a substantial number of technology-intensive industrial firms (20 firms conducting $3.2 billion of research and development), there is relatively little R&D expenditure at Wayne State University, and there are virtually no nonprofit research organizations.

In order to maximize R&DNO, which is the most important policy guideline, a number of technology-intensive nonprofit research institutions and industrial firms must be established in each of the three SMSA's already having technology-intensive universities: Ann Arbor, Detroit, and Lansing-East Lansing. One method for doing so is for those universities or the state of Michigan to establish technology parks or centers adjacent to those campuses. According to a recent Wall Street Journal article, Rensselaer Polytechnic Institute, Yale University, and State University of New York at Stony Brook are all planning to develop technology parks to attract high-technology companies to their areas. They hope these companies will provide both jobs for graduates and consulting for professors.[2] More importantly, however, the addition of technology-intensive nonprofit research institutions and industrial firms to the technology-intensive universities in Ann Arbor, Detroit, and Lansing-East Lansing by this means will create conditions conducive to the "spin-off" of new and small technology-based firms (NSTBF). Once these SMSA's develop NSTBF, secondary "spin-offs" of NSTBF will occur, accelerating the rate of economic growth.

To implement the policy guideline DEGREES, effort should be made to maximize the number of Ph.D. and Master's degrees in the life and physical sciences and in engineering conferred by the University of Michigan (Ann Arbor), Wayne State University (Detroit), and Michigan State University (Lansing-East Lansing). Officials of the state of Michigan and of these three universities should determine the feasibility of increasing the facilities at these universities for the purposes of (1) enlarging their research and development capabilities, and (2) increasing the number of Ph.D. and Master's degrees granted annually in the life and physical sciences and in engineering. The availability of state and/or federal funding for these purposes also should be explored.

Table 19 shows data by SMSA for the state of Michigan for the remaining factors shown by this study to be highly associated with the geographical distribution of the formation of NSTBF: the number of earned Ph.D. and Master's degrees awarded in science and engineering (DEGREES); federal obligations to universities and colleges for technology-based fellowships, traineeships, and training

Table 19

Data for State of Michigan on Selected Factors Highly Associated with the Geographical Distribution of the Formation of NSTBF, Circa 1975

SMSA	DEGREES (No.)	FEDOBMIL ($Mil.)	FEDOBNO (No.)	ESTBF (No.)
Ann Arbor	449	4.3	1	57
Detroit	215	.4	1	906
Lansing-E. Lansing	332	1.2	1	105
Battle Creek				42
Bay City				29
Flint				84
Grand Rapids				183
Jackson				37
Kalamazoo-Portage				76
Muskegon				33
Saginaw				56

grants (FEDOBMIL); the number of universities and colleges receiving such grants (FEDOBNO); and the number of existing small and technology-based firms (ESTBF).

Perhaps the most apparent deficiency revealed by these data is the number and size of federal obligations to the University of Michigan, Wayne State University, and Michigan State University for technology-based fellowships, traineeships, and training grants. The reason for this deficiency should be found, and, if feasible, remedied.

Michigan has a trained industrial workforce plus technological resources. These assets make the business climate in the Ann Arbor, Detroit, and Lansing-East Lansing SMSA's attractive, offsetting to some degree Michigan's relatively high taxes.

2. Other Geographical Areas of the U.S.

The data for each SMSA/NECMA in the U.S. for each of the determinants of the geographical distribution of the formation of NSTBF identified by this study are listed in Appendix Table A4. The opportunities for increasing the rate of economic growth in any other SMSA/ NECMA(s) may be identified by analyzing those data in the same manner as the data for Michigan's SMSA's were analyzed in the preceding section of this chapter.

D. Ineffectiveness of Present Methods

Another implication of this study is that efforts to optimize the conditions traditionally considered when attempting to attract industry to a geographical area will not increase the rate of formation of NSTBF in that area. The correlation between the geographical distribution of the formation of NSTBF and the traditional factors used to locate new businesses, such as state taxes, union strength, strike severity, labor cost, and energy costs, has been shown to be extremely low.

APPENDIX

Table A1

Complete Array of Technology-Intensive SIC Categories by Number of Engineers and Scientists As Percentage of Total Employment, 1970

Percentage	SIC Category	Description
27.15%	891	Engineering & architectural svs.
22.34	7391,7397	Commercial research, development & testing labs.
14.62	372	Aircraft & parts
13.24	899	Misc. professional & related svs.
11.95	361,362,364,367 3691-3694	Electrical mach'y., equip. & supplies--not specified
11.66	3573	Electronic computing equip.
10.93	365,366	Radio, television & communications equip.
10.31	281,286	Industrial chemicals
9.42	381,382	Scientific & controlling instruments
9.25	13	Crude petroleum & natural gas extraction
8.64	386	Photographic equip. & supplies
8.37	291	Petroleum refining
8.09	283	Drugs & medicines
7.86	355,356,358,3592	Mach'y.--not specified
7.28	3699	Electrical mach'y., equip. & supplies NEC
7.12	2821,2822,2824	Plastics, synthetics & resins, exc. fibers
6.56	7392	Business management & consulting svs.
6.40	351	Engines & turbines
6.24	483	Radio broadcasting & television
6.10	3572,3574,3576, 3579	Office & accounting machines
6.10	497	Other & not specified utilities
5.96	289	Misc. chemicals
5.94	491,492,493	Electric light & power & electric-gas utilities
5.80	285	Paints, varnishes & related prods.
5.61	2823	Synthetic fibers

Table Al (cont'd)

5.21	287	Agricultural chemicals
5.19	078	Horticultural svs.
5.03	353	Construction & materials-handling machines
4.86	46	Pipelines, exc natural gas
4.84	10	Metal mining
4.80	341,343,3452,3462, 3463,3466,347, 348	Metal industries--not specified
4.73	44	Water transportation
4.50	3599	Mach'y., exc. electrical NEC
4.45	284	Soaps & Cosmetics
4.42	383-385	Optical & health svs. supplies
4.31	373	Ship & boat building & repairing
4.30	494	Water supply
4.05	207	Food industries--not specified
4.02	91-97	Public administration
3.93	7372	Computer programming services
3.89	481	Telephone (wire & radio)
3.89	295,299	Misc. petroleum & coal prods.
3.86	374	Railroad locomotives & equip.
3.82	354	Metal working mach'y.
3.68	482, 489	Telegraph & misc. communications svs.
3.56	352	Farm mach'y. & equip.
3.48	824	Educational svs.--not specified
3.39	3334	Primary aluminum industries
3.37	301-304,306	Rubber Prods.
3.29	3331-3333,3339, 336,339	Other primary nonferrous industries
3.14	328-329	Misc. nonmetallic mineral & stone prods.
3.12	371	Motor vehicles & motor vehicle equip.
2.92	363	Household appliances
2.78	807,809	Health svs. NEC
2.78	344	Fabricated structural metal prods.

Table A1 (cont'd)

2.72	331	Blast furnaces, steel works, rolling & fin'g. mills
2.60	496	Gas & steam supply systems
2.50	375,376,3795,3799	Cycles & misc. transportation equip.
2.47	349	Misc. fabricated metal prods.
2.43	261-263	Pulp, paper & paperboard mills
2.38	387	Watches, clocks, & clockwork-operated devices
2.35	307	Misc. plastic prods.
2.17	321-323	Glass & glass prods.
2.13	209	Misc. food preparation & kindred prods.
2.09	332	Other primary iron & steel industries
2.07	324,327	Cement, concrete, gypsum & plaster prods.
2.06	326	Pottery & related prods.
2.05	3451	Screw machine prods.
2.03	342	Cutlery, hand tools & other hardware
1.90	3465,3469	Metal stamping
1.85	84	Museums, art galleries, & zoos
1.77	14	Nonmetaylic mining & quarrying, exc. fuel
1.75	264, 266	Misc. paper & pulp prods.
1.59	204	Grain-mill prods.
1.57	09	Fisheries
1.56	822	Colleges & universities
1.53	495	Sanitary svs.
1.49	325	Structural clay prods.
1.42	226	Dtubg & fin'g, textiles, exc. wool & knit goods
1.41	21	Tobacco mfrs.
1.31	208	Beverage industries
1.30	15	General building contractors
1.30	203	Canning & preserving fruits, veg's. & seafoods
1.28	229	Misc. textile mill prods.
1.11	311	Tanned, curried, & finished leather
1.11	11-12	Coal mining
1.02	762	Electrical repair shops
1.01	265	Paperboard containers & boxes

Table A1 (cont'd)

1.00	893	Accounting, auditing, & bookkeeping svs.
.99	45	Air transportation
.97	206	Confectionery & related prods.
.94	078	Horticultural svs.
.91	227	Floor coverings, exc. hard surfaces
.87	221-224,228	Yarn, thread, & fabric mills
.87	861-865,869	Nonprofit membership organizations
.77	0711-0762	Agricultural svs., exc. horticultural
.75	40	Railroads & railway express svs.
.73	47	Svs. incidental to transportation
.68	17	Special trade contractors
.67	244,245,249	Misc. wood prods.
.65	25	Furniture & fixtures
.64	202	Dairy prods.
.58	201	Meat prods.
.57	205	Bakery prods.
.55	3792	Mobile dwellings & campers
.51	313,315-317,319	Leather prods., exc. footwear
.48	81	Legal svs.
.47	63,64	Insurance
.46	242,243	Sawmills, planing mills, & millwork
.46	239	Misc. fabricated textile prods.
.46	763,764,769	Misc. repair svs.
.46	806	Hospitals
.45	781,783	Theaters and motion pictures
.39	736	Employment & temporary help agencies
.36	272-279	Printing, publishing, & allied inds., exc. newspapers
.35	8041	Offices of chiropractors
.34	7393	Detective & protective svs.
.33	225	Knitting mills
.33(Memo)	50	Wholesale and retail trade
.28	314	Footwear, exc. leather

Table A1 (cont'd)

.27	241	Logging
.27	731	Advertising
.27	801,803	Offices of physicians
.24	829	Educational svs. NEC
.23	65,66	Real estate, including real estate-insur.-law offices
.23	422	Warehousing & storage
.21	231-238	Apparel & accessories
.20	62	Security, commodity brokerage, & investment cos.
.19	832,833,835,839	Welfare svs.
.19	734	Services to dwellings & other buildings
.18	836	Residential welfare facilities
.17	866	Religious organizations
.16	782,791,792,794, 799	Misc. entertainment & recreation svs.
.15	751,752,754	Automobile svs., exc. repair
.15	802,	Offices of dentists
.15	8042,8049	Offices of health practitioners NEC
.15	43	Postal svs.
.13	61	Credit agencies
.12	421	Trucking sv.
.11	823	Libraries
.11	701	Hotels & motels
.11	729	Misc. personal svs.
.10	60	Banking
.09	793	Bowling alleys
.09	01-02	Agricultural prods.
.08	271	Newspaper publishing & printing
.08	702-704	Lodging places, exc. hotels & motels
.07	821	Elementary & secondary schools
.07	721	Laundering, cleaning, & other garment svs.
.05	805	Convalescent institutions
.04	725	Shoe repair shops

Table A1 (cont'd)

.03	724	Barber shops
.03	753	Automobile repair & related svs.
.03	412	Taxicab sv.
.01	88	Private households
.01	723	Beauty shops

NEC--Not elsewhere classified
Source: Table 2

Table A2

Complete Array of Technology-Intensive SIC Codes
by (R&D)/S Ratio, 1980

SIC	Description	$Millions R&D	$Millions Sales	(R&D)/S Ratio
3825	Electr meas & testg instrs	55.3	659.5	.084
3823	Industrial meas instrs	180.2	2,935.0	.061
3728	Aircraft parts & aux equip	373.9	6,226.6	.060
3861	Photographic equp & suppl	646.6	11,595.4	.056
357	Office computing & acctg machs	1,765.9	31,261.0	.056
3573	Electronic computing equip	569.0	10,187.9	.056
3661	Telephone & telegraph apparatus	68.3	1,249.6	.055
367	Electronic components & accessories	271.9	5,103.4	.053
283	Drugs	1,051.5	20,176.9	.052
3811	Engrg lab & research equip	84.0	2,053.2	.041
3721	Aircraft	392.5	10,344.4	.038
3841	Surg & med instrs & apparatus	247.1	6,822.8	.036
3662	Radio-TV transmitting equip & appar	221.1	6,374.4	.035
3651	Radio-TV receiving sets	533.3	17,096.2	.031
3843	Dental equip & supplies	6.4	214.3	.030
383	Optical instrs & lenses	24.6	816.8	.030
737	Computer & data processing svs.	26.1	886.4	.029
286	Industrial organic checmicals	21.6	747.3	.029
352	Farm & garden machy & equip.	249.8	9,033.3	.028
28	Chemicals & allied prods	1,620.5	57,844.7	.028
382	Measuring & controlling instrs	27.3	982.0	.028
3711	Motor vehicles & car bodies	3,100.7	115,983.2	.027
281	Industrial inorganic chemicals	125.5	4,954.3	.025
3536	Hoists, industr cranes, monorail	12.7	506.4	.025
279	Service industries for printing trde	3.9	162.9	.024
361	Electr transmission & distr equip	122.4	5,172.8	.024
36	Electrical & electronic mach eq & sp	622.5	27,397.1	.024

Table A2 (cont'd)

2844	Perfumes cosmetics toil prep	196.8	8,533.9	.023
354	Metalworking machy & equip	54.8	2,345.9	.023
3679	Electronic Components NEC	115.7	4,931.1	.023
289	Misc chemical prods	67.4	3,001.8	.022
3531	Construction machy & equip	258.3	11,877.2	.022
7391	Svs of research & dev labs	2.1	100.9	.021
321	Flat glass	54.8	2,625.6	.021
372	Aircraft & parts	122.4	5,994.0	.020
3699	Electrical machy & equip NEC	26.8	1,310.9	.020
394	Toys, amusement, & sporting gds	73.7	3,917.6	.019
1382	Oil & gas field exploration svs	6.0	318.8	.019
3622	Industrial controls	12.2	668.4	.018
9997	Conglomerates	649.0	38,125.3	.017
227	Floor covering mills	34.3	2,046.8	.017
3713	Truck & bus bodies	131.3	7,733.4	.017
282	Plastic materials & synthetic res.	27.4	1,632.5	.017
30	Rubber & misc plastics prods	341.2	20,467.5	.017
348	Ordinance & accessories	4.5	279.6	.016
2841	Soap & other detergents	206.9	13,312.1	.016
356	General industrial machy & equip	124.4	7,882.7	.016
351	Engines & turbines	80.5	5,127.1	.016
285	Paints, varnishes, lacquers	51.0	3,410.6	.015
3652	Phonograph records	22.9	1,498.0	.015
10	Metal mining	75.7	5,341.1	.014
364	Electric lighting & wiring equip	4.6	326.9	.014
355	Special industry machy	69.4	5,212.6	.013
375	Motorcycles, bicycles & parts	4.3	342.9	.013
3714	Motor vehicle parts & access	245.9	18,267.0	.013
329	Abrasives, asbestos & misc minerals	36.5	3,183.1	.011
358	Refrig & service industry machy	28.1	2,567.6	.011
343	Heating equip & plumbing fixts	30.6	2,891.3	.011
373	Ship & boat building & repair	35.0	3,151.2	.011
333	Prim smelt & refin nonfer mtls	132.6	12,003.0	.011

Table A2 (cont'd)

363	Household appliances	93.7	8,903.9	.011
3558	Pollution control machy	27.0	2,507.2	.011
4811	Telephone communication	522.1	50,191.5	.010
3079	Misc plastic prods	8.3	817.5	.010
02	Agricultural production-livestock	1.0	100.3	.010
3533	Oil field machy & equip	63.0	6,262.9	.010
387	Watches, clocks & parts	4.7	468.0	.010
341	Metal cans & shipping conts	74.9	7,324.5	.010
3931	Musical instruments	3.6	369.3	.010
2649	Converted paper & paperboard prods NEC	14.0	1,555.1	.009
7393	Detective & protective svs	4.0	466.1	.009
3452	Bolts, nuts, screws, rivets, washrs	7.3	856.0	.008
251	Household furniture	9.7	1,262.8	.008
3221	Glass containers	43.2	5,581.3	.008
20	Food & kindred prods	194.6	26,266.7	.007
376	Guided missiles & space vehicles	52.6	7,745.0	.007
3494	Valves & pipe fittings exc brass	9.7	1,319.1	.007
3199	Leather goods NEC	.6	80.0	.007
3429	Hardware NEC	13.4	1,987.9	.007
325	Structural clay prods	.2	22.0	.007
3499	Fabricated metal prods NEC	19.7	2,942.9	.007
399	Misc manufacturing industries	4.2	703.5	.006
295	Paving & roofing materials	30.0	5,231.8	.006
805	Svs-nursing & person care fac	.8	129.8	.006
335	Rolling & draw nonfer metals	15.0	2,452.9	.006
203	Canned & preserved fruits & vegs	26.1	4,233.8	.006
339	Misc primary metal prods	8.3	1,343.0	.006
26	Paper & allied prods	80.2	12,592.9	.006
3069	Fabricated rubber prods NEC	3.0	472.4	.006
331	Blast furnaces & steel works	134.3	26,501.9	.005
1031	Lead & zinc ores	3.4	642.2	.005
24	Lumber & wood prods	54.0	10,261.0	.005
2048	Prepared feeds for animals	17.6	3,756.3	.005

Table A2 (cont'd)

2761	Manifold business forms	3.1	654.2	.005
265	Paperboard containers & boxes	4.5	938.7	.005
2065	Candy & other confectionery	5.0	1,342.8	.004
2911	Petroleum refining	1,086.4	265,471.1	.004
202	Dairy prods	41.8	11,160.5	.004
252	Office furniture	1.0	249.8	.004
2082	Malt bev erages	15.9	4,345.8	.004
245	Wood buildings & mobile homes	7.6	1,738.4	.004
2046	Wet corn milling	5.7	1,381.8	.004
7399	Business svs NEC	6.0	1,740.1	.003
3716	Motor homes	1.1	408.6	.003
783	Motion pictures theatres	.1	22.6	.003
2121	Cigars	.9	367.7	.003
82	Educations svs	.1	47.1	.003
3449	Misc metal work	11.5	3,897.6	.003
806	Hospitals	2.1	623.9	.003
1381	Drilling oil & gas wells	3.6	1,219.1	.003
3792	Travel trailers & campers	.8	231.8	.003
22	Textile mill prods	37.6	11,836.9	.003
327	Concrete gypsum & plaster	11.4	4,003.7	.003
2085	Distilled rectif blend beverages	6.5	1,976.5	.003
374	Railroad equip	6.8	2,001.3	.003
1021	Copper ores	1.2	444.7	.003
2062	Cane sugar refining	2.9	950.4	.003
16	Construction contractors, not bldgs	37.7	13,435.6	.003
2063	Beet sugar	3.4	985.8	.003
1311	Crude petroleum & natural gas	34.5	12,581.2	.003
2086	Bottled & canned soft drinks	11.1	4,148.0	.003
3241	Hydraulic cement	1.8	916.3	.002
8911	Engineering & architectural svs	1.3	853.1	.002
1211	Bituminous coal & lignite mining	3.6	2,246.8	.002
3911	Jewelry & precious metals	.5	264.4	.002
201	Meat prods	29.8	13,158.7	.002

Table A2 (cont'd)

207	Fats & oils	7.9	5,239.5	.002
2111	Cigarettes	19.9	8,804.3	.002
7213	Linen supply svs	.3	277.6	.001
3341	Sec smelting & refining nonfer mtls	1.1	863.0	.001
7011	Hotels & motels	1.8	1,361.4	.001
275	Commercial printing	1.9	1,452.8	.001
7394	Equip rental & leasing svs	.6	491.5	.001
152	General building contractors	.5	669.3	.001
4011	Railroads line haul operating	15.8	12,895.6	.001
205	Bakery prods	.8	1,513.3	.001
2041	Flour & other grain mill prods	1.6	1,651.2	.001
4926	Natural gas transmission	6.3	5,318.2	.001
395	Pens & pencils & oth offic mtls	.4	282.5	.001
314	Footwear except rubber	1.2	3,942.3	.000
75	Automotive repair services & garages	.2	694.8	.000
23	Apparel & other finished prods	3.9	9,295.8	.000
72	Personal svs	.1	282.2	.000
2099	Food preparations NEC	.1	309.3	.000
2711	Newspaper publishing & printing	.9	2,006.3	.000
4927	Natural gas transmission & distr.	.1	452.9	.000
332	Iron & steel foundries		101.6	.000
01	Agricultural production--crops		250.7	.000
1041	Gold ores		160.7	.000
3914	Silverware & plateware		155.7	.000
2771	Greeting card publishing		13.6	.000
7311	Advertising agencies		272.6	.000
17	Construction special contractors		86.6	.000
612	Savings & loan associations		470.9	.000
2721	Periodicals publishing & printing		459.0	.000
799	Misc amusement & recreation svs		97.1	.000
1499	Misc nonmetallic minerals		58.5	.000
495	Sanitary services		405.6	.000

Table A2 (cont'd)

287	Agricultural chemicals		2,519.8	.000
7392	Mgmt cons & pub rels svs		233.4	.000
1531	Operative builders		722.4	.000
2731	Books publishing & printing		960.6	.000
781	Motion picture production		658.0	.000
44	Water transportation		649.9	.000
62	Security & commodity brokers		444.9	.000
421	Trucking local & long distance		3,549.6	.000
483	Radio-TV broadcasters		262.5	.000
47	Transportation svs		865.9	.000
679	Misc investment companies		158.1	.000
4511	Air transportation certified		9,342.3	.000
615	Business credit institutions		382.3	.000
65	Real estate		144.1	.000
4928	Natural gas distribution		554.2	.000
6798	Real estate investment trusts		505.3	.000
614	Personal credit institutions		270.6	.000
64	Insurance agents brokers & sv		237.4	.000
6552	Subdividers & developers exc cemetaries		313.2	.000
6199	Finance-svs		1,191.1	.000
50(Memo)	Wholesale & retail	32.9	99,220.6	.000

Source: Standard & Poor's Compustat Tape, 1980
NEC - Not elsewhere classified

Table A3

List of Science and Engineering Fields Used by National Science Foundation In Its Annual Surveys of Academic Science

Field	Illustrative Disciplines
Engineering	Aeronautical, agricultural, architecture, chemical, civil, electrical, industrial, mechanical, metallurgical, mining, nuclear, petroleum, bio- and biomedical, energy, textile
Physical sciences	
Astronomy	Astrophysics, optical and radio, x-ray, gamma-ray, neutrino
Chemistry	Inorganic, organo-metallic, organic, physical, analytical, pharmaceutical, polymer science (excludes bio-chemistry)
Physics	Acoustics, atomic and molecular, condensed matter, elementary particles, nuclear structure, optics, plasma
Other	Used for multidisciplinary projects within physical science and for disciplines not requested separately
Environmental sciences	Atmospheric sciences: Aeronomy, solar weather modification, meteorology, extra-terrestrial atmospheres
	Geological sciences: Engineering geophysics, geology, geodesy, geomagnetism, hydrology, geochemistry, paleomagnetism, paleontology, physical geography, cartography, seismology, soil sciences
	Oceanography: Chemical, geological, physical, marine geophysics, marine biology, biological oceanography
	Other environmental sciences, n.e.c.
Mathematical and computer sciences	
Mathematics	Algebra, analysis, applied mathematics, foundations and logic, geometry, numerical analysis, statistics, topology

Table A3 (cont'd)

Computer sciences	Design, development, and application of computer capabilities to data storage and manipulation, information science
Life sciences	
Biological sciences	Anatomy, biochemistry, biophysics, biogeography, ecology, embryology, entomology, genetics, immunology, microbiology, nutrition, pathology, pharmacology, physical anthropology, physiology, botany, zoology
Agricultural	Agricultural chemistry, agronomy, animal science, conservation, dairy science, plant science, range science, wildlife
Medical	Anesthesiology, cardiology, endocrinology, gastrenterology, hematology, neurology, obstetrics, ophthalmology, preventive medicine and community health, psychiatry, radiology, surgery, veterinary medicine, denistry, pharmacy
Other	Used for multidisciplinary projects within life sciences
Psychology	Animal behavior, clinical, educational, experimental, human development and personality, social
Social sciences	
Economics	Econometrics, international, industrial, labor agricultural, public finance and fiscal policy
Political science	Regional studies, comparative government, international relations, legal systems, political theory, public administration
Sociology	Comparative and historical, complex organizations, culture and social structure, demography, group interactions, social problems and welfare, theory
Other	History of science, cultural anthropology, linguistics, socioeconomic geography

Table A3 (cont'd)

Other sciences, n.e.c.	To be used when the multidisciplinary and interdisciplinary aspects make the classification under one primary field impossible

n.e.c.--Not elsewhere classified

Source: National Science Foundation, *Academic Science, R & D Funds, Fiscal Year 1980*, NSF 79-320

Table A4

Data by SMSA/NECMA on Factors Highly Associated With the Geographical Distribution of the Formation of NSTBF, Circa 1975

SMSA/NECMA	R&DNO (No.)	DEGREES (No.)	R&DMIL ($Mil.)	FEDOBNO (No.)	FEDOBMIL ($MIL.)	ESTBF (No.)
Abilene TX	4	16	66.0	1	1.7	59
Akron OH	6	52	249.3	1	1.7	123
Albany GA	0	49	-2.8	1	1.3	39
Albany-Schenectady-Troy NY	8	107	33.7	1	0.5	191
Albuquerque NM	2	41	25.2	1	1.7	131
Alexandria LA	0	49	-2.8	1	1.3	50
Allentown-Bethlehem-Easton PA-NJ	3	52	74.4	1	1.5	153
Altoona PA	1	214	64.4	1	0.8	36
Amarillo TX	1	38	6.7	1	1.3	83
Anaheim-Santa Ana-Garden Grove CA	12	220	69.0	1	1.0	422
Anderson IN	0	49	-2.8	1	1.7	40
Ann Arbor MI	3	449	95.1	1	4.3	57
Anniston AL	0	18	0.4	1	1.3	19
Appleton-Oshkosh WI	2	39	26.3	1	1.3	88
Asheville NC	1	25	19.7	1	1.3	40
Atlanta GA	6	205	64.1	1	0.9	609
Atlantic City NJ	1	53	2.0	1	1.3	63
Augusta GA-SC	1	10	5.1	1	1.3	67
Austin TX	4	261	93.8	1	1.0	102
Bakersfield CA	4	1	77.8	1	1.7	97

Table A4 (cont'd)

Baltimore MD	5	222	94.2	1	6.8	513
Baton Rouge LA	2	116	41.8	1	1.5	95
Battle Creek MI	1	48	7.7	1	1.3	42
Bay City MI	1	46	203.3	1	1.3	29
Beaumont-Port Arthur-Orange TX	1	93	6.7	1	1.3	77
Billings MT	0	49	-2.8	1	1.3	54
Biloxi-Gulfport MS	0	51	-0.4	1	1.3	30
Binghamton NY-PA	2	329	86.3	1	3.4	99
Birmingham AL	4	22	33.1	1	1.3	196
Bloomington IN	1	177	12.3	1	0.9	29
Bloomington-Normal IL	0	49	-2.8	1	1.3	50
Boise ID	1	51	4.0	1	1.3	47
Boston-Lowell-Brockton-Lawrence-Haverhill MA-NH	67	1056	676.1	4	14.7	1049
Bradenton FL	2	74	30.4	1	1.5	34
Bridgeport-Stamford-Norwalk-Danbury CT	39	67	1179.3	1	2.6	255
Brownsville-Harlingen-Sanbenito TX	1	13	6.7	1	1.3	51
Bryan-College Station TX	1	180	59.6	1	1.3	19
Buffalo NY	8	207	25.2	1	1.2	392
Burlington NC	0	51	30.4	1	1.3	27
Canton OH	3	60	17.1	1	1.4	89
Cedar Rapids IA	1	105	27.3	1	2.3	49
Champaign-Urbana-Rantoul IL	2	412	73.9	1	1.8	44
Charleston-North Charleston SC	1	24	5.9	1	1.3	69
Charleston WV	1	3	0.2	1	1.3	52
Charlotte-Gastonia NC	2	18	0.3	1	1.5	234

Table A4 (cont'd)

Chattanooga TN-GA	1	3	0.5	1	1.3	121
Chicago IL	70	1056	1051.9	3	8.4	1943
Cincinnati OH-KY-IN	8	186	198.3	1	0.6	363
Cleveland OH	20	278	283.5	1	2.5	531
Colorado Springs CO	1	60	11.5	1	1.4	81
Columbia MO	3	155	34.7	1	0.4	31
Columbia SC	3	34	4.3	1	1.4	82
Columbus OH	5	316	94.5	1	1.6	277
Corpus Christi TX	3	99	58.9	1	1.6	83
Dallas-Fort Worth TX	21	131	208.9	1	1.3	969
Davenport-Rock Island-Moline IA-IL	1	12	137.5	1	1.3	129
Dayton OH	11	180	155.2	1	1.8	204
Daytona Beach FL	3	2	47.0	1	1.5	71
Decatur IL	1	46	4.8	1	1.3	40
Denver-Boulder CO	12	247	90.6	2	3.1	530
Des Moines IA	2	219	91.9	1	1.4	157
Detroit, MI	22	215	3235.3	1	0.4	906
Dubuque IA	0	13	-7.5	1	1.3	49
Duluth-Superior MN-WI	1	30	4.4	1	1.3	57
Eau Claire WI	0	32	-7.5	1	1.3	49
El Paso TX	2	117	15.9	1	1.4	108
Elmira NY	0	48	-5.1	1	1.3	28
Erie PA	4	60	7.8	1	1.4	71
Eugene-Springfield OR	4	248	41.8	2	1.0	58
Evansville IN-KY	1	5	18.6	1	1.4	103

Table A4 (cont'd)

Fayetteville NC	0	49	-2.8	1	1.3	37
Fayetteville-Springdale AR	1	49	16.1	1	1.3	45
Flint MI	0	46	-7.5	1	1.3	84
Florence AL	1	56	6.7	1	1.3	29
Fort Collins CO	1	122	34.6	1	0.3	37
Fort Lauderdale-Hollywood FL	5	83	5.2	1	2.1	269
Fort Myers FL	3	91	54.1	1	1.6	53
Fort Smith AR-OK	1	49	1.6	1	1.3	54
Fort Wayne IN	3	35	6.5	1	1.4	128
Fresno CA	3	72	42.3	1	1.5	169
Gainesville FL	1	209	46.6	1	1.9	39
Galveston-Texas City TX	2	10	12.8	1	0.5	28
Gary-Hammond-East Chicago IN	1	59	11.5	1	1.4	98
Grand Forks ND-MN	1	19	4.1	1	1.3	38
Grand Rapids MI	3	97	3.0	1	1.6	183
Great Falls MT	0	48	-5.1	1	1.3	35
Greeley CO	1	20	2.0	1	1.3	46
Green Bay WI	1	55	0.6	1	1.3	59
Greensboro-Winston-Salem-High Point NC	4	31	12.4	1	0.6	191
Greenville-Spartanburg SC	4	64	16.3	1	1.5	131
Hamilton-Middletown OH	1	53	2.0	1	1.3	47
Harrisburg PA	3	39	61.8	1	1.4	125
Hartford-New Britain-Bristol CT	15	234	461.0	1	0.9	235
Honolulu HI	4	83	35.0	1	1.7	296
Houston TX	25	257	136.5	3	2.5	600

Table A4 (cont'd)

Huntington-Ashland WV-KY-OH	1	66	5.5	1	1.3	79
Huntsville AL	1	20	16.2	1	1.4	77
Indianapolis IN	5	67	162.4	1	0.9	324
Jackson MI	2	55	2.5	1	1.3	37
Jackson MS	1	21	18.6	1	1.4	77
Jacksonville FL	3	4	61.2	1	1.6	203
Janesville-Beloit WI	1	49	2.1	1	1.3	36
Jersey City NJ	4	40	287.8	1	1.6	203
Johnson City-Kingsport-Bristol TN-VA	0	48	-5.1	1	1.3	81
Johnstown PA	1	44	0.1	1	1.3	50
Kalamazoo-Portage MI	4	5	103.0	1	1.3	76
Kansas City MO-KS	9	65	37.5	1	2.3	492
Kenosha WI	1	53	2.3	1	1.3	29
Killeen-Temple TX	0	48	-5.1	1	1.3	37
Knoxville TN	2	146	23.2	1	0.5	111
Kokomoa IN	0	48	-5.1	1	1.3	26
La Crosse WI	1	23	9.0	1	1.3	37
Lafayette LA	3	8	56.5	1	1.6	40
Lafayette-West Lafayette IN	3	366	50.5	1	1.2	35
Lake Charles LA	1	14	9.1	1	1.3	38
Lakeland-Winter Haven FL	1	74	0.2	1	1.5	94
Lancaster PA	1	37	27.1	1	1.4	111
Lansing-East Lansing MI	1	332	55.4	1	1.2	105
Laredo TX	1	58	9.1	1	1.3	33
Las Vegas NV	2	15	30.4	1	1.5	99

Table A4 (cont'd)

Lawrence KS	1	167	15.4	1	1.1	13
Lawton OK	0	49	-2.8	1	1.3	21
Lewiston-Auburn ME	0	48	-5.1	1	1.3	31
Lexington-Fayette KY	1	140	25.8	1	1.4	95
Lima OH	0	48	-5.1	1	1.3	71
Lincoln NE	1	110	25.5	1	1.3	67
Little Rock-North Little Rock AR	1	48	4.5	1	1.4	120
Long Branch-Asbury Park NJ	2	107	2.8	1	1.7	107
Longview TX	1	58	9.1	1	1.3	41
Lorain-Elyria OH	1	56	6.7	1	1.3	34
Los Angeles-Long Beach CA	55	1617	712.7	3	8.0	2303
Louisville KY-IN	3	27	11.2	1	1.8	219
Lubbock TX	1	74	9.7	1	1.4	89
Lynchburg VA	0	4	-0.4	1	1.3	39
Macon GA	0	3	-7.5	1	1.3	72
Madison WI	3	473	114.4	1	4.9	124
Manchester-Nashua NH	4	5	15.8	1	1.5	61
Mansfield OH	2	48	4.4	1	1.3	36
McAllen-Pharr-Edinburg TX	1	55	4.4	1	1.3	69
Melbourne-Titusville-Cocoa FL	1	97	25.9	1	1.6	59
Memphis TN-AR-MS	2	31	7.3	1	1.7	276
Miami FL	6	43	39.1	1	0.6	609
Midland TX	1	111	0.0	1	1.7	19
Milwaukee WI	18	74	91.4	1	2.1	398
Minneapolis-St. Paul MN-WI	21	301	588.6	1	4.9	710

Table A4 (cont'd)

Mobile AL	1	67	21.0	1	1.4	116
Modesto CA	1	4	13.8	1	1.4	72
Monroe LA	2	43	25.7	1	1.4	42
Montgomery AL	1	105	11.5	1	1.4	83
Muncie IN	1	4	4.7	1	1.3	39
Muskegon-Norton Shores-Muskegon Heights MI	1	55	2.6	1	1.3	33
Nashville-Davidson TN	2	308	20.5	1	1.5	220
Nassau-Suffolk NY	17	338	70.6	2	3.4	1124
New Bedford-Fall River MA	1	56	6.7	1	1.3	110
New Brunswick-Perth Amboy-Sayreville NJ	7	201	165.8	1	1.7	121
New Haven-West Haven-Waterbury-Meriden CT	8	304	122.3	1	5.6	211
New London-Norwich CT	1	12	9.1	1	1.3	39
New Orleans LA	4	101	16.6	1	0.8	316
New York NY-NJ	146	1976	4051.1	6	13.8	4727
Newark NJ	22	225	391.2	1	0.4	556
Newport News-Hampton VA	1	21	4.4	1	1.3	55
Norfolk-Virginia Beach-Portsmouth VA-NC	1	1	2.6	1	1.5	165
Northeast Pennsylvania	3	114	42.3	1	1.5	167
Odessa TX	3	2	58.9	1	1.6	17
Oklahoma City OK	5	188	18.7	1	2.0	239
Omaha NE-IA	1	48	7.1	1	1.6	215
Orlando FL	19	137	390.7	2	3.4	182
Owensboro KY	1	53	2.0	1	1.3	32
Oxnard-Simi Valley-Ventura CA	6	133	111.0	1	1.9	97
Panama City FL	1	55	4.4	1	1.3	16

Table A4 (cont'd)

Parkersburg-Marietta WV-OH	1	53	2.0	1	1.3	37
Pascagoula-Moss Point MS	0	49	-2.8	1	1.3	11
Paterson-Clifton-Passaic NJ	8	80	122.9	1	1.9	167
Pensacola FL	2	124	25.7	1	1.4	57
Peoria IL	2	57	150.2	1	1.4	141
Petersburg-Colonial Heights-Hopewell VA	0	48	-5.1	1	1.3	22
Philadelphia PA-NJ	40	523	370.4	3	7.0	1232
Phoenix AZ	5	53	24.8	2	3.3	450
Pittsburgh PA	27	110	512.3	2	1.6	543
Pittsfield MA	1	171	8.4	1	0.7	25
Portland ME	0	17	-7.5	1	1.3	53
Portland OR-WA	7	109	73.2	1	0.7	363
Poughkeepsie NY	1	15	4.4	1	1.3	54
Providence-Warwick-Pawtucket RI	8	198	93.4	1	0.5	228
Provo-Orem UT	1	28	3.9	1	1.3	28
Pueblo CO	0	49	-2.8	1	1.3	32
Racine WI	1	5	2.3	1	1.3	46
Raleigh-Durham NC	6	449	109.6	3	9.3	139
Rapid City SD	0	4	-7.5	1	1.3	28
Reading PA	1	26	9.2	1	1.3	87
Reno NV	2	14	6.8	1	1.4	54
Richland-Kennewick WA	3	86	47.0	1	1.5	48
Richmond VA	6	59	85.5	1	0.9	152
Riverside-San Bernardino-Ontario CA	3	97	26.0	1	1.8	315
Roanoke VA	1	105	26.2	1	1.3	65

Table A4 (cont'd)

Rochester NY	7	271	440.2	1	2.9	262
Rockford IL	2	55	22.8	1	1.3	70
Sacremento CA	1	271	51.4	1	1.7	230
Saginaw MI	1	58	9.1	1	1.3	56
St. Cloud MN	1	7	4.4	1	1.3	53
St. Joseph MO	0	40	-2.8	1	1.3	48
St. Louis MO-IL	12	349	407.1	2	4.9	732
Salem OR	1	58	9.1	1	1.3	65
Salinas-Seaside-Monterey CA	1	15	4.5	1	1.4	94
Salt Lake City-Ogden UT	5	168	49.1	1	1.1	239
San Angelo TX	0	16	-0.4	1	1.3	29
San Antonio TX	5	130	28.5	1	1.9	256
San Diego CA	11	261	123.8	1	3.5	401
San Francisco-Oakland CA	24	1213	422.8	3	15.3	1192
San Jose CA	20	374	296.0	2	4.3	315
Santa Barbara-Santa Maria-Lompoc CA	3	154	12.3	1	1.5	94
Santa Cruz CA	1	28	6.9	1	1.4	61
Santa Rosa CA	1	8	21.0	1	1.4	87
Sarasota FL	1	98	0.0	1	1.6	59
Savannah GA	1	56	0.3	1	1.4	58
Seattle-Everett WA	12	244	374.8	2	6.3	449
Sherman-Denison TX	0	46	-7.5	1	1.3	24
Shreveport LA	3	90	51.8	1	1.6	95
Sioux City IA-NE	0	1	-7.5	1	1.3	63

Table A4 (cont'd)

Sioux Falls SD	1	53	2.0	1	1.3	49
South Bend IN	1	102	6.3	1	1.4	69
Spokane WA	5	59	87.3	1	1.8	113
Springfield IL	1	113	4.4	1	1.3	74
Springfield-Chicopee-Holyoke MA	2	198	23.8	1	0.3	160
Springfield MO	0	10	-0.4	1	1.3	97
Springfield OH	0	48	-5.1	1	1.3	44
Steubenville-Weirton OH-WV	0	48	-5.1	1	1.3	35
Stockton CA	1	62	13.8	1	1.4	105
Syracuse NY	5	192	30.6	1	0.5	191
Tacoma WA	7	217	141.8	1	2.1	87
Tallahassee FL	1	107	16.5	1	0.5	35
Tampa-St. Petersburg FL	3	18	11.6	2	4.0	402
Terre Haute IN	0	10	-2.8	1	1.3	66
Texarkana TX-AR	0	49	-2.8	1	1.3	35
Toledo OH-MI	6	34	86.1	1	1.5	199
Topeka KS	1	41	0.3	1	1.3	61
Trenton NJ	7	173	26.3	1	1.6	74
Tucson AZ	2	157	44.0	1	0.8	117
Tulsa OK	4	8	17.3	1	2.2	205
Tuscaloosa AL	0	19	-7.5	1	1.3	25
Tyler TX	1	56	11.5	1	1.4	55
Utica-Rome NY	1	55	4.4	1	1.3	88
Vallejo-Fairfield-Napa CA	1	55	4.4	1	1.3	54
Vineland-Millville-Bridgeton NJ	1	48	0.3	1	1.3	30

Table A4 (cont'd)

Waco TX	0	17	-2.8	1	1.3	61
Washington DC-MD-VA	43	423	121.4	3	1.8	677
Waterloo-Cedar Falls IA	0	23	-5.1	1	1.3	42
West Palm Besch-Boca Raton FL	4	102	68.3	1	1.7	164
Wichita KS	4	82	55.0	1	1.8	137
Wichita Falls TX	3	19	47.0	1	1.5	43
Wilmington DE-NJ-MD	3	53	415.7	1	1.5	120
Wilmington NC	0	48	-5.1	1	1.3	26
Worcester-Fitchburg-Leominster MA	4	129	41.2	1	1.4	160
Yakima WA	2	72	28.1	1	1.4	69
York PA	3	65	5.1	1	1.4	87
Youngstown-Warren OH	1	28	19.2	1	1.4	100

Table A5

Summary by State of Selected Taxes on Hypothetical NSTBF and on Its Entrepreneur for 1979

State	Unemployment Insurance Tax	Business Income Tax	Property Tax	Capital Values and Franchise Tax	State Personal Income Tax	Total
AL	40,000	12,500	8,378	750	2,415	64,043
AK	55,000	23,500	11,919	-	3,250	93,669
AZ	37,500	25,966	25,406	-	-	88,872
AR	44,000	14,440	15,054	100	3,790	77,384
CA	33,000	22,500	25,270	-	4,745	85,515
CO	45,000	12,500	25,242	-	3,650	86,392
CT	60,000	25,000	31,005	3,100	3,500	122,605
DE	45,000	21,750	16,606	30	4,584	87,970
DC	45,000	47,500	12,788	100	4,700	110,088
FL	45,000	12,500	24,454	-	-	81,954
GA	57,100	15,000	16,620	500	2,740	91,960
HI	45,000	15,942	12,213	-	4,945	78,100
ID	44,000	16,260	24,280	100	3,610	88,250
IL	53,000	9,960	26,317	25	1,250	90,552
IN	32,000	7,500	33,683	-	950	74,133
IA	60,000	22,500	29,060	-	4,420	115,980
KS	36,000	16,313	34,554	1,000	3,875	91,742
KY	52,000	14,050	59,100	700	2,800	128,650
LA	33,000	16,250	14,612	1,500	1,800	67,162
ME	50,000	16,831	20,813	-	4,200	91,844

Table A5 (cont'd)

MD	50,000	15,750	17,062	-	2,440	85,242
MA	60,000	38,850	67,810	-	6,250	172,910
MI	90,000	5,875	15,700	-	2,300	113,875
MN	75,000	30,000	75,452	-	6,930	187,382
MS	27,000	9,950	18,253	2,500	1,950	59,653
MO	41,000	12,500	17,354	5,000	2,775	78,629
MT	44,000	16,875	88,215	-	4,500	153,590
NE	37,000	12,263	33,537	165	8,500	91,465
NV	30,000	-	16,877	-	-	46,877
NH	65,000	20,000	34,998	400	-	120,398
NJ	62,000	18,750	36,352	2,000	1,150	120,252
NM	42,000	12,500	11,325	550	2,286	68,661
NY	52,000	25,000	59,537	-	5,560	142,097
NC	57,000	15,000	15,080	1,500	3,280	91,860
ND	60,000	22,890	50,833	-	2,720	136,443
OH	38,000	19,000	18,718	-	1,250	76,968
OK	52,000	10,000	17,007	1,250	2,745	83,002
OR	40,000	18,750	24,700	75	4,845	88,370
PA	40,000	26,250	38,971	2,500	1,100	108,821
RI	40,000	20,000	31,623	63	1,758	93,444
SC	41,000	15,000	18,819	500	3,200	78,519
SD	55,000	-	47,575	-	-	102,575
TN	40,000	15,000	19,279	1,530	-	75,809
TX	40,000	-	14,192	4,250	-	58,442
UT	30,000	10,000	18,788	-	3,650	62,438

Table A5 (cont'd)

VT	55,000	17,150	38,030	-	2,313	112,493
VA	32,000	15,000	13,747	120	2,655	63,522
WA	30,000	-	16,999	130	-	47,129
WV	33,000	15,000	16,244	190	2,252	66,686
WI	65,000	19,530	28,017	-	4,330	116,877
WY	27,000	-	18,833	50	-	45,883

Table A6

Data by SMSA/NECMA on Selected Criteria Traditionally Considered When Locating a New Business

SMSA/NECMA	State Taxes ($000) (a)	Union Strength % (b)	Strike Severity (No.) (c)	Labor Cost ($) (d)	Energy Costs (Cents) (e)
Abilene TX	58.4	12.5	326	186	217
Akron OH	77.0	32.4	259	224	241
Albany GA	92.0	14.4	95	152	243
Albany-Schenectady-Troy NY	142.1	37.6	75	191	267
Albuquerque NM	68.7	16.4	111	144	242
Alexandria LA	67.2	16.3	240	209	249
Allentown-Bethlehem-Easton PA-NJ	114.6	31.9	170	197	297
Altoona PA	108.8	37.0	192	193	291
Amarillo TX	58.4	12.5	326	186	217
Anaheim-Santa Ana-Garden Grove CA	85.8	27.3	169	206	324
Anderson IN	74.1	32.0	219	219	293
Ann Arbor MI	113.9	35.6	199	351	287
Anniston AL	64.0	19.1	356	162	214
Appleton-Oshkosh WI	116.9	29.1	331	212	305
Asheville NC	91.9	6.9	271	135	234
Atlanta GA	92.0	14.4	95	152	243
Atlantic City NJ	120.3	26.8	148	200	303
Augusta GA-SC	85.3	10.9	104	147	243
Austin TX	58.4	12.5	326	186	217
Bakersfield CA	85.5	27.3	169	206	324

Table A6 (cont'd)

Baltimore MD	85.2	23.7	218	197	237
Baton Rouge LA	67.2	16.3	240	209	249
Battle Creek MI	113.9	35.6	199	251	287
Bay City MI	113.9	35.6	199	251	287
Beaumont-Port Arthur-Orange TX	58.4	12.5	325	186	217
Billings MT	153.6	24.8	247	196	114
Biloxi-Gulfport MS	59.7	12.0	284	141	230
Binghamton NY-PA	125.5	37.3	133	192	279
Birmingham AL	64.0	19.1	356	162	214
Bloomington IN	74.1	32.0	219	219	293
Bloomington-Normal IL	90.6	33.6	176	219	342
Boise ID	88.3	14.8	439	185	161
Boston-Lowell-Brockton-Lawrence Haverhill MA-NH	146.7	19.5	118	165	292
Bradenton FL	82.0	12.8	200	164	243
Bridgeport-Stamford-Norwalk-Danbury CT	122.6	25.0	231	194	436
Brownsville-Harlingen-Sanbenito TX	58.4	12.5	326	186	217
Bryan-College Station TX	58.4	12.5	326	186	217
Buffalo NY	142.1	37.6	75	191	267
Burlington NC	91.9	6.9	271	135	234
Canton OH	77.0	32.4	259	224	241
Cedar Rapids IA	116.0	19.9	326	214	194
Champaign-Urbana-Rantoul IL	90.6	33.6	176	219	342
Charleston-North Charleston SC	78.5	7.3	113	141	242
Charleston WV	66.7	38.6	557	192	269
Charleston-Gastonia NC	91.9	6.9	271	135	234

Table A6 (cont'd)

Chattanooga TN-GA	83.9	16.5	185	154	215
Chicago IL	90.6	33.6	176	219	342
Cincinnati Oh-KY-IN	93.3	29.8	284	208	235
Cleveland OH	77.0	32.4	259	224	241
Colorado Springs CO	86.4	18.2	81	190	282
Columbia MO	78.6	32.1	305	185	224
Columbia SC	78.5	7.3	113	141	242
Columbus OH	77.0	32.4	259	224	241
Corpus Christi TX	58.4	12.5	326	186	217
Dallas-Fort Worth TX	58.4	12.5	326	186	217
Davenport-Rock Island-Moline IA-IL	103.3	26.8	251	217	268
Dayton OH	77.0	32.4	259	224	241
Daytona Beach FL	82.0	12.8	200	164	243
Decatur IL	90.6	33.6	176	219	342
Denver-Boulder CO	86.4	18.2	81	194	282
Des Moines IA	116.0	19.9	326	214	194
Detroit MI	113.9	35.6	199	251	287
Dubuque IA	116.0	19.9	326	214	194
Duluth-Superior MN-WI	152.2	27.2	233	206	294
Eau Claire WI	116.9	29.1	331	212	305
El Paso TX	58.4	12.5	326	186	217
Elmira NY	142.1	37.6	75	191	267
Erie PA	108.8	37.0	192	193	291
Eugene-Springfield OR	88.4	25.8	136	213	305
Evansville IN-KY	101.4	28.5	297	200	232

Table A6 (cont'd)

Fayetteville NC	91.9	6.9	271	135	234
Fayetteville-Springdale AR	77.4	16.2	187	139	231
Flint MI	113.9	35.6	199	251	287
Florence AL	64.0	19.1	356	162	214
Fort Collins CO	86.4	18.2	81	190	282
Fort Lauderdale-Hollywood FL	82.0	12.8	200	164	243
Fort Myers FL	82.0	12.8	200	164	243
Fort Smith AR-OK	80.2	15.3	215	159	222
Fort Wayne IN	74.1	32.0	219	219	293
Fresno CA	85.5	27.3	169	206	324
Gainesville FL	82.0	12.8	200	164	243
Galveston-Texas City FL	58.4	12.5	326	186	217
Gary-Hammond-East Chicago IN	74.1	32.0	219	219	293
Grand Fords ND-MN	161.9	19.5	102	186	205
Grand Rapids MI	113.9	35.6	199	251	287
Great Falls MT	153.6	24.8	247	196	114
Greeley CO	86.4	18.2	81	190	282
Green Bay WI	116.9	29.1	331	212	305
Greensboro-Winston-Salem-High Point NC	91.9	6.9	271	135	234
Greenville-Spartanburg SC	78.5	7.3	113	141	242
Hamilton-Middletown OH	77.0	32.4	259	224	241
Harrisburg PA	108.8	37.0	192	193	291
Hartford-New Britain-Bristol CT	122.6	25.0	231	194	436
Honolulu HI	78.1	36.6	142	183	259
Houston TX	58.4	12.5	326	186	217

Table A6 (cont'd)

Huntington-Ashland WV-KY-OH	90.8	32.0	397	199	227
Huntsville AL	64.0	19.1	356	162	214
Indianapolis IN	74.1	32.0	219	219	293
Jackson MI	113.9	35.6	199	251	287
Jackson MS	59.7	12.0	284	141	230
Jacksonville FL	82.0	12.8	200	164	243
Janesville-Beloit WI	116.9	29.1	331	212	305
Jersey City NJ	120.3	26.8	148	200	303
Johnson City-Kingsport-Bristol TN-VA	69.7	16.1	265	156	237
Johnstown PA	108.8	37.0	192	193	291
Kalamazoo-Portage MI	113.9	35.6	199	251	287
Kansas City MO-KS	85.2	23.4	255	187	185
Kenosha WI	116.9	29.1	331	212	305
Killeen-Temple TX	58.4	12.5	326	186	217
Knoxville TN	75.8	18.5	274	156	187
Kokomo IN	74.1	32.0	219	219	293
La Crosse WI	116.9	29.1	331	212	305
Lafayette LA	67.2	16.3	240	209	249
Lafayette-West Lafayette IN	74.1	32.0	219	219	293
Lake Charles LA	67.2	16.3	240	209	249
Lakeland-Winter Haven FL	82.0	12.8	200	164	243
Lancaster PA	108.8	37.0	192	193	291
Lansing-East Lansing MI	113.9	35.6	199	251	287
Laredo TX	58.4	12.5	326	186	217
Las Vegas NV	46.9	26.0	224	201	216

Table A6 (cont'd)

Lawrence KS	91.7	14.6	205	189	146
Lawton OK	83.0	14.3	243	178	213
Lewiston-Auburn ME	91.8	17.1	68	152	379
Lexington-Fayette KY	128.7	24.9	375	180	170
Lima OH	77.0	32.4	259	224	241
Lincoln NE	91.5	15.2	244	184	200
Little Rock-North Little Rock AR	77.4	16.2	187	139	231
Long Branch-Asbury Park NJ	120.3	26.8	148	200	303
Longview TX	58.4	12.5	326	186	217
Lorain-Elyria OH	77.0	32.4	259	224	241
Los Angeles-Long Beach CA	85.5	27.3	169	206	324
Louisville KY-IN	101.4	28.5	297	200	232
Lubbock TX	58.4	12.5	326	186	217
Lynchburg VA	63.5	13.7	255	156	287
Macon GA	92.0	14.4	95	152	243
Madison WI	116.9	29.1	331	212	305
Manchester-Nashua NH	120.4	14.4	76	155	247
Mansfield OH	77.0	32.4	259	224	241
McAllen-Pharr-Edinburg TX	58.4	12.5	326	186	217
Melbourne-Titusville-Cocoa FL	82.0	12.8	200	164	243
Memphis TN-AR-MS	71.0	23.4	248	145	216
Miami FL	82.0	12.8	200	164	243
Midland TX	58.4	12.5	326	186	217
Milwaukee WI	116.9	29.1	331	212	305
Minneapolis-St. Paul MN-WI	152.2	27.2	233	206	294

Table A6 (cont'd)

Mobile Al	64.0	19.1	356	162	214
Modesto CA	85.5	27.3	169	206	324
Monroe LA	67.2	16.3	240	209	249
Montgomery AL	64.0	19.1	356	162	214
Muncie IN	74.1	32.0	219	219	293
Muskegon-Norton Shores-Muskegon Heights MI	113.9	35.6	199	251	287
Nashville-Davidson TN	75.8	18.5	274	156	187
Nassau-Suffolk NY	142.1	37.6	75	191	267
New Bedford-Fall River MA	172.9	24.5	159	175	337
New Brunswick-Perth Amboy-Sayreville NJ	120.3	26.8	148	200	303
New Haven-West Haven-Waterbury-Meriden CT	122.6	25.0	231	194	436
New London-Norwich CT	122.6	25.0	231	194	436
New Orleans LA	67.2	16.3	240	209	249
New York NY-NJ	131.2	32.2	112	196	285
Newark NJ	120.3	26.8	148	200	303
Newport News-Hampton VA	63.5	13.7	255	156	287
Norfold-Virginia Beach-Portsmouth VA-NC	77.7	10.3	263	146	261
Northeast Pennsylvania	108.8	37.0	192	193	291
Odessa TX	58.4	12.5	326	186	217
Oklahoma City OK	83.0	14.3	243	178	213
Omaha NE-IA	103.8	17.6	285	199	197
Orlando FL	82.0	12.8	200	164	243
Owensboro KY	128.7	24.9	375	180	170
Oxnard-Simi Valley-Ventura CA	85.5	27.3	169	206	324
Panama City FL	82.0	12.8	200	164	243

Table A6 (cont'd)

Parkersburg-Marietta WV-OH	71.9	35.5	408	208	255
Pascagoula-Moss Point MS	59.7	12.0	284	141	230
Paterson-Clifton-Passaic NJ	120.3	26.8	148	200	303
Pensacola FL	82.0	12.8	200	164	243
Peoria IL	90.6	33.6	176	219	342
Petersburg-Colonial Heights-Hopewell VA	63.5	13.7	255	156	287
Philadelphia PA-NJ	114.6	31.9	170	197	297
Phoenix AZ	88.9	15.7	248	189	265
Pittsburgh PA	108.8	37.0	192	193	291
Pittsfield MA	172.9	24.5	159	175	337
Portland ME	91.8	17.1	68	152	379
Portland OR-WA	67.8	31.0	214	219	268
Poughkeepsie NY	142.1	37.6	75	191	267
Providence-Warwick-Pawtucket RI	93.4	29.2	192	149	267
Provo-Orem UT	62.4	14.2	158	156	172
Pueblo CO	86.4	18.2	81	190	282
Racine WI	116.9	29.1	331	212	305
Raleigh-Durham NC	91.9	6.9	271	135	234
Rapid City SD	102.6	10.3	245	172	144
Reading PA	108.8	37.0	192	193	291
Reno NV	46.9	26.0	224	201	216
Richland-Kennewick WA	47.1	36.2	291	224	230
Richmond VA	63.5	13.7	255	156	287
Riverside-San Bernardino-Ontario CA	85.5	27.3	169	206	324
Roanoke VA	63.5	13.7	255	156	287

Table A6 (cont'd)

Rochester NY	142.1	37.6	75	191	267
Rockford IL	90.6	33.6	176	219	342
Sacramento CA	85.5	27.3	169	206	324
Saginaw MI	113.9	35.6	199	251	287
St. Cloud MN	187.4	25.3	135	200	282
St. Joseph MO	78.6	32.1	305	185	224
St. Louis MO-IL	84.6	32.9	241	202	283
Salem OR	88.4	25.8	136	213	305
Salinas-Seaside-Monterey CA	85.5	27.3	169	206	324
Salt Lake City-Ogden UT	62.4	14.2	158	156	172
San Angelo TX	58.4	12.5	326	186	217
San Antonio TX	58.4	12.5	326	186	217
San Diego CA	85.5	27.3	169	206	324
San Francisco-Oakland CA	85.5	27.3	169	206	324
San Jose CA	85.5	27.3	169	206	324.
Santa Barbara-Santa Maria-Lompoc CA	85.5	27.3	169	206	324
Santa Cruz CA	85.5	27.3	169	206	324
Santa Rosa CA	85.5	27.3	169	206	324
Sarasota FL	82.0	12.8	200	164	243
Savannah GA	92.0	14.4	95	152	243
Seattle-Everett WA	47.1	36.2	291	224	230
Sherman-Denison TX	58.4	12.5	326	186	217
Shreveport LA	67.2	16.3	240	209	249
Sioux City IA-NE	103.8	17.6	285	199	197

Table A6 (cont'd)

Sioux Falls SD	102.6	10.3	245	172	144
South Bend IN	74.1	32.0	219	219	293
Spokane WA	47.1	36.2	291	224	230
Springfield IL	90.6	33.6	176	219	342
Springfield-Chicopee-Holyoke MA	172.9	24.5	156	175	337
Springfield MO	78.6	32.1	305	185	224
Springfield OH	77.0	32.4	259	224	241
Steubenville-Weirton OH-WV	71.9	35.5	408	208	255
Stockton CA	85.5	27.3	169	206	324
Syracuse NY	142.1	37.6	75	191	267
Tacome WA	47.1	36.2	291	224	230
Tallahassee FL	82.0	12.8	200	164	243
Tampa-St. Petersburg FL	82.0	12.8	200	164	243
Terre Haute IN	74.1	32.0	219	219	293
Texarkana TX-AR	67.9	16.2	187	139	231
Toledo OH-MI	95.5	34.0	229	340	264
Topeka KS	91.7	14.6	205	146	146
Trenton NJ	120.3	26.8	148	268	303
Tucson AZ	88.9	15.7	248	157	265
Tulsa OK	83.0	14.3	243	143	213
Tuscaloosa AL	64.0	19.1	356	191	214
Tyler TX	58.4	12.5	326	125	217
Utica-Rome NY	142.1	37.6	75	376	267
Vallejo-Fairfield-Napa CA	85.5	27.3	169	273	324
Vineland-Millville-Bridgeton NJ	120.3	26.8	148	268	303

Tabe A6 (cont'd)

Waco TX	58.4	12.5	326	125	217
Washington DC-MD-VA	86.2	17.6	219	176	264
Waterloo-Cedar Falls IA	116.0	19.9	326	199	194
West Palm Beach-Boca Raton FL	82.0	12.8	200	128	243
Wichita KS	91.7	14.6	205	146	146
Wichita Falls TX	58.4	12.5	326	125	217
Wilmington DE-NJ-MD	97.8	23.7	159	237	277
Wilmington NC	91.9	6.9	271	69	234
Worcester-Fitchburg-Leominster MA	172.9	24.5	159	245	337
Yakima WA	47.1	36.2	291	362	230
York PA	108.8	37.0	192	370	291
Youngstown-Warren OH	77.0	32.4	259	324	241

(a) Based on data by state in Appendix Table A5 for a hypothetical new firm.

(b) Average annual labor union membership as a percentage of nonagricultural employment, 1974-6.

(c) Average annual number of days idle per 100 union members, 1974-6.

(d) Average weekly earnings, 1975.

(e) An unweighted average of the costs, in cents per million BTU, of each of the three types of fuel used by electric utility plants in July, 1980: coal, oil, and gas.

Table A7

Data by SMSA/NECMA on Number of Patents Issued in 1975

SMSA/NECMA	Patents (No.)	SMSA/NECMA	Patents (No.)
Abilene TX	2096	Baltimore MD	972
Akron OH	2934	Baton Rouge LA	376
Albany GA	343	Battle Creek MI	2588
Albany-Schenectady-Troy NY	4468	Bay City MI	2588
Albuquerque NM	114	Beaumont-Port Arthur-Orange TX	2096
Alexandria LA	376	Billings MT	51
Allentown-Bethlehem-Easton PA-NJ	3569	Biloxi-Gulfport MS	105
Altoona PA	3416	Binghamton NY-PA	3942
Amarillo TX	2096	Birmingham AL	230
Anaheim-Santa Ana-Garden Grove CA	6213	Bloomington IN	1069
Anderson IN	1069	Bloomington-Normal IL	3677
Ann Arbor MI	2588	Boise ID	102
Anniston AL	230	Boston-Lowell-Brockton-Lawrence	
Appleton-Oshkosh WI	881	Haverhill MA-NH	1058
Asheville NC	514	Bradenton FL	974
		Bridgeport-Stamford-Norwalk-	
Atlanta GA	343	Danbury CT	1515
Atlantic City NJ	3721		
Augusta GA-SC	294	Brownsville-Harlingen-Sanbenito TX	2096
Austin TX	2096	Bryan-College Station TX	2096
Bakersfield CA	6213	Buffalo NY	4468
		Burlington NC	514
		Canton OH	2934

Table A7 (cont'd)

Cedar Rapids IA	346	El Paso TX	2096
Champaign-Urbana-Rantoul IL	3677	Elmira NY	4468
Charleston-North Charleston SC	244	Erie PA	3416
Charleston WV	141	Eugene-Springfield OR	326
Charlotte-Gastonia NC	514	Evansville IN-KY	693
Chattanooga TN-GA	353	Fayetteville NC	514
Chicago Il	3677	Fayetteville-Springdale AR	78
Cincinnati OH-Ky-IN	1440	Flint MI	588
Cleveland OH	2934	Florence AL	230
Colorado Springs CO	546	Fort Collins CO	546
Columbia MO	637	Fort Lauderdale-Hollywood FL	974
Columbia SC	244	Fort Myers FL	974
Columbus OH	2934	Fort Smith AR-OK	378
Corpus Christi TX	2096	Fort Wayne IN	1069
Dallas-Fort Worth TX	2096	Fresno CA	6213
Davenport-Rock Island-Moline IA-IL	2012	Gainsville FL	974
Dayton OH	2934	Galveston-Texas City TX	2096
Daytona Beach FL	974	Gary-Hammond-East Chicago IN	1069
Decatur IL	3677	Grand Forks ND-MN	511
Denver-Boulder CO	546	Grand Rapids MI	2588
Des Moines IA	346	Great Falls MT	51
Detroit MI	2588	Greeley CO	546
Dubuque IA	346	Green Bay WI	881
Duluth-Superior MN-WI	933	Greensboro-Winston-Salem-High Point NC	514
Eau Claire WI	881	Greenville-Spartanburg SC	244

Table A7 (cont'd)

Hamilton-Middleton OH	2934
Harrisburg PA	3416
Hartford-New Britain-Bristol CT	1515
Honolulu HI	61
Houston TX	2096
Huntington-Ashland WV-KY-OH	1130
Huntsville AL	230
Indianapolis IN	1069
Jackson MI	2588
Jackson MS	105
Jacksonville FL	974
Janesville-Beloit WI	881
Jersey City NJ	3721
Johnson City-Kingsport-Bristol TN-VA	491
Johnstown PA	3416
Kalamazoo-Portage MI	2588
Kansas City MO-KS	479
Kenosha WI	881
Killeen-Temple TX	2096
Knoxville TN	362
Kokomo IN	1069
LaCrosse WI	881
Lafayette LA	376
Lafayette-West Lafayette IN	1069
Lake Charles LA	376

Lakeland-Winter Haven FL	974
Lancaster PA	3416
Lansing-East Lansing MI	2588
Laredo TX	2096
Las Vega NV	90
Lawrence KS	321
Lawton OK	677
Lewiston-Auburn ME	66
Lexington-Fayette KY	316
Lima OH	2934
Lincoln NE	134
Little Rock-North Little Rock AR	78
Long Branch-Asbury Park NJ	3721
Longview TX	2096
Lorain-Elyria OH	2934
Los Angeles-Long Beach CA	6213
Louisville KY-IN	693
Lubbock TX	2096
Lynchburg VA	619
Macon GA	343
Madison WI	881
Manchester-Nashua NH	170
Mansfield OH	2934
McAllen-Pharr-Edinburg TX	2096
Melbourne-Titusville-Cocoa FL	974

Table A7 (cont'd)

Memphis TN-AR-MS	182
Miami FL	974
Midland TX	2096
Milwaukee WI	881
Minneapolis-St. Paul MN-WI	933
Mobile AL	230
Modesto CA	213
Monroe LA	376
Montgomery AL	230
Muncie IN	1069
Muskegon-Norton Shores-Muskegon Heights MI	2588
Nashville-Davidson TN	362
Nassau-Suffolk NY	4468
New Bedford-Fall River MA	1945
New Brunswick-Perth Amboy-Sayreville NJ	3721
New Haven-West Haven-Waterbury-Meriden CT	1515
New London-Norwich CT	1515
New Orleans LA	376
New York NY-NJ	4095
Newark NJ	3721
Newport News-Hampton VA	619
Norfolk-Virginia Beach-Portsmouth VA-NC	567
Northeast Pennsylvania	3416
Odessa TX	2096
Oklahoma City OK	677
Omaha NE-IA	240
Orlando FL	974
Owensboro KY	316
Oxnard-Simi Valley-Ventura CA	6213
Panama City FL	974
Parkersburg-Marietta WV-OH	538
Pascagoula-Moss Point MS	105
Paterson-Clifton-Passaic NJ	3721
Pensacola FL	974
Peoria IL	3677
Petersburg-Colonia Heights-Hopewell VA	619
Philadelphia PA-NJ	3569
Phoenix AZ	436
Pittsburgh PA	3416
Pittsfield MA	1945
Portland ME	66
Portland OR-WA	420
Poughkeepsie NY	4468
Providence-Warwick-Pawtucket RI	173
Provo-Orem UT	208

Table A7 (cont'd)

Pueblo CO	546	Santa Barbara-Santa Maria Lompoc CA	6213
Racine WI	881	Santa Cruz CA	6213
Raleigh-Durham NC	514	Santa Rosa CA	6213
Rapid City SD	41	Sarasota FL	974
Reading PA	3416		
Reno NV	90	Savannah GA	343
Richland-Kennewick WA	513	Seattle-Everett WA	513
Richmond VA	619	Sherman-Denison TX	2096
Riverside-San Bernardino-Ontario CA	6213	Shreveport LA	376
Roanoke VA	619	Sioux City IA-NE	240
Rochester NY	4468	Sioux Falls SD	41
Rockford IL	3677	South Bend IN	1069
Sacremento CA	6213	Spokane WA	513
Saginaw MI	2588	Springfield IL	3677
St. Cloud MN	985	Springfield-Chicopee-Holyoke MA	1945
St. Joseph MO	637	Springfield MO	637
St. Louis MO-IL	2157	Springfield OH	2934
Salem OR	326	Steubenville-Weirton OH-WV	1538
Salinas-Seaside-Monterey CA	6213	Stockton CA	6213
Salt Lake City-Ogden UT	208	Syracuse NY	4468
San Angelo TX	2096	Tacoma WA	513
San Antonio TX	2096	Tallahassee FL	974
San Diego CA	6213	Tampa-St. Petersburg FL	974
San Francisco-Oakland CA	6213	Terre Haute IN	1069
San Jose CA	6213	Texarkana TX-AR	78

Table A7 (cont'd)

Toledo OH-MI	2761	Wichita Falls TX	2096
Topeka KS	321	Wilmington DE-NJ-MD	1721
Trenton NJ	3721	Wilmington NC	514
Tucson AZ	436	Worcester-Fitchburg-Leominster MA	1945
Tulsa OK	677		
Tuscaloosa AL	230	Yakima WA	513
Tyler TX	2096	York PA	3416
Utica-Rome NY	4468	Youngstown-Warren OH	2934
Vallejo-Fairfield-Napa CA	6213		
Vineland-Millville-Bridgeton NJ	3721		
Waco TX	2096		
Washington DC-MD-VA	558		
Waterloo-Cedar Falls IA	346		
West Palm Beach-Baco Raton FL	974		
Wichita KS	321		

ENDNOTES

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CHAPTER I - INTRODUCTION

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[2]Deloitte, Haskins and Sells, _Report to Governor's Advisory Commission on the Regulation of Financial Institutions_ (Detroit: Deloitte, Haskins and Sells, 1977), part IV, p. 2.

[3]_Ibid_., part IV, p. 7.

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[2]_Ibid_., pp. 85-6.

[3]Deloitte, Haskins and Sells, _op. cit_.

[4]David J. Brophy, _Finance, Entrepreneurship, and Economic Development_ (Ann Arbor MI: Industrial Development Division, Institute of Science and Technology, University of Michigan, 1974), p. v.

[5]Clark Chastain and Marvin DeVries, _Financing in Michigan: R&D vs. Manufacturing Firms_ (Ann Arbor MI: Industrial Development Division, Institute for Science and Technology, University of Michigan, 1966).

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[17]R. G. Spiegelman, "A Method for Determining the Location Characteristics of Footloose Industries: A Case Study of the Precision Instrument Industry," Land Economics, 40 (February 1964): 79-86.

[18]Cooper, op. cit., p. 76.

[19]Rubel, op. cit.

[20]John Dominguez, Venture Capital (Lexington MA: D.C. Heath and Co., 1974).

CHAPTER III - METHOD OF RESEARCH

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[3]U.S., Department of Commerce, Bureau of the Census, Census of Population, 1970, Subject Reports, Detailed Occupation by Detailed Industry, Series No. PC(2)-7C-Table 8.

[4]Standard and Poor's Compustat Services, Inc., Compustat Tape (Denver: Standard and Poor's Compustat Services, Inc., 1977).

[5]American Electronics Association, Directory, 31st ed. (Palo Alto: American Electronics Association, 1979).

[6]Industrial Development Division, Directory of Research, Development, and Testing Facilities in Michigan (Ann Arbor MI: Industrial Development Division, Institute of Science and Technology, University of Michigan, 1980).

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[16]Ibid., p. 1.

[17]U.S., National Science Foundation, Federal Support to Universities, Colleges, and Selected Nonprofit Institutions, Fiscal Year 1977, NSF 79-311, Table B-37.

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[19]U.S., National Science Foundation, Division of Information Systems, Earned Degrees Conferred, 1974-1975.

[20]U.S., National Science Foundation, Federal Support to Universities, Colleges, and Selected Nonprofit Institutions, Fiscal Year 1975, NSF 77-303, Table B-10.

[21]U.S., Department of Commerce, Patent and Trademark Office, News, July 6, 1976, p. 4.

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CHAPTER IV - FINDINGS AND CONCLUSIONS

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[2]Brophy, op. cit., p. v.

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[7]Daniel Seligman, "A Thinking Man's Guide to Losing at the Track," Fortune, 91 (September 1975): 81-87.

CHAPTER V - POLICY IMPLICATIONS AND RECOMMENDATIONS

[1]New York Times, 30 January 1981, p. 14.

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