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LOCATION OF HIGH TECHNOLOGY FIRMS AND REGIONAL ECONOMIC DEVELOPMENT

A STAFF STUDY

PREPARED FOR THE USE OF THE

SUBCOMMITTEE ON MONETARY AND FISCAL POLICY

OF THE

JOINT ECONOMIC COMMITTEE

CONGRESS OF THE UNITED STATES

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LETTER OF TRANSMITTAL

Congress of the United States
JOINT ECONOMIC COMMITTEE
(CREATED PURSUANT TO SEC. 5(a) OF PUBLIC LAW 304, 79TH CONGRESS)
WASHINGTON, D.C. 20510

May 1982

The Honorable Henry S. Reuss
Chairman
Joint Economic Committee
Congress of the United States
Washington, D.C.

Dear Mr. Chairman:

I am pleased to transmit herewith a staff study entitled, "Location of High Technology Firms and Regional Economic Development," prepared by Dr. Robert Premus of the Joint Economic Committee staff. Comments and assistance by staff economists, Dr. Charles H. Bradford and Mark R. Policinski, were most helpful, although the author assumes full responsibility for any errors that may appear in the manuscript. Also, the author wishes to thank Doris Irwin who typed the study, and Kim Teets, Stuart Hengsteller and Grant Cannon who provided research and assistance.

I am happy to transmit this study.

Sincerely,

Roger W. Jepsen, U.S.S.
Chairman, Subcommittee on
Monetary and Fiscal Policy

FOREWORD

By Congressman Clarence J. Brown

Seldom has the Joint Economic Committee published a more important study than this.

As the American economy has declined over the past decade, the importance of high technology industries has increased. These firms are not only important because of their high growth records but because they develop and transmit new ideas, new capital, and new skills to the other firms in the economy which, in turn, help contribute their own future growth.

High technology companies offer a brighter future for America, but they offer salvation for those regions of America that have borne the brunt of our economic decline. The ability of these states and localities to be a part of the technological renaissance will diversify their economies and make them less susceptible to large-scale economic downturns.

Though these high technology companies are important to the Nation and our most economically distressed areas, little is known about them. In particular, little is known concerning what factors determine where they locate their plants and facilities.

This staff study is a seminal work for two reasons. First, it identifies what factors influence the location decision of high technology firms. The most important of these factors are labor skills/availability, labor costs and State and local taxes. Secondly, the study shows that there will be a significant increase in the portion of the country's high technology firms located in the Midwest, Southeast, Southwest, and the Mountain and Plains states. The most significant gain in this regard is registered by the Midwest region of the country. This obviously is good news for this region which has borne the brunt of our Nation's economic problems during the last decade.

It is very important to know that these conclusions are reached not by the simple statement of theory or by econometric wizardry. They are a precise reflection of what 691 high technology firms told the Committee staff. To the best of our knowledge, no similar systematic survey of high technology firms in this country has taken place before.

The importance of skilled labor points up the necessity of linking State and local development efforts with a region's universities in order to attract high technology industries. The potential contribution of universities has generally been ignored or underestimated by localities. The survey shows that if properly utilized higher education, and secondary education as well, may play the major role in helping a community or region attract high technology firms.

Finally, the study examines what states, in an attempt to overcome fiscal pressure, are doing to develop bold, imaginative economic development programs to attract the emerging high technology industries. A major conclusion of this study, with which I fully concur, is that the State initiatives will play a major role in the reemergence of the U.S. economy in the decades ahead. Central to this development of the high technology sector are Federal policies that encourage this growth.

As we approach the twenty-first century, America will have to maintain and improve its technological advantage. This study provides some answers as to how Federal, State and local governments can help high technology industries flourish in America.

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LOCATION OF HIGH TECHNOLOGY FIRMS AND REGIONAL ECONOMIC DEVELOPMENT

By Robert Premus

I. INTRODUCTION

The "New Federalism" policy of the Reagan Administration is ushering in a major realignment of Federal, State, and local fiscal relations. As the rate of increase in Federal aid is reduced, State and local governments are assuming a larger share of responsibility for providing services to their citizens and businesses. As a result, State and local governments, especially in the slow-growth States of the Midwest and Mideast regions, are experiencing increased fiscal pressure. Moreover, the options available to these governments to deal with fiscal pressures are severely constrained by political and market forces. Increasing State and local taxes is not an attractive option given the anti-growth effects of tax increases. Cutting expenditures is always politically unattractive. High interest rates make borrowing an expensive and risky source of funds. Thus, while the New Federalism offers new opportunities for State and local governments, it also presents new challenges.

The basic thesis of this study is that more and more State and local governments will turn to local development programs to accelerate local economic growth and boost revenues. These development programs are likely to center around the high growth and high technology industries such as semiconductors, telecommunications, medical instruments, and related products. The result will be a significant increase in competition between States and localities for skilled jobs and people.

The enhanced competitive atmosphere that is likely to emerge among States and localities has great potential to stimulate industrial innovation and technical change, the foundation of the Nation's long-term economic progress. State and local governments are anxious to improve their business climate to attract business investment and they are much more cognizant of the impact of their actions on the business community and of the quality and timely provisions of government services offered to businesses, such as police and fire protection, utility extensions, spur roads, etc.. Also, States are making every effort to hold taxes in line by instituting a system of expenditure controls. Finally, States are streamlining their regulatory processes to lower compliance costs. The net result of these actions will be an economic environment at the State and local government level that complements Federal supply-side

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policies, such as lower taxes, regulatory reform, and a stable monetary environment.

State and local efforts to expand their technology base will not be a zero sum game. The Nation's productivity has been lagging, and its share of international markets dwindling. State and local policy efforts to remove barriers to technology development and transfer has the potential to reverse the Nation's decline in productivity, expand its export, and lead to a gain in real per capita income for all States.

One important factor in the likely success of these State and local development initiatives is the extent to which they are attuned to the needs of high technology businesses. Yet, very little information exists on the expansion plans and locational determinants of high technology companies. The purpose of this study is to fill this gap in the economic development literature. The study examines current literature on the subject, analyzes data on high technology sector jobs and conducts an extensive questionnaire survey into factors that influence the location choices of high technology companies.

This study is organized into four chapters. Chapter I presents an introduction and outline of the study. Chapter II examines the growth of high technology sector jobs in the U.S. economy and looks at differences in growth rates among the high technology sectors. The analysis found that the high technology industries accounted for 75 percent of the net increase in manufacturing jobs from 1955 to 1979. Although the high technology sectors viewed individually have an unstable growth rate, taken collectively, it is little wonder that the high technology sectors are the "apple of the eye" of the State and local economic planners.

Chapter III presents the results of a Joint Economic Committee Survey on the Location of High Technology Companies. The 691 respondents were asked to report their plant expansion plans, the factors that influenced their choice of a region(s) in which to locate the plant(s), and the factors that influenced choice of location within a region. In general, the survey results reveal that high technology companies plan to expand at much faster rates in the Midwest, Southeast, and Southwest, and Mountain and Plains States than they have in the past. Determinants that were found to be most important to location decisions between regions were labor skills/availability, labor costs and State and local taxes. These same variables also were found to be the most important factors in decisions involving location within regions. In addition, community attitudes towards business, cost of property and construction, a good people-oriented transportation system, ample area for expansion, good schools, and proximity to recreational and cultural

locational factors of access to markets, access to raw materials, and transportation of products and raw materials generally were not rated as significant compared to the aforementioned factors.

Chapter IV provides a summary of the study and a discussion of State and local development intitiatives centered around the needs of the high technology industries. Almost all States have entered the competition to attract high technology companies. Although the State and local initiatives vary in form and emphasis, most are aimed at removing technical, financial, and institutional barriers to R&D investment and technological innovation. The current shortage of technicians, engineers, and scientists, and the number one rating given to the cost and availability of these highly skilled human resources in the JEC survey, underscore the important role that universities must play in the development strategies. In general, a balanced State and local policy to stimulate new capital formation and provide for human resource development, particularly in the older manufacturing States with large numbers of unemployed workers, would be appropriate. Finally a tax policy to encourage industrial innovation and attract skilled labor is also very necessary. Attempts to improve linkages between the university and business communities (e.g., by establishing university-based research parks) would make many regions more attractive to high technology companies.

Regardless of their emphasis, State and local development initiatives are likely to meet with only limited success unless they are accompanied by appropriate Federal Government policies. Industrial innovation and technological change flourish in a stable economic environment with appropriate incentives for economic growth. Monetary policies to provide for monetary stability, low inflation, and low interest rates, when coupled with appropriate fiscal provisions of the tax code to encourage investment in new technologies, will provide the necessary environment at the national level to unleash the inventiveness and ingenuity inherent in the American economy.

Finally, a literature review of the development of the high technology centers in the Silicon Valley in California, Highway 128 in Boston, and the Research Triangle in North Carolina is presented in Appendix A. The literature review gave important insights into the locational propensities of high technology companies. These insights were important in designing the questionnaire, found in Appendix B, used in the Joint Economic Committee Survey of High Technology Companies in the United States.

II. HIGH TECHNOLOGY INDUSTRIES AND JOB GROWTH

Many of the older industries in the manufacturing sector are suffering from sluggish growth and obsolescence, while job openings in the computer, medical, telecommunications, aerospace, semiconductor, electronics and other high technology industries remain unfilled. This chapter will examine the contribution that these high technology industries have made to job growth in the U.S. economy and to selected states. It also examines the job potential that high technology industries offer to states seeking to attract these firms.

HIGH TECHNOLOGY INDUSTRIES AND THE NATIONAL ECONOMY

High technology industries consist of heterogeneous collections of firms that share several attributes. First, the firms are labor-intensive rather than capital-intensive in their production processes, employing a higher percentage of technicians, engineers and scientists than other manufacturing companies. Second, the industries are science-based in that they thrive on the application of advances in science to the marketplace in the form of new products and production methods. Third, R & D inputs are much more important to the continued successful operation of high technology firms than is the case for other manufacturing industries.

Although analysts have reached no general agreement on a definition of a high technology industry, there is a general agreement that the following Standard Industrial Classification (SIC) industries qualify: chemicals and allied products (SIC 28); machinery, except electrical (SIC 35); electrical and electronic machinery, equipment and supplies (SIC 36); transportation equipment (SIC 37); and measuring, analyzing, and controlling instruments; photographic, medical and optical goods; watches and clocks (SIC 38). Employment is these industries is used in this section to measure the importance of the high technology industries to job development in the national economy.1/

These high technology industries accounted for 33.0 percent of all jobs in the manufacturing sector in 1955 and 40 percent in 1979, an increase of 21.2 percent. The increase in relative importance of high technology industries is illustrated in Table II.1. Total manufacturing employment increased from 16,882,000 in 1955 to 18,061,000 in 1965, or by 7.0 percent. In contrast,

high technology employment grew by 17.6 percent over the period, offsetting the sluggish 2.6 percent gain in employment in the other manufacturing industries category. Overall, the high technology industries generated 985,200, or 83.5 percent, of the 1,179,000 jobs created in the manufacturing sector from 1955 to 1965.

TABLE II.1

TOTAL HIGH TECHNOLOGY AND OTHER MANUFACTURING EMPLOYMENT IN THE U.S. ECONOMY
(in thousands)

	1955	1965	1975	1979	1955-1965	1965-1975	1975-1979
High Technology Employment	5,590.9	6,576.1	7,047.2	8,422.6	17.6%	7.2%	19.5%
Other Mfg.	11,191.1	11,484.9	11,275.8	12,550.4	2.6%	-1.8%	11.3%
Total Mfg.	16,882.0	18,061.0	18,323.0	20,973.0	7.0%	1.5%	14.5%

SOURCE: Calculated from data provided by the Bureau of Labor Statistics, Department of Labor, Handbook of Labor Statistics, Table 22, December 1980.

The period from 1965 to 1975 saw a sharp decline in the rate of job growth in high technology and other manufacturing industries, reflecting the severity of the 1975 recession. Over this period, high technology employment advanced by 7.2 percent, down 59 percent from growth over the previous ten-year period. Other manufacturing industries experienced a 1.8 percent decline in employment, reflecting the procyclical behavior of these industries. Total manufacturing employment advanced by 1.5 percent, down about 79 percent from growth in the previous period. Thus, although their net contribution diminished, unlike the other manufacturing industries, high technology industries were a net contributor to job creation over the 1965 to 1975 period.

The post-1975 recession saw a sharp rebound in the rate of job growth in the manufacturing sector. Jobs in the manufacturing sector increased by 14.5 percent from 1975 to 1979, a surprisingly large increase given the generally lackluster

performance of the manufacturing sector. The high technology industries led the way with a 19.5 percent increase in employment. The 11.3 percent increase in jobs in the "Other Manufacturing" category reversed the decline of jobs in that category from 1965 to 1975.

What accounts for the acceleration of job growth in employment in the manufacturing sector after 1975? A number of factors bear on the situation, but several stand out as most important. First, employment growth from 1975 to 1979 reflects a movement out of a recession as well as long-term employment growth. Second, the demographic changes in the population were an important contributing factor. Labor supply growth accelerated over this period as quit rates declined and labor force participation rates increased. Also, growth in the labor supply was bolstered by the unusually large rate of increase of new entrants into the labor force, reflecting the maturing of the "baby boom" population of the 1950's. Finally, higher energy prices after 1973 resulted in a shift in technology to the more labor intensive production methods because, as the price of energy rose relative to the price of labor, businessmen attempt to substitute energy saving (or labor intensive) methods of production for energy using (or capital intensive) methods of production. As this restructuring of the economy occurred in the 1970's, the result was an acceleration in the rate of growth in employment in the manufacturing sector and, because growth in capital per worker declined, a reduction in the growth of labor productivity occurred.

Overall, the high technology industries accounted for 75 percent of the growth of jobs in the manufacturing sector from 1955 to 1979. Of course, not all of the industries in the high technology sector contributed equally to employment growth. The electronic equipment (SIC 36) and chemicals and allied products (SIC 28) were the dynamic components of employment change in the high technology sector over the 1955 to 1965 period. As can be calculated from Table II.2, these two industries accounted for 656,200 of the 985,200 new jobs in the high technology sector over this period.

TABLE II.2

HIGH TECHNOLOGY EMPLOYMENT AND PERCENTAGE CHANGE
BY INDUSTRY CATEGORY FOR THE U.S. ECONOMY

	SIC 35 Machinery Except Electrical	SIC36 Electric Equipment	SIC 37 Transpor-tation Equipment	SIC 38 Instruments and Related Products	SIC 28 Chemicals & Allied Products	Total High Tech. Employ.
			Thousands			
1955	1,448.5	1,226.8	1,893.8	381.8	640.0	5,590.9
1965	1,735.3	1,615.2	1,872.6	445.2	907.8	6,576.1
1975	2,056.8	1,701.6	1,715.0	550.1	1,014.7	7,047.2
1979	2,462.5	2,108.7	2,048.3	690.4	1,112.7	8,422.6
			Percent Change			
1955-65	19.8%	31.7%	-1.1%	16.6%	41.8%	17.6%
1965-75	18.5%	5.3%	-8.4%	23.6%	11.8%	7.2%
1975-79	19.7%	23.9%	19.4%	25.5%	9.7%	19.5%

SOURCE: Calculated from data provided by the Bureau of Labor Statistics, Department of Labor, Handbook of Labor Statistics, Table II.23, December 1980.

Non-electrical machinery (SIC 35) and instruments and related products (SIC 38) were the dynamic sectors over the 1965 to 1975 and 1975 to 1979 periods. From 1975 to 1979, electric products (SIC 38) led the way. In addition, the transportation equipment (SIC 37) industry exhibited resiliency. With job growth of 19.4 percent from 1975 to 1979, the transportation equipment industry reversed two decades of decline in employment.

The sectoral analysis of growth patterns among industries in the high technology sector illustrates the extremely complex, dynamic nature of job generation in these science-based industries. A great deal of instability of growth patterns exists among the industries within the high technology sector but overall the high technology sector performed well. Instability

of growth pattern should provide a warning to State and local governments that attempts to specialize in a few of the high technology industries may be destabilizing. State and local governments wishing to encourage the development of high technology industries can avoid these pitfalls by diversifying their mix of high technology industries.

WHERE ARE THE HIGH TECHNOLOGY INDUSTRIES GROWING?: A STATE COMPARISON

Which states and regions benefit the most from expansion in the science-based industries? Some notion of the relative benefits can be obtained by examining Table II.3, which shows the absolute and percentage growth in high technology employment in 24 states for which data are available. About 83 percent of the Nation's high technology jobs were located in these 24 states in both 1975 and 1979, and they collectively accounted for about 82 percent of the net increase in high technology jobs in the United States over the period. Thus, although geographical coverage is not complete, it includes those states and regions which are noted for their concentrations of science-based high technology industries (e.g., California and Massachusetts), and it allows comparisons with other states that are also making significant contributions to the high technology sectors.

TABLE II.3

THE NUMBER AND CHANGE IN HIGH TECHNOLOGY JOBS
FOR SELECTED STATES: 1979 AND 1975

State	Thousands 1979	Thousands 1975	Absolute Change 1975-79	Percent Change 1975-79
Arizona	57.8	37.3	20.5	54.96
California	574.9	420.6	154.3	36.69
Connecticut	94.4	80.0	14.4	18.00
Colorado	53.1	33.0	20.1	60.90
Florida	98.3	60.9	37.4	61.41
Georgia	28.3	19.0	9.3	48.95
Illinois	242.5	229.9	12.6	5.48
Maine	10.6	6.1	4.5	73.77
Maryland	37.3	29.4	7.9	26.87
Massachusetts	222.0	167.6	54.4	32.46
Michigan	92.3	73.7	18.6	25.24
Minnesota	104.8	75.8	29.0	38.26
Nevada	3.6	1.8	1.8	100.00
New Hampshire	36.5	20.4	16.1	78.92
New Jersey	182.2	167.0	15.2	9.10
New York	375.0	342.3	32.7	9.55
North Carolina	83.7	55.0	28.7	52.18
Ohio	161.9	148.9	13.0	8.73
Pennsylvania	209.9	196.6	13.3	6.77
Rhode Island	19.2	16.0	3.2	20.00
Texas	143.6	95.6	48.0	50.21
Utah	17.9	10.8	7.1	65.74
Vermont	15.9	11.0	4.9	44.55
Virginia	40.1	35.9	4.2	11.70
Washington	19.3	10.1	9.2	91.09

SOURCE: Calculated from High Technology Employment in Massachusetts and Selected States, Massachusetts Division of Employment Security, Table II.4, March 1981.

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The data in this chapter are taken from a study by Doody and Munzer, of the Massachusetts Division of Employment Security.2/ Doody and Munzer included the following three-digit SIC code industries in their calculation of high technology employment for each of the 24 states in their study: Drugs (SIC 283); Ordnance and Accessories, NEC (SIC 348); Office Computing and Accounting Machine (SIC 357); Electrical and Electronic Machinery, Equipment and Supplies (SIC 36); Guided Missiles and Space Vehicles and Parts (SIC 376); Miscellaneous Transportation Equipment (SIC 379) and Measuring, Analyzing, and Controlling Instrument Photographic, Medical and Optical Goods; Watches and Clocks (SIC 38).

This group of industries represents the manufacturing arm of high technology industries in the states. As Doody and Munzer point out, it does not include technical service companies that provide services in the form of educational, scientific and research activities. Thus, the data are confined primarily to companies engaged in the manufacturing of high technology products and services.

The 24 states were included in the Doody and Munzer survey because of their general importance to the high technology industries and to the Massachusetts economy in general. The researchers mailed a survey to each of the states in their sample to obtain the state's specific data on high technology manufacturing employment in the select industries. The data provide an estimate of the high technology manufacturing jobs in each of the states in 1975 and 1979. This time period is ideal for analyzing the growth and dispersion of high technology industries. First, it coincides with a period of recovery in the national economy from the 1975 recession. Second, the real reduction in military expenditures over this period made scientific and technical resources available to high technology industries that were engaged in commercial activities. Many of the unemployed Federal and military engineers and scientists found their way into private sector high technology companies. Thus, the current shortage of engineers and scientists that threatens to constrain expansion in high technology industries in the 1980's was not a constraint in the 1970's.

Table II.4 presents the absolute increase in total manufacturing and high technology employment in California, Massachusetts and North Carolina from 1975 to 1979. These states have been major beneficiaries of job growth emanating from the university-based high technology centers within their borders. Collectively, these states accounted for 41 percent of the U.S. growth in high technology manufacturing employment. California dominated all states in absolute growth, capturing about 22 percent of the growth in U.S. high technology jobs.

TABLE II.4

PERCENT OF CHANGE IN MANUFACTURING JOBS
ACCOUNTED FOR BY THE CHANGE IN HIGH TECHNOLOGY JOBS
FOR SELECTED STATES, 1975 TO 1979

State	Change in Mfg. Jobs 1975-1979 (Thousands)	Change in High-Tech Jobs 1975-1979 (Thousands)	Increase in mfg. Jobs Accounted for by High-Tech Jobs
Massachusetts	94.1	54.5	57.8%
California	421.4	154.3	36.6%
North Carolina	125.0	28.7	23.0%
U.S.	2,739.0	712.2	26.0%

SOURCE: Calculated from High Technology Employment in Massachusetts and Selected States, Massachusetts Division of Employment Security, Tables 3 and 4, March 1981.

The column on the right in Table II.4 suggests that Massachusetts' manufacturing industries are heavily dependent upon the high technology sectors for economic growth. Massachusetts' high technology industries generated 58 percent of the 94,100 increase in manufacturing jobs in that state. In California, high technology industries accounted for approximately 36.5 percent of the 421,400 increase in total manufacturing employment in the state. North Carolina experienced a net increase of 125,000 in total manufacturing employment but it received a significantly lower percentage of its manufacturing employment growth directly from high technology industries. About 23 percent of the growth of employment in the manufacturing sector in North Carolina resulted from expansion in its high technology industries. Although these data do not take into consideration the indirect employment effects of interactions between the high technology and other industries within the state, they do indicate that growth in the science-based industries in the Silicon Valley in California, along Highway 128 in Massachusetts and in the Research Triangle in North Carolina are a significant, dynamic factor in the growth of the manufacturing sector and overall state economic development.

Next, the discussion is widened to include a comparative analysis of the emerging trends in high technology employment growth among all of the states in the study. In particular, Table II.5 shows the relative share of high technology production jobs in each of the 24 states in the study in 1975 and 1979, and the percent change in these relative shares over the 1975 to 1979 period. States that are experiencing a relative gain in their share of high technology production jobs in Table II.5 are the states in Table II.3 that exhibit percentage growth in high technology industries in excess of the national average (24.4 percent). On the other hand, the relative share of high technology production jobs will be declining in those states that are experiencing high technology employment growth at below the national rate. In general, the states in which high technology jobs are becoming increasingly concentrated are identified as having a comparative cost advantage in the science-based industries.

TABLE II.5

RELATIVE DISTRIBUTION OF HIGH TECHNOLOGY JOBS BY SELECTED STATE: 1979 and 1975

State	Percent of U.S. High-Tech Employment 1979	Percent of U.S. High-Tech Employment 1975	Percent Change 1975-1979
Western States			
Arizona	1.59%	1.28%	24.2%
California	15.85	14.40	10.1
Colorado	1.46	1.30	12.3
Texas	3.96	3.28	20.7
Utah	0.49	0.37	32.4
Washington	0.53	0.35	51.4
Nevada	0.10	0.06	66.6
New England States			
Connecticut	2.60	2.70	-3.7
Maine	0.29	0.21	38.1
Massachusetts	6.13	5.80	5.7
New Hampshire	1.00	0.70	42.9
Rhode Island	0.53	0.55	3.6
Vermont	0.44	0.38	15.8
Mideast/ Great Lake States			
Illinois	6.69	7.89	-15.2
Michigan	2.54	2.51	1.2
New Jersey	5.02	5.75	-12.4
New York	10.34	11.74	-11.9
Ohio	4.46	5.11	-12.7
Pennsylvania	5.79	6.75	-14.2
Minnesota	2.89	2.60	11.2
Southern States			
Florida	2.71	11.10	29.0
Georgia	0.78	0.65	27.7
Maryland	1.03	1.00	3.0
Virginia	1.11	1.23	-9.8
North Carolina	2.31	1.89	22.2

SOURCE: Calculated from High Technology Employment in Massachusetts and Selected States, Massachusetts

Division of Employment Security, Tables 1 and 8, March 1981.

When the discussion is widened to include comparison with other states, several interesting regional patterns emerge. First, as can be seen on Table II.5, the states in the West are experiencing a growing relative share of high technology employment. Arizona, California, Colorado, Texas, Utah, and Washington all experienced gains in relative share of high technology employment. Second, the New England states of Maine, Massachusetts, New Hampshire, and Vermont all experienced significant gains in relative share of high technology jobs. (Although Connecticut and Rhode Island experienced growth at below the national average.) Thus, it would appear that the high technology centers in California and Massachusetts are not only contributing to growth in their State's economies, but they are generating positive employment gains, or "spread effects," in states within their respective regions.

Something akin to the product cycle model of industry growth and transformation would appear to undergird the dispersion of high technology production jobs in the Far West and Northeast regions. During the early stages of development, high technology companies grow rapidly and their markets are not clearly established. At this early stage, they prefer to locate near other high technology companies. Browne explains this clustering tendency this way:

> Industries which are undergoing rapid change and innovation and which produce specialty products tend to cluster together because of the need for specialized resources, particularly skilled labor, not available elsewhere.3/

At a later stage as the industry matures, production becomes more standardized and routine. High technology companies become less dependent upon proximity to specialized resorces and markets; i.e., they become "footloose" in the sense that they can choose a location for a new plant, giving more weight to factors such as prevailing wage rates, land costs, local taxes, and regional amenities. In fact, long-run survivability in these competitive markets requires the adoption of cost-cutting measures, including locating new plants and expanding old ones in states and regions that minimize costs of production.

Next, the regional trends show that the high technology industries in the manufacturing states of the Great Lakes and Mideast regions are faring badly. Ohio, Illinois, Pennsylvania, New Jersey, and New York all experienced a relative decline in

their share of high technology jobs over the 1975 to 1979 period, with Illinois, Ohio, and Pennsylvania leading the way. Michigan and Minnesota were the only states in these regions that experienced a growth rate in high technology jobs at slightly above the national rate.

Finally, only a small percent of the high technology jobs were located in the Southeast region in 1975, but this region's share of high technology jobs is increasing. In particular, Florida and Georgia experienced robust growth in high technology jobs over the period, raising their relative shares. Maryland experienced a slight increase in relative share and Virginia a relatively slight decrease.

In conclusion, the high technology industries are shown to be a major source of job generation in the U.S. economy, but their relative contribution varies considerably among the states and regions. All states in this study experienced growth in high technology manufacturing employment, but states in the Far West and New England regions benefitted the most. The high technology industries in the Southwest and Southeast are relatively underrepresented but they are growing rapidly, especially in Florida, Texas, and Georgia. States in the manufacturing belt (namely Ohio, Illinois, Pennsylvania, New York, and New Jersey) have not kept pace with the country in the emerging new high technology industries. These states have not remained competitive in these industries at a time when they need to replace the massive job losses that have been occurring in the traditional manufacturing sector.

III. DETERMINANTS OF HIGH TECHNOLOGY PLANT LOCATION DECISIONS: SOME SURVEY RESULTS

A growing opinion is emerging that high technology industries hold the key to maintaining and improving the competitiveness of the American economy at home and abroad. Despite this opinion and the realization that the high technology sector is important to the revitalization of the Nation's basic industries, very little systematically organized data is available on high technology companies. A review of the literature revealed that none of the numerous business location and expansion studies make high technology companies their major focus.

Because of the growing awareness of the emerging role of high technology industries and their importance to the American economy, the Joint Economic Committee conducted a survey to find out more about how high technology companies go about choosing a location site and what their expansion plans are for the future. This chapter presents the results of the Joint Economic Committee Survey of High Technology Companies in the United States, conducted over the period October 1981 to May 1982.

In general, the survey results indicate that high technology companies are "footloose" in that access to raw materials, access to markets and transportation are not major locational determinants. Nor are factors such as water resources, energy supplies, and climate important determinants of the location of high technology companies. In contrast to other manufacturing companies, high technology companies are drawn more to highly specialized resources such as labor skills and education and to factors that make it easier to attract and maintain a skilled labor force, most notably State and local taxes. Other factors such as attitudes towards business, land costs, room for expansion also have an important effect on the location decisions of high technology businesses.

In addition, the survey indicated that most high technology companies prefer an urban environment to a rural environment. The clustering of high technology companies in an urban environment may generate agglomeration economies that make the high technology centers even more attractive. The agglomeration economies could occur in the form of improved public and private infrastructure (e.g., roads and schools), a diverse pool of skilled labor, and an improved technology transfer among the companies.

This chapter is divided into several sections. The first section discusses the nature of the questionnaire design and the data base. The results of the survey are presented in the second section. In section three we examine the regional patterns of existing and planned additions of plants and permanent offices operated by the high technology companies and how these patterns relate to the questionnaire respondents' perceptions of the locational attributes of the regions in the study. Finally, the chapter is concluded with a summary and discussion of the implications of the findings. The main implication of the findings relate to State and local development initiatives to attract high technology companies. The "footloose" nature of high technology companies makes them illusive targets for State and local development planners. Regions that have good access to raw materials and markets, including an efficient transportation network, will not necessarily develop successful high technology centers. Success may require a concerted effort to improve labor skills and provide a favorable business and tax climate. A commitment to a strong university system with emphasis on science and technology transfer would also be very helpful.

QUESTIONNAIRE DESIGN AND DATA BASE

The development of the survey questionnaire was preceded by an extensive review of the literature on factors that influence the location and expansion of high technology companies in the Silicon Valley, California, the Highway 128 area in Boston, Massachusetts, and the Research Triangle Park in North Carolina.

These three prominent high technology centers have been the subject of a voluminous popular literature, primarily in newspapers, business magazines, and trade journals, but strangely they have received little scholarly attention. The literature is based primarily upon these studies and expert opinion rather than evaluating systematically organized data on the expansion and location of high technology companies in these areas and the problems they face. Nevertheless, the survey of the literature, which is presented in Appendix A of this study, provided important insights into the location and growth of high technology companies. First, it provided insights into the complex cause and effect relationships of plant expansion and location (e.g., the importance of a good university environment to high technology companies). In general, the literature survey revealed that the following factors have played at least some role in the growth and location of high technology companies: labor availability, taxes, proximity to universities, recreational amenities, climate, transportation, regulations, energy costs, room for expansion, housing costs, tax incentives, and business climate. Of course, the quantitative importance of

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these various location factors could not be ascertained because of the subjective nature of the studies that were reviewed.

The literature review also provided insights into the growth and development of high technology centers from an historical perspective, revealing that (1) these high technology centers reach their prominent status only after a long and laborious gestation period, (2) Federal procurement of R&D, products, and services is, and continues to be, an important source of support for the scientific and technological infrastructure of these regions, and (3) the scientific and technological infrastructure of these prominent high technology centers creates an environment that acts as an incubator to spin-off new companies and encourages the expansion of existing companies. The review also revealed that although the high technology centers in the Silicon Valley and along Highway 128 possess a formidable comparative advantage in the new high technology industries, they have, or will shortly, approach the "holding capacity" of their respective regions to accommodate new growth and development. High wages, congestion, lack of room for expansion, a shortage of labor skills, excessive regulations, and high taxes are frequently cited complaints of businessmen and high technology entrepreneurs. Many companies in these areas have announced that they are planning to locate their new facilities in other regions.

Questionnaire Design. The JEC survey questionnnaire is designed to address these concerns. All of the factors that were revealed in the literature review as determinants of high technology plant location decisions are included in the JEC questionnaire (see Appendix B). In addition, the high technology companies in the survey were asked to reveal their plant expansion plans and in what region(s) their new facilities are likely to be located. Finally, to get some idea of the ability of other regions (e.g., the Midwest and Southeast) to compete for the new plants and facilities, an important regional dimension was added to the questionnaire. Respondents were asked to rate the Far West, Midwest, Mideast, Southeast, Southwest, Mountain and Plain States, and the Northeast regions on locational attributes (e.g., climate and taxes) so that regional preferences could be ascertained.

Another unique feature of the JEC questionnaire is the way the location decision is viewed. Following McMillan1/, the JEC questionnaire is designed with a two-stage view of the location decision in mind. McMillan pointed out that a serious bias in most business location surveys is the failure to distinguish between factors that influence the choice of a region from factors that influence the choice of location within a region. Failure to make this distinction may result in some potentially important locational factors being overlooked. For example,

Pluta2/, after surveying five recent business location studies, did not find State and local taxes to be important, but a study by McGraw-Hill 3/ ranked State and local taxes as the third most important factor. Apparently, the discrepancy in findings is a result of differences in emphasis on the various stages in decisionmaking. The studies reviewed by Pluta asked respondents to rate factors that influence their choice of a region; whereas, the McGraw-Hill studies worded questions to focus on the choice of location within a region.

The Joint Economic Committee Survey attempts to overcome this controversy by explicitly separating factors that influence choice of a region from factors that influence choice of a location within a region. The JEC questionnaire lists the seven regions included in this study and the States within each region. Since each region consists of a number of States, the second stage of the location decision really involves a choice among States within a region.

The Data Base. The data base consists of the 691 responses to the questionnaire that was mailed to approximately 1,750 high technology companies. The companies consisted of selected members of the American Electronics Association, the Nation's leading high technology trade association, and approximately 400 companies in the Highway 128 area of Boston, Massachusetts. Fifty-six of the questionnaires were returned by the U.S. Postal Service, mostly because the forwarding expiration date had expired. Fifteen were returned by the company, indicating that the questionnaire was inappropriate for their office to consider. After subtracting the returned questionnaires from total mailings, the response rate on the JEC survey was 41 percent. As it turned out, 322 of the respondents were from California, 190 from Massachusetts, and 179 from the other states. No attempt was made to stratify the sample by State or by region.

The responding firms are quite young, and they produce a wide variety of high technology products. Over one-half of the respondents indicated that they were incorporated after 1968, and about one-fourth of the respondents were incorporated after 1975. Some notion of the product mix of the sample firms can be obtained from Table III.1. Semiconductor firms dominate the sample although telecommunications, research, aerospace, chemical, and medical instruments are also represented. The most frequently cited types of products discussed under "other" were computer-related products, specialized measuring instruments and advance guidance systems.

The market served by these companies is primarily national and international. As Table III.2 shows, not many respondents served only State and local markets. Most respondents indicated

that their markets have not changed significantly over the last five years.

Table III.3 presents the size distribution of companies by the number of employees. About 75 percent of the companies in the sample reported 500 or fewer employees. About 31 percent had fewer than 50 employees, and only 18 percent had greater than 1,000 employees. In general, the high technology companies that responded to the survey can be classified as small businesses, although some very large companies responded to the questionnaire. Also, most of the respondents are single plant firms (see Table III.4) though 28 percent of the responding firms had six or more plants and permanent offices.

In general, the typical respondent to the survey is a small, young, high technology firm with fewer than 500 employees operating one plant. The company serves a national or international market and is likely to be in electronics, telecommunications, research, aerospace, or medical instruments. Annual sales are likely to be between $1 million and $10 million.

TABLE III.1

TYPE OF PRODUCTS OF RESPONDENTS TO SURVEY ON REGIONAL LOCATION CHOICES OF HIGH TECHNOLOGY COMPANIES

	Response
Semiconductor	29.5%
Telecommunications	12.8
Research	9.4
Aerospace	8.5
Chemical	2.8
Medical Instruments	7.6
Other1/	32.0
Total	100.0%

1/ Respondents most frequently listed computer related products, specialized measuring instruments, and advanced guidance systems.

TABLE III.2

GEOGRAPHICAL MARKETS OF RESPONDENTS TO SURVEY ON REGIONAL LOCATION CHOICES OF HIGH TECHNOLOGY COMPANIES

Predominantly International	34.0%
Predominantly National	62.2
Predominantly Regional	2.3
Predominantly in State	2.5
	100.0%

TABLE III.3

EMPLOYMENT SIZE DISTRIBUTION OF RESPONDENTS TO SURVEY ON THE LOCATION CHOICES OF HIGH TECHNOLOGY COMPANIES

Employees	Percent
0 to 50	31.0
51 to 100	14.0
101 to 500	30.0
501 to 1,000	7.0
1,000 +	18.0

TABLE III.4

NUMBER OF PLANTS OF RESPONDENTS TO THE SURVEY ON THE LOCATION CHOICES OF HIGH TECHNOLOGY COMPANIES

Number of Plants	Percent
1	40
2	13
3	9
4	6
5	4
6 +	28

SURVEY RESULTS

Table III.5 presents the survey results for 12 factors that were thought to influence the choice of a region. Respondents were asked to rate each factor as "very significant, significant, some significance, or no significance." The percent of responses that were significant or very significant are added and presented in Table III.5.

Choice of Region. Labor skills and availability received the highest score for choice of region at 89.3 percent. Although not shown, this response can be broken down into 66.1 percent very significant, 23.2 percent significant responses. Unquestionably, labor skills and availability are viewed by high technology firms as their most significant concern when choosing plant locations among regions.

Labor costs ranked second as a locational factor. Interestingly, the availability of labor skills takes precedence over their cost, although wages and benefits, which are necessary to attract labor skills to the region, are apparently given careful consideration.

A region's tax climate was listed as the third most important locational factor.4/ Sixty-seven percent of the respondents felt that taxes were a significant or very significant factor in their preference for a region. This result is consistent with survey

studies on the relationship between taxes and plant location choices by McMillan and McGraw-Hill, as discussed previously.

TABLE III.5

FACTORS THAT INFLUENCE THE REGIONAL LOCATION CHOICES OF HIGH TECHNOLOGY COMPANIES

Rank	Attribute	Percent Significant or Very Significant1/
1	Labor skills/availability	89.3
2	Labor Costs	72.2
3	Tax climate within the region	67.2
4	Academic institutions	58.7
5	Cost of living	58.5
6	Transportation	58.4
7	Access to markets	58.1
8	Regional regulatory practices	49.0
9	Energy costs/availability	41.4
10	Cultural amenities	36.8
11	Climate	35.8
12	Access to raw materials	27.6

1/ Respondents were asked to rate each attribute as "very significant, significant, somewhat significant, or no significance" with respect to their location choices. The percent of very significant and significant responses were added together to obtain an index of overall importance.

Other factors listed as important in the choice of a region are access to markets (58.1 percent), cost of living (58.5 percent), transportation (58.4 percent), and academic institutions (58.7 percent). Regional regulatory practices (49.0 pecent) and energy costs/availability (41.4 percent) were rated as somewhat significant for location choices at the regional level. Access to raw materials (27.6 percent), climate (35.8 percent), and cultural amenities (36.8 percent), ranked lowest in the survey as locational factors.

Finally, a catchall category "other" received comments by 84 of the respondents. Although this might be expected for a "catchall" category, the written responses were bunched around only two concerns. First, where the founder of the company was born was often listed as a significant "other" factor in the location choices. Second, public attitudes toward business were also frequently cited as an "other" factor in the survey. Apparently, businessmen prefer to locate in a region where profit is not a dirty word and where their contribution to society is recognized and appreciated.

Choice Within Region. The factors that could potentially influence the second, or plant siting, stage of the location decision are defined more precisely in Table III.6. As stated previously, the second stage of the location decision in our study is a choice of a state within a chosen region.

Labor skills, labor availability, taxes, and business climate again dominate the location choice. Interestingly, proximity to skilled labor (88.1 percent) and professional labor (87.3 percent) were listed as significant or very significant by a large percent of the respondents, but the availability of technical workers ranked highest in the labor category (96.1 percent). One reason for this greater emphasis on technical workers may be the difference in the mobility rates of machinists, welders, and computer programmers on the one hand, and engineers and scientists on the other. While the data are scarce, engineers and scientists appear to be a highly mobile population.5/ High technology companies may perceive that a regional shortage that may exist can be overcome by offering the appropriate financial inducements; whereas, technical workers may be more difficult to entice to a region. If this is correct, as the evidence suggests, it would be a rational response to rank the availability of technical workers above the region's supply of engineers and professional personnel in the choice of a site within the region.

TABLE III.6

FACTORS THAT INFLUENCE THE LOCATION CHOICES
OF HIGH TECHNOLOGY COMPANIES WITHIN REGIONS

Rank	Attribute	Percent Significant or Very Significant
1	Availability of workers:	96.1
	Skilled	88.1
	Unskilled	52.4
	Technical	96.1
	Professional	87.3
2	State and/or local government tax structure	85.5
3	Community attitudes towards business	81.9
4	Cost of property and construction	78.8
5	Good transportation for people	76.1
6	Ample area for expansion	75.4
7	Proximity to good schools	70.8
8	Proximity to recreational and cultural opportunities	61.1
9	Good transportation facilities for materials & products	56.9
10	Proximity to customers	46.8
11	Availability of energy supplies	45.6
12	Proximity to raw materials & component supplies	35.7
13	Water supply	35.3
14	Adequate waste treatment facilities	26.4

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State and local government tax structure ranked second in the choice of locational factors within a region. State and local taxes were listed as "very significant or significant" by 85.5 percent of the respondents at the second stage of decisionmaking in comparision with 67.2 percent at the first stage. This confirms the hypothesis that fiscal competition for businesses is likely to be more intense for States in competition with their neighbors (e.g., Ohio and Indiana) than it would be between geographically distant States (e.g., Ohio and California). It also reinforces the conclusion in the preceding section that State and local taxes are an important locational factor considered by high technology companies.

One of the arguments against State and local taxes as a locational determinant is that they represent only a small percent of the total cost of production. Labor, raw materials, energy, and transportation all generally rank above taxes as a share of production costs. Moreover, it is argued that a quid pro quo exists between taxes paid and benefits received. While the results of this study cannot refute these claims, they do suggest another more reasonable linkage between State and local taxes and high technology plant location decisions. Plant location decisions are, as discussed, quite sensitive to labor costs and labor availability. Thus, businessmen may be opposed to high taxes simply because it hinders their ability to attract the type of skilled labor that they require.

An important question is whether or not the heavy representation of high technology companies in Massachusetts and California, states with a reputation for high taxes, are biasing the JEC survey results. A breakdown of the responses of the high technology companies in California, Massachusetts, and the "other" states suggests that if any aggregation bias exists, it is not serious. The bottom row in Table III.7 indicates that 72.3 percent of the high technology companies in California rated State and local tax structure as "very significant or significant," in comparison to a rating of 79.1 percent and 77.7 percent of the high technology companies in Massachusetts and the "other States," respectively. Although fewer California firms rated taxes as "very significant" in comparison to the response of high technology companies in Massachusetts and other States, a higher percentage of California firms ranked State and local taxes as "significant." Thus, in general, it would appear that there are no significant differences among the high technology companies in the various regions of the country on the State and local tax issue: State and local taxes are an important factor in high technology company plant location decisions.

TABLE III.7

RESPONSES OF HIGH TECHNOLOGY COMPANIES IN CALIFORNIA, MASSACHUSETTS AND OTHER STATES ON THE IMPORTANCE OF STATE AND LOCAL TAXES TO LOCATION CHOICES WITHIN A REGION

	California	Massachusetts	Other
Very significant	28.0	37.3	30.7
Significant	44.3	41.8	47.0
Some significance	23.3	19.8	20.5
No significance	4.3	1.1	1.8
Very significant + Significant1/	72.3	79.1	77.7

1/ The summation of percent very significant and significant responses.

Community attitudes toward business ranked third as a locational determinant at the second stage of the location decision (81.9 percent). This finding adds credence to the hypothesis expressed earlier that businessmen prefer a location that is supportive rather than antagonistic, and they like to be recognized for their contribution to the community (e.g., creating jobs and adding to the tax base).

Cost of property and construction (78.8 percent) and ample space for expansion (75.4 percent) were each cited as relatively significant. Interestingly, the literature survey in Appendix A, cited high land costs and lack of room for expansion in California and Massachusetts as a major factor inducing high technology companies to expand in surrounding States. Apparently, labor costs, land costs, high taxes, and congestion are all contributing factors in the alleged spatial dispersion of high technology companies emanating from the Silicon Valley and Highway 128.

Proximity to markets ranked fairly high as an attribute that influenced the choice of a region, but it received a relatively

low rating for choice of location within a region (46.8 percent). Likewise, proximity to raw materials and component supplies was ranked significant or very significant by only 35.7 percent of the respondents. Clearly, the traditional locational factors of access to markets and raw materials were not important factors for high technology plant location decisions. Transportation entered the decision matrix in another manner, however. A good transportation system for people was rated as significant or very significant by 76.1 percent of the respondents. This finding is consistent with the view that commuting time is becoming an important factor influencing the migration decision of engineers, scientists, professionals, and technicians required by high technology companies.

Proximity to good schools was rated as important by a significant percentage of the respondents (70.8 percent), but this response was not as strong as might be expected. One reason may be attributed to the Tiebout Effect. According to Tiebout6/, in a local government setting, people "vote with their feet" (move to a new location) for the community of their choice. Thus, given the size of the geographic regions being considered, it may be perceived that workers and their families are likely to have little trouble in finding a school of their choice. Likewise, universities in the region are likely to give the prospective college students ample choice.

Finally, several factors were not listed as important locational attributes at the second stage. Water supply (35.3 percent), energy supplies (45.6 percent), and unskilled labor (52.4 percent) received relatively low responses. This would suggest that communities that base their high technology development strategy on water, energy, and unskilled labor are likely to meet with little success.

CURRENT AND FUTURE PLANT DISTRIBUTIONS BY REGION

Next, we examine and compare the distribution by region of approximately 1,831 plants and permanent offices currently operated by the 691 questionnaire respondents, with the distribution by region of the approximately 1,329 plant and permanent office additions planned by the respondents over the next five years. Any regional discrepancies in actual and planned plant location patterns will then be evaluated in terms of the respondents rating of the regions on the locational determinants considered earlier.

Table III.8 presents the actual regional distribution of plants and permanent offices in 1981, the regional distribution of planned additions, and the regional distribution in 1986 that

would occur if the planned plant and permanent office additions, closings, and moves are realized.

TABLE III.8

ACTUAL AND PLANNED DISTRIBUTION OF HIGH TECHNOLOGY PLANTS AND PERMANENT OFFICES BY REGION, 1981 to 1986

Regions	(1) Percent Distribution of Existing Plants	(2) Percent Distribution of Planned Plant Additions	(3) Percent Distribution of Future Plants, 1986 1/	(4) Percent Change in Column 1 & Column 3 2/
New England	16.8	15.5	16.3	-3.0
Midwest	7.2	10.2	9.6	33.3
Mideast	10.5	8.2	9.5	-9.5
Southeast	7.2	10.1	8.4	16.7
Southwest	9.3	11.4	10.2	9.7
Mt. & Plains	5.1	6.3	5.6	9.8
Far West	24.1	18.1	21.6	-10.4
Overseas	10.7	14.2	12.2	14.0
Canada	3.5	3.4	3.5	0.0
Latin America	2.2	1.4	1.8	-18.2
South America	1.5	1.2	1.4	-6.6
Total Plants & Permanent Offices	1,831	1,329	3,160	72.5

1/ This is the distribution that would prevail if plant expansion, closure, and location plans over the next five years are realized.

2/ Projected percent change in the regional distribution of high technology plants and permanent offices from 1981 to 1986.

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Several significant trends are apparent in the data. First, the regions with the highest concentrations of high technology plants and permanent offices in 1981 -- New England, Mideast, and the Far West -- are all expected to suffer a decline in their relative shares. The Far West is expected to experience a 10.4 percent decline in relative share. This finding supports the view found in the literature review that growth of the high technology industries in the already developed high technology centers (e.g., the Silicon Valley and Highway 128) is being constrained by shortages of skilled labor, high taxes, housing costs, congestion, and insufficient room for expansion.

Second, the regions expected to experience the largest percentage increase in new plants and permanent offices are the regions that currently have a relatively low percentage of high technology firms: the Midwest, Southeast, Southwest, and Mountain and Plain States. Of these regions, the Midwest is expected to have the largest percentage gain in relative share at 33.3 percent, followed by the Southeast at 16.7 percent, the Mountain and Plains States at 9.8 percent, and the Southwest at 9.7 percent. This finding supports the product cycle hypothesis advanced by Krumme and Hayter that as they mature new industries seek low-cost regions for their production facilities while maintaining their research and product development activities near the research and technology centers in the more technologically advanced regions.7/ The expected regional shift in plant location patterns toward the Midwestern and Southern regions could be reflecting, at least to some extent, this pattern of regional specialization.

Another important finding is the apparent lack of interest in Canada, Latin America and South America for expansion. Perhaps the increasingly unfavorable political and business environments in these regions are discouraging high technology entrepreneurs from considering them as a location for their new plants and permanent offices.

Overseas is another matter; their share of high technology plants and permanent offices operated by the survey respondents is expected to rise from 10.7 percent in 1981 to 12.2 percent in 1986, a 14.1 percent increase.

REGIONAL PREFERENCES OF HIGH TECHNOLOGY COMPANIES

Finally, in this section we consider the rating of the regions by attribute as perceived by the questionnaire respondents. Each respondent was asked to rate each of the regions of the country as "excellent, good, average, or poor" in terms of 12 locational attributes (see question 14 of Survey, Appendix B). The locational attributes are listed in the column

on the left in Table III.9 in the order of their significance in the location choices of high technology companies as revealed previously in Table III.6 of this chapter. The percent "excellent or good" responses were summed to obtain the index of regional preferences for each attribute as presented in Table III.9. For example, the cost of living was rated as good or excellent for the South by 90.6 percent of the respondents. High scores are underscored by a single line and low scores by a double line. No attempt was made to aggregate the attributes into a single index of regional preferences.

TABLE III.9

QUESTIONNAIRE RESPONDENTS' PREFERENCES FOR EACH REGION BY REGIONAL ATTRIBUTE 1/

Rank	Attribute	New Eng.	Far West	Mid-East	South	South-west	Mt. & Plain	Mid-west
1 & 2	Labor cost/ availability2/	36.3	32.4	34.6	75.2	68.5	53.2	43.0
1 & 2	Labor productivity	49.2	53.7	41.8	54.6	63.1	63.2	53.7
3	Tax climate within the region	8.0	22.8	17.3	91.2	86.3	68.7	31.5
4	Academic institutions	96.6	93.0	79.9	28.9	41.3	27.2	68.0
5	Cost of living	13.2	9.0	22.9	90.6	76.2	72.2	49.6
6	Transportation	70.7	69.9	73.8	43.0	48.4	31.7	66.0
7	Access to market	76.5	81.5	76.1	42.3	53.2	30.6	62.7
8	Regional regulatory practices	16.0	27.1	25.1	72.9	71.7	56.9	35.2
9	Energy costs/ availability	10.5	46.0	21.1	74.8	70.7	49.3	29.9
10	Cultural amenities	90.9	87.1	75.2	18.8	31.0	20.3	41.9
11	Climate	21.4	93.2	20.8	62.1	82.7	50.5	11.6
12	Access to raw materials	64.0	71.3	64.6	41.1	51.9	37.9	61.9

1/ Respondents were asked to rate each attribute as "excellent, good, average, poor." Each attribute index was calculated by aggregating percent of excellent and good responses for each region.

2/ A low preference rating is indicated by a double line and a high rating by a single line. Ratings that are not underlined represent intermediate scores for that attribute.

The purpose of adding a regional dimension to the JEC survey was twofold. First, it was included to provide insights into causal forces behind regional shifts in high technology industries from regions of high concentration of high technology companies (New England, Far West, and Mideast) to regions of relatively low concentrations (Midwest, South, Southwest, and the Mountain and Plains States). Second, a regional dimension was added to provide information that can be used to evaluate the likely success of the various State and local development efforts to attract high technology companies to their respective regions.

A striking similarity of responses for the New England, Far West, and Mideast regions was found. In particular, these regions received a poor rating on four of the five most important attributes that influence locational choices of high technology companies. Labor costs/availability, labor productivity, tax climate within the region, and cost of living were rated as excellent or good by a low percent of the respondents. Academic institutions was the only one of the top five locational attributes to receive a high rating in all three of these regions. Academic institutions in the New England, Far West, and Mideast regions were rated as excellent or good by 96.6, 93.0, and 79.9 percent of the respondents, respectively. In contrast, transportation, access to markets, cultural amenities, and access to raw materials -- the relatively unimportant attributes for high technology companies -- received high preference rating for the New England, Far West, and Mideast regions.

The only real difference in ratings among these three regions was regarding energy and climate. New England and the Mideast received a poor preference rating on each; whereas, the Far West was viewed favorably. Both energy and climate were previously rated as relatively insignificant locational determinants (see Tables III.5 and III.6).

The Southeast, Southwest, and the Mountain and Plains States -- viewed singularly and collectively -- received quite favorable ratings on the top five locational attributes, with the exception of academic institutions. Academic institutions in the Southeast, Southwest, and the Mountain and Plains States were rated as excellent or good by only 28.9, 41.3, and 27.2 percent of the respondents, respectively. In addition, these regions all scored low on the relatively unimportant attributes such as transportation, access to markets, cultural amenities, and, with the exception of the Southwest, access to raw materials. The Southwest scored relatively high on access to raw materials, regional regulatory practices, and energy costs/availability.

Overall, 68 percent of the respondents rated the Midwest's academic institutions as excellent or good. This rating ranked well above academic institutions in the Southeast, Southwest, and

Mountain and Plains States but below their rating in New England, Far West, and the Mideast. Thus, the Midwest may lag somewhat in the reputation and quality of its academic institutions, but the lag is not as great as it is in other parts of the country. Also, it is important to note that the Midwest had fewer negative ratings than any of the other regions, scoring low only on energy cost/availability and climate. Thus, on balance, the Midwest may offer the best bundle of locational attributes to high technology companies, explaining why this region ranked first in relative gain in planned plant expansions (Table III.8)

SUMMARY AND CONCLUSIONS

This chapter presented the results of a Joint Economic Committee Survey of High Technology Companies in the United States. The location decisions of high technology companies were found to differ from the location decisions of other manufacturing companies in several important respects. First, high technology companies are much less concerned with access to markets, raw materials, and transportation. The low cost of transportation per unit value of output reduces their dependence on accessibility to markets and raw materials. The result is that high technology companies are "footloose" in their location choices because of their heavy reliance on skilled labor and scientific inputs. Second, accessibility to highly skilled labor (technical, skilled, and professional) was found to be the most significant concern of high technology companies in choosing among location sites. Most industrial location studies indicate that the other manufacturing companies are not quite as labor oriented.

Third, the JEC survey found high technology companies to be quite concerned about State and local tax structures in their location choices. The potential mobility of their technical and professional employees, upon which they place so much dependence, probably accounts for the sensitivity of high technology companies to State and local taxes. Fourth, unlike the more traditional manufacturing companies, high technology companies apparently seek out a community noted for the excellence of its academic institutions, particularly in the sciences. Academic institutions ranked among the top five determinants of high technology company location decisions. Universities provide benefits to high technology companies through their basic research activities and through the intellectual and cultural climate that they provide. More important, perhaps, universities provide skilled labor in the form of faculty consultants, research assistants, and graduating students.

The cost of living, ample room for expansion, and a transportation system oriented toward the commuter were other

important concerns of high technology companies. Regulatory practices and procedures and the availability of recreational and cultural activities were somewhat less important. Finally, the availability of water, waste treatment facilities, and energy were not listed as important.

The regions of the United States that are expected to receive the largest percentage increase in new plants and permanent offices are the Midwest, Southeast, Southwest, and Mountain and Plains States, with the Midwest leading the way. New England, the Mideast, and the Far West, the traditional leaders of high technology industry growth, are not expected to maintain their positions over the next five years. In general, it would appear that the New England and Far West regions may have exceeded their "holding capacity" as high technology centers. The JEC survey revealed major problems with labor availability and cost, taxes, congestion, housing costs, and availability of land for expansion at a competitive cost, all of which are apparently affecting the growth of high technology companies within these regions. Thus, while these regions monopolized growth in the high technology industries in the past -- particularly in Massachusetts and California -- they are likely to experience increasing difficulty in remaining competitive in the future. The likely result over time will be the spatial diffusion of high technology companies into the technologically less advantaged regions of the country.

Finally, planned expansion in European and other overseas markets is likely to be robust, but Latin America, South America, and Canada are not likely to be major beneficiaries of the expected large increase in new planned expansions and additions.

IV. SUMMARY AND IMPLICATIONS

The high technology sectors consist of many small, innovative companies that are at the center of technological change and industrial innovation in the United States. The importance of technical change and industrial innovation to the productivity and growth of the national economy makes high technology companies an important national resource.

Recently many State and local governments have entered into competition with one another for the Nation's high technology companies. State and local governments are revamping their institutions to provide an environment more conducive to the growth of the high technology industries such as electronics, telecommunications, medical equipment, research and development, and aerospace. The basic thesis of this study, presented in Chapter I, was that this kind of competition at the State and local government level is not destructive or counterproductive. Instead, the removal of important technical, financial, and economic impediments to technology transfer will be an important factor in the technological and industrial revitalization of the American economy, particularly when accompanied by appropriate Federal policies such as favorable tax treatment for investment in the new technologies, stable prices, and low interest rates.

Chapter II of the study highlighted the importance of the high technology sectors to job generation in the manufacturing sector. About 75 percent of the net increase in manufacturing jobs from 1955 to 1979 is attributable to expansion in the emerging high technology industries. Thus, while the high technology industries are an important source of industrial innovation and process technologies that can displace labor, their net impact is to create jobs, not destroy them. The older manufacturing sectors that have failed to adopt the new emerging process technologies are the ones that are providing fewer job opportunities. The lesson from Chapter II is quite clear. Job opportunities are more plentiful and secure in industries that remain competitive by keeping pace with the new emerging technologies.

Chapter III presented the results of the Joint Economic Committee Survey of High Technology Companies. The JEC survey listed skilled labor, taxes, and academic institutions of a region as its most important attractions to high technology companies. The importance of labor in the location decision suggests that state development strategies that ignore human

resource development are not likely to succeed. The role of the university is important because universities are the major suppliers of technicians, engineers, and scientists and they are a major source of new ideas upon which high technology companies so heavily depend to remain competitive. Universities also add to the recreational and intellectual opportunities of a region. The propensity of high technology companies to cluster in urban communities noted for the quality of their academic institutions, such as Highway 128 in Boston and the Silicon Valley near San Franciso, is discussed in Appendix A.

State and local taxes influence the willingness of high technology companies to invest in a region for two interrelated reasons. First, the portion of the tax bill that falls directly on business will result in a reduction in the rate of return on investment in new technologies. Second, the portion of the tax that falls on workers will result in a reduction in real after-tax income and make it more difficult for high technology companies to attract and hold skilled labor. As a result, in a tight labor market, State and local taxes are likely to be forced onto the businesses in the form of tax-compensated wage increases, reducing further the rate of return on investment in the region.

Other factors that were found to be of some importance in the location choices of high technology companies are a favorable business climate, regulatory practices and procedures, the cost of living (including housing), the availability and cost of land for expansion, a good people-oriented transportation system, and good schools.

Also, the JEC survey found that high technology companies are "footloose" in their location choices. Unlike many other manufacturing companies, they are less dependent upon access to markets and raw materials in remaining competitive. Factors such as water supply, waste treatment facilities, cultural amenities (exclusive of recreational opportunities), energy and climate were, likewise, not important to most high technology companies. These findings dispel the myth that sunshine and energy are responsible for the emergence of the Sunbelt economy, at least as far as the high technology industries are concerned.

Finally, Chapter III presented the respondents' perceptions of the regions of the country in terms of their desirability for investment and planned plant additions. The New England and Far West regions ranked lowest in terms of the cost and availability of labor, mainly because the demand for technicians, engineers, and scientists in these regions outranks their supply. High taxes, congestion, and inadequate room for expansion are also a plaguing problem. However, these regions ranked highest in terms of the quality of their academic institutions.

The Southeast, Southwest, and Mountain and Plains states ranked above the other regions in terms of the cost and availability of skilled labor, reflecting the relatively lower demand for skilled labor in these regions. The tax environment was found to be very attractive. Apparently, the most important impediment to the growth of high technology industries in these regions is the perceived low quality of their academic institutions. The survey ranked academic institutions in these regions as the lowest in the Nation.

The Midwest was found to offer the best overall investment climate for the high technology companies. Its labor markets compared favorably with the high cost markets in New England and the Far West. Also, its academic institutions were ranked above academic institutions in the Southeast, Southwest, and Mountain and Plains states, and it had fewer low ratings on the other locational attributes (e.g., cost of living and cultural amenities) than the other regions. Perhaps this explains why this region was found to lead the other regions in the percentage increase in new plant additions over the next five years. The Southeast, Southwest, and Mountain and Plains states are also expected to increase their relative share of high technology companies over this period. New England and the Far West are not expected to keep pace in the growth of high technology companies. Apparently, the high cost and availability of labor, high taxes, congestion, and inadequate room for expansion in the New England and Far West regions are beginning to outweigh their advantages, resulting in the geographical dispersion of new plants and permanent offices.

Policy Implications

It is argued in this paper that continuing economic pressures will direct State and local interest to development policies that encourage the expansion of high technology industries, the source of most net job creation in the manufacturing sector.

A recently conducted survey of state activities to encourage technological innovation prepared for the Conference of Governors suggests that the new State and local development initiatives are taking several forms.1/ Some initiatives emphasize the development of venture capital funds to assist in the financing of new high technology companies and the expansion of existing companies. General fund revenue, private contributions, and earnings from investments are used to form a "pool of financial capital." Loan guarantees, low interest loans, matching grants, and similar arrangements are the primary way that venture capital funds use their resources to "leverage" private investment in high technology companies. Pension funds and life insurance

companies are also being urged to participate in the financing of high technology companies.

Other programs emphasize factors that would lower the technical barriers to the commercialization of new products and processes. For example, Connecticut formed a product development corporation aimed at providing financial assistance for R & D on new products that have potential for wide commercial applications. The objective is to reduce the lead time in which new ideas get transformed into marketable products and processes. Other states, such as California and North Carolina, have funded state laboratories that specialize in R & D activities related to the needs of the electronics industries. The objective is to achieve national prominence in those areas of science and high technology that have the widest applicability within the state.

Still other initiatives attempt to remove information barriers that impede technology transfer. High technology councils, public or private, have been formed in many states to disseminate information about scientific advances, educate the public on the importance of technological progress, and influence state education policy toward the sciences. Prizes, awards, and scholarships are among the ways excellence in science is being encouraged.

Policies to increase the training of technical personnel are also being actively pursued by many states. The importance of skilled technicians in the JEC survey suggests that such investments in human capital will have a high payoff, particularly in states in the older manufacturing regions with large numbers of unemployed, blue collar workers. The current shortage of skilled blue collar workers, (i.e., workers with manual and technical skills such as machinists and electrical technicians) is largely a function of the decline in the manufacturing sectors because on-the-job training is the primary source of skilled blue collar labor. Also, businesses in these sectors have cut back on their investments in human capital as profits have fallen. Consequently, though an important bottleneck has emerged in the labor market for emerging high technology industries, other sectors have trained idle workers. Many states such as California, Kentucky, Illinois, and Indiana are investing heavily in employment-based training and vocational educational programs to match workers with needed skills.

Finally, new institutional forms are being shaped to reorient State and local development efforts to encourage high technology development. A major complaint about State and local government economic development in the past has been its bias toward government-only initiatives. By and large, the private sector was all too often viewed with neglect and indifference. Also, the potential that universities have in economic development has

largely been ignored. The new initiatives aimed at strengthening linkages between the academic, business and local government institutions, such as the establishment of university-based research parks in Florida, Utah, and Ohio, recognize the need to pool resources and fine tune development efforts.

An important question of public policy is whether or not the increased intergovernmental competition for high technology companies is likely to be a negative, zero, or positive sum game. It was argued in this paper that State and local government efforts to promote high technology development are likely to be a positive sum game. Unlike the efforts to influence the redistribution of existing manufacturing plants, through financial inducements, efforts to become competitive in attracting high technology growth industries are (1) strengthening linkages between the financial, R & D and business communities, (2) increasing investment in human capital, and (3) improving the scientific and technological base of a state's economy. These efforts will have the effect of reducing barriers to technology transfer while simultaneously expanding the research and scientific infrastructure of State and local governments and their communities.

Another important policy concern is the Federal role in the development of the emerging high technology industries and the funding of science and engineering programs. Federal R & D and procurement policies have a profound impact on the level and direction of basic and applied research. A Federal role in the development of large scale process technologies aimed at revitalizing the Nation's industrial base should receive serious consideration. Also, Federal tax and funding policies to encourage cooperative research efforts to strengthen R & D linkages between the private sector and universities should be considered. Finally, the appropriate Federal role in encouraging the corporate community to assist universities and technical schools to upgrade their laboratory and research facilities ought to receive public attention. Perhaps these Federal policies ought to be considered in the broader contex of a national science and industrial policy aimed at restoring the technological and industrial superiority of the American economy.

The impact of these Federal, State and local development initiatives on the national economy could be quite large. Productivity gains could be substantial, leading to a significant increase in real per capita income. But, just as important, the flow of ideas from the laboratory to the marketplace will be speeded up. The shortening of the time span between the development of an idea and its application in the marketplace (in the form of new products and processes) can do much to increase the rate of return on investment in basic and applied research and revive entrepreneurial instincts. The result of the new

Federal-State-local partnership that is being forged is likely to be a positive sum game bringing substantial gains to all Americans.

APPENDIX A.

THE GROWTH OF HIGH TECHNOLOGY CENTERS: A STUDY OF THE SILICON VALLEY, HIGHWAY 128, AND THE RESEARCH TRIANGLE

A February 1982 survey of State activities to encourage technological innovation, by the National Association of Governors, identified a variety of new State initiatives to attract high technology industries.1/ The State initiatives are generally aimed at removing the financial, technical, and institutional barriers to technological innovation and development.

In spite of all this excitement, though, not all regions will succeed in attracting high technology industries. Of the 81 high technology research parks surveyed in 1971 by Industrial Research magazine, only about one-fourth of them seemed to be doing well.2/ The Silicon Valley in California, Highway 128 near Boston, and the Research Triangle Park in North Carolina rank among the few major successes.

Through a literature survey, this appendix will examine factors which have either contributed to the success of these three high technology centers or inhibited their development. A historical overview of the development in these high technology centers will be presented, followed by an analysis of the factors that played an important role in their successful development, including universities, skilled labor, taxes, amenities, and State and local development initiatives. Consideration of locational determinants for high technology companies in these successful areas will be helpful to government officials and others in different parts of the country in judging whether their area might prove capable of supporting a similar concentration of high technology industries, perhaps on a smaller scale.

HISTORICAL OVERVIEW

Silicon Valley

The Silicon Valley area lies in Santa Clara County, near San Jose, California. The valley did not rise to prominence due to conscious planning by State officials or businessmen but, instead, developed haphazardly along with growth in the electronics industry. Ted Bradshaw, a research sociologist at

the Institute of Governmental Studies at the University of California, Berkeley, claims that electronics was well established in the State as early as 1917. The industry began to grow during the 1930's and then developed rapidly as the Federal Government injected $35 billion into the California economy during World War II. During this period, the State's aviation industry, including firms located in Silicon Valley, received 60 percent of the wartime Federal spending in California.3/

The success of firms located in the valley attracted many newcomers, as the growth of the electronics industry continued unabated into the early 1960's. U.S. rearmament during the Korean and Cold Wars meant large defense contracts, providing more and more employment in the electronics sector. By the 1960's, 40 percent of total U.S. space and defense work was completed in California, with electronics accounting for a good share of this production and research. In the 1970's, as defense spending abated, other industries, such as automobiles, computers, and telecommunictions, began to use the integrated circuits manufactured in California.4/

Route 128-Boston

The path of development has proven quite similar in the Route 128 area near Boston. Originally, the high technology firms in the area relied on contracts from the military/aerospace community for their survival. To some extent, firms still depend on these contracts. The high-tech sector, according to the State's Secretary of Economic Affairs, George Kariotis, gets 30 percent of its income from defense contracts.5/ Much as in California, however, increased private sector use of high technology products has proven a boon to the economy of Massachusetts. The State has become exceptionally strong in the areas of computers and instrumentation,6/ largely through random expansion, not conscious planning. Companies which had been in the area for years, such as Polaroid, just expanded at their original sites as the demand for their products grew.7/ In addition, executives of some of the established firms would move down the road and open a new concern to supply a market which they felt was being neglected.

The growth of high technology industry in Boston, especially in the area of Route 128, is documented in Russell B. Adams, Jr.'s book, The Boston Money Tree.8/ The author contends that until World War II, Boston was a city in decline. Residents with money to invest put their resources into relatively safe ventures, seeking more to preserve inherited money than to create new fortunes. Funding for risky new ventures just could not be obtained, resulting in a stifling of entrepreneurial ambitions. What investment did occur in new operations often went to other areas of the country, particularly the West, leading Charles

Francis Adams to comment during the mid-1800's that Bostonians could only blame themselves for their city's decline relative to other areas. He stated that Boston's development was being hurt by the tendency for local investors to put their money into projects in other parts of the country.

Even with this out-migration of capital and hesitancy on the part of the investors to get involved in risky new ventures, high technology industry did begin to gain a foothold in the Boston area during the 1920's and 30's. The American Appliance Company, which became Raytheon Manufacturing Company, began to manufacture a radio tube that made it possible for radios to run on household current instead of batteries, and by the 1930's the company had annual sales of several million dollars. Edwin H. Land set up a research and production facility called the Polaroid Corporation to manufacture polarizing filters for automobile headlights and windshields. Land located his new facility in the Boston-Cambridge area to be near Harvard and MIT, the first of which he once attended. His financing came from New York, both because he had contacts in that area and because capital was more readily available there than in Boston for such a risky new operation.

Not all Bostonians were unwilling to take a chance on new technology. Venture capital markets began to form at this time, adding momentum to the development process of investing in items besides standard blue-chip stocks and bonds. The first investment made by this group backed a MIT graduate, Richard S. Morse, in the creation of the National Research Corporation. His first undertaking, coating glass by use of a vacuum technique in order to prevent a glare, proved valuable for use in bombsights and periscopes during World War II. Morse's company also developed a process for making penicillin faster and more cheaply and did work with concentrated orange juice which resulted in the formation of the Minute Maid Company.

Adams considers World War II to be an important element in the revitalization of industry in Massachusetts. MIT and Harvard participated to a large extent in the development of new technologies relating to fire control, missile guidance and navigation, metallurgy, optics, photography, and most importantly, electronics. While the universities performed research, private industry began the production of high technology materials which contributed to the war effort. Once the war ended, the release of pent-up consumer demand provided ever-increasing markets for the products developed during the war and manufactured by firms in the Boston area. The advent of the Cold War again brought government research grants to the area universities and production contracts to Boston firms. Engineers from successful firms would also contribute to the growth of high-tech in Massachusetts by resigning their positions and opening up their own spin-off companies.

Aggressive promotion was important in the development of high technology industries in Boston. Much of Boston's wealth was held by fiduciaries such as insurance companies and investment trusts, and these organizations generally sought to avoid risk whenever possible. In 1946 American Research and Development began to attempt to change this state of affairs by supplying venture capital to new science-based companies. The three-man executive committee representing this organization came from prestigious positions in Harvard Business School, MIT, and the financial community. Their standing in the Boston Area helped prod some of the more cautious investors into providing funds for the upstart high-tech companies.

Route 128, or the Boston Circumferential Highway, neared completion in 1951. It provided a means for north- and south-bound traffic to avoid the congestion of Boston, and just as importantly, it happened to be completed at about the same time as high technology industry really began to prosper in the Boston area. Timing, coupled with the vision of Gerald W. Blakeley, Jr., a Bowdoin College graduate whose father taught at MIT, made Highway 128 come to be regarded as synonymous with high technology industry.

Mr. Blakeley started a real estate development company when he left the Navy in 1947. He envisioned a campuslike industrial park to take advantage of Boston's universities and cultural amenities. Blakeley soon met F. Murray Forbes, who headed a respectable, solid Boston land development firm called Cabot, Cabot & Forbes. The developer offered Blakeley a position with his firm, which would allow Blakeley to promote his industrial park idea while making use of the prestigious Cabot, Cabot & Forbes name. The combination of Blakeley's idea and Forbes's reputation proved very successful. By 1955 approximately 40 companies had located near Route 128, and a decade later this figure had risen to 600. By the 1970's Cabot, Cabot & Forbes had done 85 percent of the building in the 16 parks near the highway and had figured highly in the development of Route 495 which lay further out from Boston.

Despite this aggressive promotion by developers, the area could not have succeeded without the availability of financing for new ventures. One man especially is credited with enabling unproven companies to obtain capital in the Boston area. Gerald Tsai, Jr., took a job in 1952 as a junior stock analyst with the Fidelity Fund. He rapidly began buying and selling stocks recklessly, but profitably. Within five years he had launched his own Fidelity Capital Fund and bought stock in immature companies such as Polaroid and Xerox. Others who viewed his enormous success began to imitate his style, and the "go-go" era of investment had begun in Boston. This period proved to be a bonanza for new Boston companies, and until Tsai moved to New

York and Wall Street crashed in the late 1960's, many thought that nothing could stop the amazing success obtained through investment in high technology industry in Boston.

Research Triangle Park--North Carolina

The growth of the Research Triangle Park of North Carolina, centrally located between the cities of Raleigh, Durham, and Chapel Hill, differs considerably from the previous two examples. Its 5500 acres of land represent the largest planned research center in the world.9/ The park was established exclusively for research, not manufacturing. During the 1940's and 1950's, Dr. Howard W. Odum of the University of North Carolina theorized that the three universities located in the cities surrounding the area now occupied the park could pool their resources to support scientific research. The economy of North Carolina has been dominated for many years by the low-wage textile, furniture, and tobacco industries10/, and Dr. Odum believed that research activity in the State could lead future development in a more positive direction.

In 1958 the late Governor Luther H. Hodges, the late Robert M. Hanes, then president of Wachovia Bank and Trust Co., and the late Brandon P. Hodges, a former State treasurer, incorporated the Research Triangle Committee. The next step came in 1957, as the late Karl Robbins, a retired textile manufacturer, began to assemble land for a research park through an organization called The Pinelands Company. After raising $1.5 million in contributions in 70 days, the Research Triangle Committee became the nonprofit Research Triangle Foundation, which acquired the Pinelands stock and established the park, while using $500,000 to found the Research Triangle Institute.11/ The institute, a separately-operated affiliate of the three universities, provides research for government and industry.12/

The Research Triangle Park officially opened in 1959.13/ Seven years after the park was established, however, the Research Triangle Institute and Monsanto constituted the only substantial operations on the grounds. The area got a substantial boost in 1965 as both IBM and the EPA's Environmental Research Center announced their intention to locate in the park.14/ The area has continued to grow, but within stringent guidelines. Occupants must maintain distance between each building, and landscaping is required.15/ The smallest available site is eight acres,16/ and building is allowed only on 15 percent of the land.17/ The park has relaxed its restrictions somewhat to allow for light, applied-science manufacturing in a certain prescribed area.18/ Even so, the park remains committed to research, and the executive director of the Foundation, Ned Huffman, stresses the desire for diversity by saying, "We do not want to be known as a health park or an electronics park or an educational park. We

would not want to have a dominant group because things have a way of changing."19/

The diversity of research activities in the Research Triangle Park can be seen in the mix of its occupants. Table A-1 presents the top ten corporations ranked by employment and it provides a brief description of research activities undertaken by each corporation. The primary research activities of the major employers are also listed in Table A-1. Of the approximately 43 occupants of the park, the top ten corporations account for 45 percent of the approximately 13,393 jobs in the Research Triangle Park.

TABLE A-1

TOP TEN RESEARCH TRIANGLE PARK OCCUPANTS
RANKED BY EMPLOYMENT SIZE

	Occupant	Number of Employees	Research Activity
1.	International Business Machines Corporation	5,000	Telecommunications Equipment
2.	Northern Telecom Inc. (Telco Group)	1,500	Digital Switching Equipment
3.	U.S. Environmental Protection Agency	1,500	Human Health Research
4.	Research Triangle Institute	1,200	Contracts varying Research
5.	Burroughs Wellcome Company	1,035	Pharmaceutical Research
6.	National Institute of Environmental Health Sciences	600	Biomedical Research on Chemical/ Biological Agents
7.	Northrop Services, Inc.	390	Environmental Research
8.	Monsanto Triangle Park Development Center	250	Synthetic Fiber Research
9.	Data General Corp.	230	Computer Research & Development
10.	J.E. Sirrine Company	210	Engineering Services

SOURCE: Compiled from information provided in The Research Triangle Park of North Carolina, Research Triangle Foundation of North Carolina and the Research Triangle Park Directory, Science and Technology Research Center, North Carolina Department of Commerce, January 1981.

In summary, no single element is responsible for the seemingly spontaneous and spectacular growth of high technology industries in these regions. Instead a combination of factors, including research and teaching activities at great universities, a rich endowment of labor skills, venture capitalists, high technology entrepreneurs, and Federal procurement activities in the area, are intermingled to provide the intricate fabric of a "creative environment" that underly the economic dynamics of the region. Equilibrium, stability and certainty have been replaced by disequilibrium, change, and uncertainty. The only sense of constancy is change itself, but herein lies the economic strength of the regions. In general, the regions possess a major comparative cost advantage in creating new ideas and an institutional environment that willingly translates these new ideas into marketable commodities and services.

LOCATIONAL DETERMINANTS OF HIGH TECHNOLOGY COMPANIES: A MICROVIEW

The historical overview of the development of high technology centers in the Silicon Valley, Highway 128, and the Research Triangle reveals the complex, dynamic nature of the growth process. This section expands on the historical overview by taking a microview of the development process. In particular, the literature on the role of universities, skilled labor, State and local taxes, quality of life factors (including climate, housing costs, and the environment), and State and local development initiatives to the development of the three high technology centers is examined in more detail.

Universities. A recurrent theme in the literature on the growth of the three high technology centers is the central role of the university system as providers of basic research and as suppliers of trained personnel.20/ Nowhere is the linkage between the university system and the high technology community stressed more in promotional efforts than in the Research Triangle. In particular, the Research Triangle Foundation stressses the importance of a close relationship between the park occupants and Duke University (8 miles away in Durham), North Carolina State University (14 miles away in Raleigh), and the University of North Carolina (12 miles away in Chapel Hill).21/

> Our cluster of three great university campuses is a powerful incentive to new industry. It is their existence within a single, close-knit regional community, the challenging intellectual environment they foster, and their receptiveness to innovation and new ideas that have been the most compelling factors in bringing new industry to the area.22/

Ned Huffman invites prospective park occupants to meet university deans, department heads, and professors in their areas of interest.23/ Through their location in the park, companies can make use of the universities' mass spectrometers, phytotrons which can duplicate the climate of the Sahara, 6.5 million-volume library system, and the Triangle Universities Computation Center, with one of the world's largest educational computers.24/ In addition, the close proximity of the universities provides ample opportunity for scientists working in the area to become adjunct professors or to continue their educations.25/

Although not directly connected with the Triangle universities, State-run research projects serve much the same purpose, that of creating an atmosphere within which the quest for new technological developments flourish. In 1963 North Carolina became the first State to create an agency to encourage scientific research and technological application, with the establishment of the North Carolina Science and Technology Research Center.26/ The State recently approved the expenditure of $24 million to help construct a nonprofit microelectronics center by late 1983.27/ The center has been cited as a major factor in General Electric's decision to build a $50 million integrated circuit plant in the park.28/

Ties between industry and institutions of higher learning have also proven strong in the area near Route 128. Corporations support 10 percent of MIT's on-campus research, as compared with an average corporate support of research at all American universities which stands at 3-1/2 percent.29/ As part of this corporate involvement in university research, Exxon has sponsored an $8 million project on combustion research at MIT.30/ DuPont made a $6 million grant to Harvard Medical School's Genetics Department, retaining the right to make exclusive use of discoveries made through its financial support.31/ Harvard encourages its researchers to obtain patents on any discoveries made while at the university, and it assists in the licensing of companies outside the university to exploit the development rights.32/

Stanford's president, Donald Kennedy, views these developments as "a new era in university-industry relations."33/ On January 8, 1981, Governor Brown of California sought to aid in the development of this collaboration between industry and universities by proposing that the State spend $2.6 million next year for a microelectronics research center at the University of California, Berkeley. The State would then help finance research with yearly expenditures of $5 million.34/ The plan does have its critics, however. Some claim that microelectronics research has taken place on the Berkeley campus since 1960, and the $2.6 million proposed by Brown only represents the amount of money already requested by the university last year. At that time,

Governor Brown vetoed a portion of the funds. Solomon J. Buchsbaum, executive vice president of Bell Laboratories, believes that an adequate research center would require $150 million each year in order to operate, not the $5 million that the Governor proposes to spend.35/ Mr. Buchsbaum thus places very little faith in the ability of the proposal to benefit California business to any great degree.

In general, all three high technology centers show important ties with universities in the area, a factor that would appear to be important in their success. Some idea of the importance of this relationship was documented in a case history study of 15 Boston, 12 San Francisco, and 5 Milwaukee high technology companies by the Research and Planning Institute, Inc. On the role of university involvement, the study concluded:

> In an extraordinary number of cases a university played a major role in the history of the company. There were a number of companies that started to pursue the results of research done at the universities, although generally a significant amount of development work was still required. Often, the original research was performed under government grants. In other cases, especially apparent at MIT, the university encouraged faculty members to do outside consulting work for industry. When the consulting work begins to mushroom, colleagues or students are recruited to help and soon a company is born.
>
> For companies in extremely advanced technologies, a continuing relationship with the academic community not only keeps the senior staff informed of new research developments, but helps the company acquire the most competent technical personnel.36/

Labor Availability. In addition to proximity to universities, labor availability and cost seem to play a role, although sometimes a negative one, in the development of these parks. In California, due to excessive competition among firms, "supply and demand (for technical labor) is out of whack." Glenn E. Penisten, president of American Microsystems, Inc., of Silicon Valley, stated the above as a reason for his firm's decision to expand in Idaho.37/ Despite the fact that 80 percent of California's high school graduates receive some college training,38/ the quality of the education received in the State has sometimes been called into question. Mr. Buchsbaum of Bell Laboratories believes that a decline in the performance of California students on national achievement tests may persuade professional people not to move into the State, thereby contributing to problems in the supply of quality labor.39/

North Carolina boasts of its ability to provide a well-trained work force for any firms which might choose to locate in the Research Triangle. Governor Hunt emphasizes this point in stating that, like the universities already in the State, the new microelectronics research center would train scientists and engineers needed by the industry for expansion.40/ During the 1960's, fewer than one-fourth of the science and engineering graduates from North Carolina State University remained to work within the State. Currently, North Carolina retains over one-half of these new high-tech workers, and through improvements in this figure hopes to convince businesses of the high quality labor force readily available in the Research Triangle.41/

At the same time, Massachusetts finds itself hard-pressed to deliver the engineers and scientists desired by high-technology industries within the State. Industry leaders state that they could use 5,000 electrical engineers annually in Massachusetts, while the State's schools provide only 420 graduates each year with this degree.42/ With its ample supply of technology-based colleagues and universities, the State could attract junior and entry-level engineers if it could give promises of access to advanced degree programs, as is done in California. The failure to provide this opportunity could discourage some workers from migrating to or remaining in Massachusetts.43/

State and Local Taxes. By far, however, the tax situation in Massachusetts serves as the major factor which discourages engineers from working in the State. 1979 figures reveal that State and local taxes consume an average of 17.8 percent of a worker's personal income,44/ with a senior engineer in the $35-40,000 per year salary range paying 40 percent above the average State and local tax burden in other high-tech States.45/ Herbert Roth, president of LFE, Inc., said, "We offer a guy a job, and the first thing you hear is taxes. You hear the income tax, the unearned-income tax, the surtax, the property tax and the excise tax. It sounds kind of funny to rattle them all off like that, but that's the list they give us."46/ Personal taxes influence plant location decisions by making it difficult to attract and hold skilled labor. For example, Data General, Inc., a Massachusetts-based company, has located plants in States such as North Carolina because of a shortage of engineers in the corporation's home State.47/

The excessive burden of business taxes has also achieved recognition recently in the States seeking to attract or retain high technology industries. Proposition 2-1/2 cut Massachusetts property taxes 41 percent, by limiting them to 2.5 percent of market value.48/ California, likewise, had been regarded as a high-tax state, with taxes against corporate income, when calculated on a per capita basis, ranking 76 percent above the 1978 U.S. average.49/ Hewlit-Packard figured that the company

could have saved $8 million in taxes in 1977, had all of its operations been located outside California.50/ The business tax burden has been lightened in the State, however, with the passage of Proposition 13 and the elimination of an inventory tax which had led companies to build their warehouses in nearby States.51/

Quality of Life Factors. The literature ranks the quality of life as another factor in the location of high technology businesses. California boasts of its easy access to beaches and mountains, but traffic congestion, smog, and other symptoms of overcrowding tend to detract from the quality of life in the state.52/ Massachusetts appeals to many professional people because of its well-known abundance of cultural institutions, as well as a proximity to beaches and mountains much like those advertised in California.

North Carolina, however, seems to have done the most in recent years to improve and advertise the cultural and recreational activities readily available. The legislature was at first leery of proposals which would establish a state-operated college for the performing arts and a fulltime 77-member orchestra. Today, however, culture has gained appreciation as an expression of good business sense. A team sent to New York in order to woo industry to North Carolina distributed tickets to the State orchestra's concert at Carnegie Hall, as part of their sales pitch.53/ The accessibility of both the ocean and the mountains adds to the attractiveness of life in North Carolina. According to Tom Wooten, executive assistant to the president of the Research Triangle Institute, "I like to fish. In just a little time, you can drive to the Outer Banks. In two more hours, you're in the Gulf Stream going after marlin. There's a growing appreciation around here for the quality of life."54/

Climate. Climate seems not to be a consistent factor in the success or failure of these three high technology areas. Sunny California, Massachusetts, with its New England winters, and North Carolina, with varying seasons but mild temperatures, all have proven successful.

Other Factors. Housing costs receive mention as another locational determinant in all three areas. In California, where housing costs in urban areas recently have been more than 40 percent above the national average,55/ researchers conclude that housing prices act as a serious constraint on growth. The high cost of housing makes it difficult to recruit out-of-state personnel and tends to "motivate current residents to leave, since equity values in modest California houses will buy much larger houses in other states."56/ Companies such as Intel have indicated that housing prices act as a deterrent to their further expansion within the State.57/

Governor Edward J. King of Massachusetts claims that housing is much cheaper in his State than it is in California.58/ At the same time, Governor Hunt of North Carolina purports to have lower prices than either State. "I've got a $300,000 house (at California prices) available for $100,000," said Hunt.59/

Although not initially a factor in the attraction to industry of one park over another, space availability is becoming an increasingly important consideration in all three areas. Both the Silicon Valley and Highway 128k have become so heavily built up that firms are being forced to locate elsewhere. Office space availability along Route 128 currently stands at only 5 percent or less. The result has been increasing development in the area further from Boston near Route 495.60/ The Research Triangle, on the other hand, still has plenty of room for expansion. Only 2700 acres out of the 5,500 acre tract have been sold or donated to research-oriented firms.61/

Transportation costs seem not to figure highly in a high technology firm's decision on placement of a new facility. According to J. Bradley Stroup of Data General Corporation, "A 16-wheel truck can carry $3 million worth of computers, and that gives you enormous mobility."62/

Stringent environmental regulations may be an additional factor, although the literature surveyed fails to reveal a company which cited pollution rules as deterring them from locating in one of the parks. California has become well-known for its plethora of regulations concerning industrial emissions, and North Carolina's park bans smoke, loud noise, and vibration.63/

Energy costs may also help determine the success or failure of a high technology park. Massachusetts energy costs rank 26 percent higher than the national average, a factor which some firms certainly consider when building new plants.64/ A greater focus on energy in California might make Hewlett-Packard more inclined to expand their operations within the State.65/

Local Development Initiatives. All three States use similar development tools in order to aid new and expanding high technology industries. North Carolina utilizes revenue bonds, local development corporations working with Small Business Administration funds, and the Business Development Corporation, a consortium of banks making loans to new firms.66/ A substantial list of programs operate in Massachusetts: an industrial revenue bond program, a 3 percent investment tax credit, an urban job incentive program, the Massachusetts Capital Resource Company, the Massachusetts Technology Development Corporation, the Massachusetts Industrial Finance Commission, the Massachusetts

Business Development Corporation, the Massachusetts Government Land Bank, and the Economic Benefit Sewer Program.67/

Only recently has California begun to look towards these types of development tools. The legislature has authorized a program of industrial revenue bonds, to be under local approval subject to State review, and limited only to manufacturing concerns. The program has been delayed and may now begin operation in the fall. Likewise, an alternative energy financing plan has not yet begun operation.68/ Governor Brown has also proposed additional programs, such as an Innovation Research Grant Program which would provide $300,000 in subsidies to small firms engaged in high technology research. Another plan would provide investors and small companies which market high-tech products with $3 million in State funds as well as $2 million in Federal funds. Another $5 million would support an industrial reinvestment program which would lend money for business expansion and housing construction.69/ California demonstrates the growing realization by States that without financial support from State governments, business may decide to locate elsewhere.

Many business leaders also cite general State attitudes toward business as an important factor in their locational decisions. While California and Massachusetts have sometimes received criticism for their hostile attitudes towards business, North Carolina aggressively advertises its desire to attract industry, especially in high-tech fields. Governor Hunt made a recruiting trip to the Silicon Valley area last November, meeting with officials from companies such as Memorex, Hewlett-Packard, and Intel.70/ G.E., after considering 24 other sites, chose to locate in the Research Triangle partly because of the business climate in North Carolina and the State's attitude towards attracting and developing industry.71/ Data General decided to build a facility in the Research Triangle Park. "Within two weeks of signing the agreement the State came in with bulldozers and started working on the access road," said spokesman J. Bradley Stroup. The same company waited two years for the State of Massachusetts to install a traffic light.72/

SUMMARY AND IMPLICATIONS FOR ECONOMIC DEVELOPMENT

High technology companies are generally labor intensive with very specific labor skill requirements. They prefer to locate near a university environment, where new ideas are constantly born and old ideas are replaced. High technology companies thrive on seizing new applications that are commercially feasible and incorporating the new ideas into products and services in the marketplace.

The attraction of high technology companies to university-based communities is no accident. Universities contribute significantly to advances in basic science that high technology companies crave, but spawning new ideas is only one step in encouraging high technology industries. Entrepreneurs with the instinctive ability to capitalize on new applications and transfer these new ideas into profitable enterprises are an essential ingredient. Risks are high since nontraditional products are often developed with little market comparison, but potential profits are large. High technology entrepreneurs are a breed apart from the entrepreneurs of traditional industries like steel, rubber, oil, and automobiles. In these industries business practices and procedures are highly institutionalized, suppressing individual creativity and inventiveness. High technology entrepreneurs, in contrast, are constrained only by the marketplace. Success depends upon continuously seeking new applications of science and on overcoming the remaining barriers, technical and financial, to the application of new ideas and technology. In short, venture capitalists, high technology entrepreneurs, universities, real estate developers, and aggressive leadership and promotion are the "infrastructure" for the development of high technology centers.

The literature survey revealed that the following factors are important in the location choices of high technology companies: wages, taxes, labor availability, housing costs, proximity to universities, business climate, room for expansion, environmental regulations, and financial inducements. Unfortunately, the subjective nature of the literature, based mostly on experience and expert opinion, makes it impossible to determine the relative importance of the various locational determinants. Nevertheless, the literature review gave important insights into the locaton propensity of high technology companies that were incorporated into the Joint Economic Committee Survey of High Technology Companies in the United States, discussed in Chapter III.

APPENDIX B.

Congress of the United States

JOINT ECONOMIC COMMITTEE

(CREATED PURSUANT TO SEC. 5(a) OF PUBLIC LAW 304, 79TH CONGRESS)

WASHINGTON, D.C. 20510

October 21, 1981

THE LOCATION OF HIGH TECHNOLOGY COMPANIES

The Joint Economic Committee has selected your business for voluntary participation in a questionnaire survey on matters of importance to public policy and the business community. The enclosed questionnaire is designed to provide information on factors that influence business location choices. Summary information from the survey will be used by the Joint Economic Committee to evaluate Federal, State and local policies that influence business expansion plans.

Knowing why businesses locate where they do will enable Congress to design policies which encourage business expansion rather than thwart it. Improved public policies could mean less uncertainty and more investment for business.

Your participation in this study is vital to its success. Please assign the task of completing this questionnaire to the person(s) in your organization most knowledgeable on plant or office expansion and location plans. We are keenly aware of the value of your time and have tried to construct the questionnaire in such a way as to minimize your time and effort.

Thank you for your assistance, and be assured that all information on your response will be held strictly confidential. Only the aggregate results will be made available.

Sincerely,

Roger W. Jepsen

Roger W. Jepsen, Vice Chairman

Clarence J. Brown

Clarence J. Brown, Ranking House Republican Member

JOINT ECONOMIC COMMITTEE
Industry Location Survey

Confidential

Name of Person Completing Survey_____

Position_____

Level of involvement with plant locations within the corporation:

_____Closely involved _____Somewhat involved _____Only slightly involved, if at all

PART I. CORPORATION IDENTITY AND CHARACTERISTICS

1. Name of Company_____

2. Address: State_____County_____

   City_____

3. How would you describe your plant or office facility?

   _____Headquarters for a multiplant operation
   _____Branch of a multiplant operation
   _____A subsidiary
   _____Multiplant operation
   _____Single plant operation

4. Address of Headquarters or Parent Company if different than Question 2:

   State_____County_____

   City_____

5. Year of incorporation_____

6. How would you describe the major business activities of your company?
   (More than one response may be appropriate.)

   _____Semiconductor/computer
   _____Telecommunications
   _____Research
   _____Aerospace
   _____Chemical
   _____Medical instruments
   _____Other

   6a. List the major product (service) lines of your corporation:

   _____

   _____

7. How would you characterize the market for your major product (service)?

   _____Predominantly international
   _____Predominantly national
   _____Predominantly regional (For example, Midwest or Southwest)
   _____Predominantly within State

8. Have the geographical markets for the corporation's major products changed substantially over the past five years? _____Yes _____No

   8a. If yes, briefly how? _____

9. Roughly, total corporation employment_____

10. Roughly, total calendar 1980 corporation revenues_____

11. How many plants or permanent offices does the corporation operate?_____

12. How many of those plants or offices are located in each of these regions of the country? (See attached list of states by region.)

_____New England
_____Midwest
_____Mideast
_____South
_____Southwest
_____Mountain & Plains
_____Far West
_____Overseas
_____Canada
_____Latin America
_____South America

PART II. PLANT EXPANSION AND LOCATIONAL PREFERENCES

13. How many new plants (or sales offices) does your corporation plan to add over the next five years?_____

14. If possible, list how many of these facilities will be added in the following regions:

_____New England
_____Midwest
_____Mideast
_____South
_____Southwest
_____Mountain & Plains
_____Far West
_____Overseas
_____Canada
_____Latin America
_____South America

15. To what extent do you consider each of the following attributes as a factor in determining your regional preference for a location. (Circle 1-Very Significant; 2-Significant; 3-Some Significance; 4-No Significance):

(See attached list of states by region.)

Attribute	Impact on Locational Preferences			
Tax climate within the region	1	2	3	4
Regional regulatory practices	1	2	3	4
Access to markets	1	2	3	4
Labor costs	1	2	3	4
Labor skills/availability	1	2	3	4
Access to raw materials	1	2	3	4
Cost of living	1	2	3	4
Transportation	1	2	3	4
Energy costs/availability	1	2	3	4
Climate	1	2	3	4
Cultural amenities	1	2	3	4
Academic institutions	1	2	3	4
Other_____	1	2	3	4

16. Based upon your perceptions, rate each region by attribute using the following scale: 1-Excellent; 2-Good; 3-Adequate; 4-Poor:

Attribute	New England	Midwest	Mideast	South	Southwest	Mt. & Plain States	Far West
Tax climate within the region							
Regional regulatory practices							
Access to market							
Labor cost/availability							
Labor productivity							
Access to raw materials							
Cost of living							
Transportation							
Energy costs/availability							
Climate							
Cultural amenities							
Academic institutions							

17. What impact would each of the following attributes have on your company's choice of a location within a region? (1-Very Significant; 2-Significant; 3-Some Significance; 4-No Significance):

_____Good transportation facilities for materials and products
_____Good transportation for people
_____Cost of property and construction
_____Proximity to customers
_____Ample area for expansion
_____Community attitudes towards business
_____Availability of workers:
  _____Skilled
  _____Unskilled
  _____Technical
  _____Professional
_____Proximity to raw materials and component supplies
_____Availability of energy supplies
_____Adequate waste treatment facilities
_____State and/or local government tax structure
_____Water supply
_____Proximity to good schools
_____Proximity to recreational and cultural opportunities

17a. In general, these attributes can best be obtained in an _____urban; _____rural; _____other environment

17b. If other, please specify:_____

18. The following are actions that State and local governments can undertake to encourage business expansion within their jurisdictions. How would you rate each action in terms of its likely success? (Circle 1-Very Significant; 2-Significant; 3-Some Significance; 4-No Significance):

Train labor	1	2	3	4
Offer financial incentives	1	2	3	4
Procure resources from local business	1	2	3	4
Reduce taxes	1	2	3	4
Cut red tape	1	2	3	4
Reduce lost time during inspections	1	2	3	4
Improve community attitude	1	2	3	4
Improve cultural amenities	1	2	3	4
Improve recreational facilities	1	2	3	4
Other_____.	1	2	3	4

19. To what extent does your company interact with other firms in the area in the course of daily business activities? _____Significant interaction; _____Moderate interaction; _____Very little interaction; _____No interaction

19a. If significant or moderate, describe the nature of this interaction:

_____

_____

19b. Was the possibility of this contact with other firms a factor in your company's location decision? _____Yes _____No

20. Roughly, what percentage of your business activity is conducted under contract to the Federal Government?_____

20a. How does this percentage compare with the percentage of your company's business activity conducted for the Federal Government five years ago? _____Higher today; _____About the same; _____Lower today

20b. How important would you rate location near a Federal facility (military or other) as a factor in your ability to obtain Federal grants? _____Very significant; _____Significant; _____Some significance; _____No significance

21. Do you consider the proximity to a university system a factor in your location choice? _____Yes _____No

21a. If yes, which of the following university attributes do you consider important? (Circle 1-Important; 2-Somewhat important; 3-Not important)

Attribute	Impact on Locational Choice		
Degree programs for employees	1	2	3
Part-time teaching opportunities for employees	1	2	3
Faculty research activity	1	2	3
Faculty consultants	1	2	3
Access to laboratories	1	2	3
Access to libraries & information systems	1	2	3
College graduates	1	2	3
Cultural activities	1	2	3
Other_____	1	2	3

21b. Rate each of the following in terms of importance to the transfer of scientific knowledge from the university to your business enterprise.
(1-Very important; 2-Important; 3-Some importance; 4-No importance)

University publications (books, articles, etc.)	1	2	3	4
University services	1	2	3	4
Student recruiting	1	2	3	4
Faculty consulting	1	2	3	4
Corporate support for basic research at universities	1	2	3	4
Government dissimenation of the results of basic research	1	2	3	4

21c. In your opinion, what can be done to improve the transfer of scientific knowledge from the university to the community?

_____

_____

PART III. GOVERNMENT REGULATIONS, TAXES AND EXPANSION ACTIVITY

22. To what extent does Federal Government regulation affect the expansion plans of your business? ..... Large impact; .. Moderate impact; Insignificant impact

23. With which of the following government agencies has your business had contact within the last two years? (Circle all items that apply to your company).

Agency	Degree of Contact					Impact on Business		
	No contact	Inspected or investigated by	File routine reports to	Rec'd. contract from	Ordered to comply by	Little	Moderate	Great
Environmental Protection Agency	1	2	3	4	5	1	2	3
Department of Labor	1	2	3	4	5	1	2	3
Department of Defense	1	2	3	4	5	1	2	3
Ofc. of Federal Contract Compliance Programs	1	2	3	4	5	1	2	3
Department of Energy	1	2	3	4	5	1	2	3
Consumer Product Safety Commission	1	2	3	4	5	1	2	3
Food and Drug Administration	1	2	3	4	5	1	2	3
Federal Trade Commission	1	2	3	4	5	1	2	3
Occupational Safety & Health Admin.	1	2	3	4	5	1	2	3
Equal Employment Opportunity Comm.	1	2	3	4	5	1	2	3
Interstate Commerce Commission	1	2	3	4	5	1	2	3
Census Bureau	1	2	3	4	5	1	2	3
Department of Transportation	1	2	3	4	5	1	2	3
Dept. of Health & Human Services	1	2	3	4	5	1	2	3
Dept. of Housing & Urban Develop.	1	2	3	4	5	1	2	3
Small Business Administration	1	2	3	4	5	1	2	3
Securities and Exchange Commission	1	2	3	4	5	1	2	3
Other _____	1	2	3	4	5	1	2	3

24. Which of the federal agencies listed above have the most impact on the way you operate your business?

1. _____

2. _____

3. _____

25. What has been the impact of State and local regulatory requirements on your business location plans? _____Very significant; _____Significant; _____Some significance; _____Insignificant

25a. If significant or very significant, rate the importance of the following: (Circle 1-Very significant; 2-Significant; 3-Some significance; 4-Insignificant)

Zoning Practices	1	2	3	4
Building permit procedures	1	2	3	4
Building codes	1	2	3	4
Filing and inspection procedures	1	2	3	4
Environmental Restrictions	1	2	3	4
Other_____	1	2	3	4
_____	1	2	3	4
_____	1	2	3	4

26. What has been the impact of State and local government financial incentives on your business location plans?

_____Very significant; _____Significant; _____Some Significance; _____Insignificant

26a. Which of the incentive programs do you consider to be effective local development tools? (Circle 1-Very significant; 2-Significant; 3-Some Significance; 4-Insignificant)

Loan guarantees	1	2	3	4
Low interest loans	1	2	3	4
Industrial development bonds	1	2	3	4
Property tax abatement	1	2	3	4
Research subsidies	1	2	3	4
Investment tax credits	1	2	3	4
Other_____	1	2	3	4
_____	1	2	3	4

27. Approximately what percent of your workforce is unionized?_____%

27a. What impact have unions had on your choice of a location?

_____ Very Significant; _____ Significant; _____ Some impact; _____ No impact

Please return in the enclosed
postage free envelope to:

Senator Roger W. Jepsen, Vice Chairman
Joint Economic Committee
House Annex 2, Room 359
3rd & D Streets, S.W.
Washington, D.C. 20515
Attn: Dr. Robert Premus, Economist

LIST OF STATES BY REGION

NEW ENGLAND

Connecticut
Maine
Massachusetts
New Hampshire
Rhode Island
Vermont

MIDEAST

Delaware
District of Columbia
Maryland
New Jersey
New York
Pennsylvania
Virginia

MIDWEST

Illinois
Indiana
Michigan
Minnesota
Ohio
Wisconsin

FAR WEST

California
Nevada
Oregon
Washington
Alaska
Hawaii

MOUNTAIN AND PLAINS

Colorado
Idaho
Iowa
Kansas
Missouri
Montana
Nebraska
North Dakota
South Dakota
Utah
Wyoming

SOUTH

Alabama
Arkansas
Florida
Georgia
Kentucky
Louisiana
Mississippi
North Carolina
South Carolina
Tennessee
West Virginia

SOUTHWEST

Arizona
New Mexico
Oklahoma
Texas

NOTES

CHAPTER II

1/ This method of computing high technology employment by industry has the advantage that data are readily available, but it is not without serious limitations. First, not all jobs in each of the two digit SIC Code industries can rightfully be classified as high technology jobs, nor can all jobs excluded from the other industries be rightfully excluded. Nevertheless, the fact that few researchers quarrel with the selection of industries as science-based suggests that this measurement is not without merit. See Michael Borefsky, "U.S. Technology Trends and Policy Issues," Monograph No. 17, George Washington University Program of Policy Studies in Science and Technology, October 1973.

2/ Eugene J. Doody and Helen B. Munzer, High Technology Employment in Massachusetts and Selected States, a report prepared for the Massachusetts Division of Employment Security, Job Search, March 1981.

3/ Lynn E. Browne, "Regional Investment Patterns," New England Economic Review, Federal Reserve Bank of Boston, July/August 1980, p. 16, citing John Hekman, "What Attracts Industry to New England?" New England Economic Indicators, December 1978.

CHAPTER III

1/ T. E. McMillan, Jr., "Why Manufacturers Choose Plant Locations vs. Determinants of Plant Location," Land Economics, August 1965, pp. 232-8.

2/ Joseph F. Pluta, "Taxes and Industrial Location," Texas Business Review, January/February 1980, pp. 1-6.

3/ One of the few studies that has attempted to distinguish between choice of a region and choice within a region when locating a plant was the McGraw-Hill, Plant Site Survey. See McGraw-Hill, Plant Site Survey, A Study Among Business Week Subscribers, 1964. Approximately 2,000 subscribers responded to the survey.

4/ The tax climate does not refer just to high or low taxes within the State. Cornia, Testa, and Stocker suggest that tax climate refers to certainty of future State and local taxes as much as it refers to the average burden of these taxes. For example, States that may have a lower than average tax burden may nonetheless be undesirable if they are constantly imposing surcharges and taxes to balance their budget, or if some businesses are granted lucrative tax incentives (e.g., tax abatement) and others are not. Apparently, businessmen evaluate tax climate not only in terms of the level and structure of taxes but in terms of its stability as well. See, Gary C. Cornia, William A. Testa, and Frederick D. Stocker, State-Local Fiscal Incentives and Economic Development (Columbus, Ohio: Academy for Contemporary Problems, June 1978).

5/ Some notion of the mobility of scientists and engineers can be obtained from National Science Foundation, Science and Engineering Personnel: A National Overview, U.S. Government Printing Office, June 1980. Also, see National Science Foundation, Employment Patterns of Academic Scientists and Engineers, 1973-78, Special Report U.S. Government Printing Office, July 1980. Finally, see Richard J. Harris, "Rewards of Migration for Income Change and Income Attainment, 1973-78," Social Science Quarterly, June 1981, pp. 275-93.

6/ Charles M. Tiebout, "A Pure Theory of Local Expenditures," Journal of Political Economy, 64 (1956): 416-24.

7/ G. Krumme and R. Hayter, "Implications of Corporate Strategies and Product Cycle Adjustments for Regional Employment Changes," in L. Collins and D. F. Walker (eds.), Locational Dynamics of Manufacturing Activity, New York: John Wiley, 1975, pp. 325-356.

CHAPTER IV

1/ "State Activities to Encourage Technological Innovation," prepared for the National Governors Association Task Force on Technological Innovation, by Governor Edmund G. Brown, Jr., California, and Governor William G. Milliken, Michigan, Co-Chairmen, February 1982.

APPENDIX A

1/ "State Activities to Encourage Technological Innovation," prepared for the National Governors Association Task Force on Technological Innovation, by Governor Edmund G. Brown, Jr., California, and Governor William G. Milliken, Michigan, Co-Chairmen, February 1982.

2/ Luther J. Carter, "Research Triangle Park Succeeds Beyond Its Promoters' Expectations," Science 200 (June 30, 1978): 1470.

3/ "California: The Entrepreneurial Imperative," Business Week, October 20, 1980, Special Advertising Section.

4/ Ibid.

5/ Gary McMillan, "High Tech Making It in Massachusetts," Boston Globe, March 10, 1981, p. 51.

6/ "High Technology Enterprise in Massachusetts: Its role and Its Concerns," prepared for the Commonwealth of Massachusetts Executive Office of Economic Affairs, Boston, Massachusetts, by Technical Marketing Associates, Inc., October 1979, p.iii.

7/ Telephone conversation with Charles (Ned) Allen, plant manager for Polaroid, July 14, 1981.

8/ Russell B. Adams, Jr., The Boston Money Tree, (New York: Thomas Y. Crowell, 1977).

9/ Brochure: "A Dynamic Concept for Research: The Research Triangle Park of North Carolina."

10/ Carter, p. 1470.

11/ Paul Horvitz, "A Park That's Always in Season," The News and Observer (Raleigh North Carolina), February 27, 1977, p.8.

12/ "A Dynamic Concept."

13/ Horvitz, p. 8.

14/ Carter, p. 1470.

15/ "Research Park Where the Grass is Already Greener," The Times (London), September 9, 1977, Higher Education Supplement.

16/ "A Dynamic Concept."

17/ Carter, p. 1470.

18/ Ibid.

19/ Horvitz, p. 8.

20/ Ann Crittenden, "Industry's Role in Academia," The New York Times, July 22, 1981, p. D11.

21/ "A Dynamic Concept."

22/ Ibid.

23/ Carter, p. 1470.

24/ "North Carolina Shows How to Keep 'Em Home," U.S. News and World Report, July 17, 1978, p. 56.

25/ Horvitz, p. 8.

26/ "A Dynamic Concept."

27/ Doug McInnis, "Going After High Tech," The New York Times, July 19, 1981, p. 6F.

28/ Thomas Lueck, "Gov. Brown Seeks Business Aid," The New York Times, February 12, 1981, p. D15.

29/ Crittenden, p. D11.

30/ Ibid., p. D1.

31/ "DuPont Gives Harvard $6 Million," Washington Post, June 30, 1981, p. D7.

32/ Ibid., p. D8.

33/ Crittenden, p. D1.

34/ Robert Fairbanks, "North Carolina Eyes State's 'Golden Goose'," Los Angeles Times, March 15, 1981, pp. 28, 30.

35/ Ibid., p. 30.

36/ Research and Planning Institute, inc., Case Studies Examining the Role of Government R&D Contract Funding in the Early History of High Technology Companies, prepared under contract for the Small Business Administration, July 1980, p. 20.

37/ "More Elbowroom for the Electronics Industry," Business Week, March 10, 1980, p. 97.

38/ "California: The Entrepreneurial Imperative," p. 35.

39/ Fairbanks, p. 30.

40/ Ibid., p. 28.

41/ "North Carolina Shows How to Keep Em Home," p. 56.

42/ Michael Knight, "Taxes Hurt Massachusetts Jobs," The New York Times, March 26, 1978, p. D8.

43/ "High Technology Enterprise in Massachusetts: Its Role and Its Concerns," p. vii.

44/ Knight, p. D1.

45/ "High Technology Enterprise in Massachusetts," p. vi.

46/ Knight, p. D1.

47/ Ibid., p. D8.

48/ Rowland Evans and Robert Novak, "'Taxachusetts' No More," Washington Post, July 20, 1981, p. A13.

49/ John Quirt, "Why the Future No Longer Looks so Golden in California," Fortune, March 27, 1978, p. 131.

50/ Ibid.

51/ "California: The Entrepreneurial Imperative," p. 35.

52/ Robert Lindsay, "California's Inland Areas Face Wave of Migration," The New York Times, June 11, 1981, p.A16.

53/ "How to Keep 'Em Home," p. 57.

54/ Ibid.

55/ Lindsay, p. A16

56/ Fairbanks, p. 30.

57/ Ibid.

58/ Ibid.

59/ Ibid.

60/ McMillan, p. 51.

61/ Horvitz, p. 1.

62/ "More Elbowroom," p. 97.

63/ "North Carolina Shows How to Keep 'Em Home," p. 56.

64/ Knight, p. D8.

65/ Fairbanks, p. 30.

66/ Phone call to Jane Curtis of North Carolina Industrial Development Division, Department of Commerce, Finance Section, July 24, 1981.

67/ Phone call to Massachusetts Governor's Executive Office for Communities and Development, July 24, 1981.

68/ Phone call to California Office of Business and Industrial Development, July 24, 1981.

69/ Lueck, p. D15.

70/ McInnis, p. 6F.

71/ "A Dynamic Concept."

72/ "More Elbowroom," p. 100.