

VENTURE CAPITAL

International Comparisons



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ROUTLEDGE


4 Regional patterns of venture capital investment

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INTRODUCTION

Venture capital investment is a critical component of high-technology economic growth. Although investment is perhaps the most important dimension of venture capital activity, there is virtually no literature on it. The academic literature has generally focused on the concentration and distribution of venture capital resources and firms, largely because of unavailable or unreliable data. While most studies assert that venture capitalists tend to invest within 200 miles of the home office, none have systematically reviewed many of the considerations that make geography such an important factor in a venture capitalist's investment decision. This may stem from the fact that most academic studies suffer from over-aggregation, convey only regional totals or state-wide aggregates, which prevents an in-depth analysis of state or metropolitan level flows of venture capital.

In this chapter, we overcome these problems by basing our analysis on a new, comprehensive database on venture capital investment. This database is derived from information published by *Venture Capital Journal* over the 3-year period 1984–87, and provides a 40–45 per cent sample of all venture investment made over that period. The database provides 'micro-level' information on venture capital investments in actual companies. This enables us to look closely at investment flows at the micro level, thereby overcoming the shortcomings of previous studies.

Our major findings can be summarized as three major points. First, venture capital investments are highly concentrated by region. Just two regions – the Northeast and the Pacific – accounted for almost 75 per cent of the venture capital invested in 1986. Second, at the state level, just two states – California and Massachusetts –

accounted for over 50 per cent of all venture capital invested in that year. And third, venture capital investments are highly concentrated within most states. According to our data, the San Francisco–Silicon Valley area accounted for 58 per cent of all venture capital investments made in California, and 23 per cent of all venture capital investments made nationwide; the Route 128 area around Boston received 95 per cent of the venture capital investments in Massachusetts and 14 per cent of the national total (Map 4.1). Moreover, this pattern is also observable in states that are not leading centers of venture capital. A prime example of this is Georgia – almost all the venture capital investments in that state are concentrated in the Atlanta area.

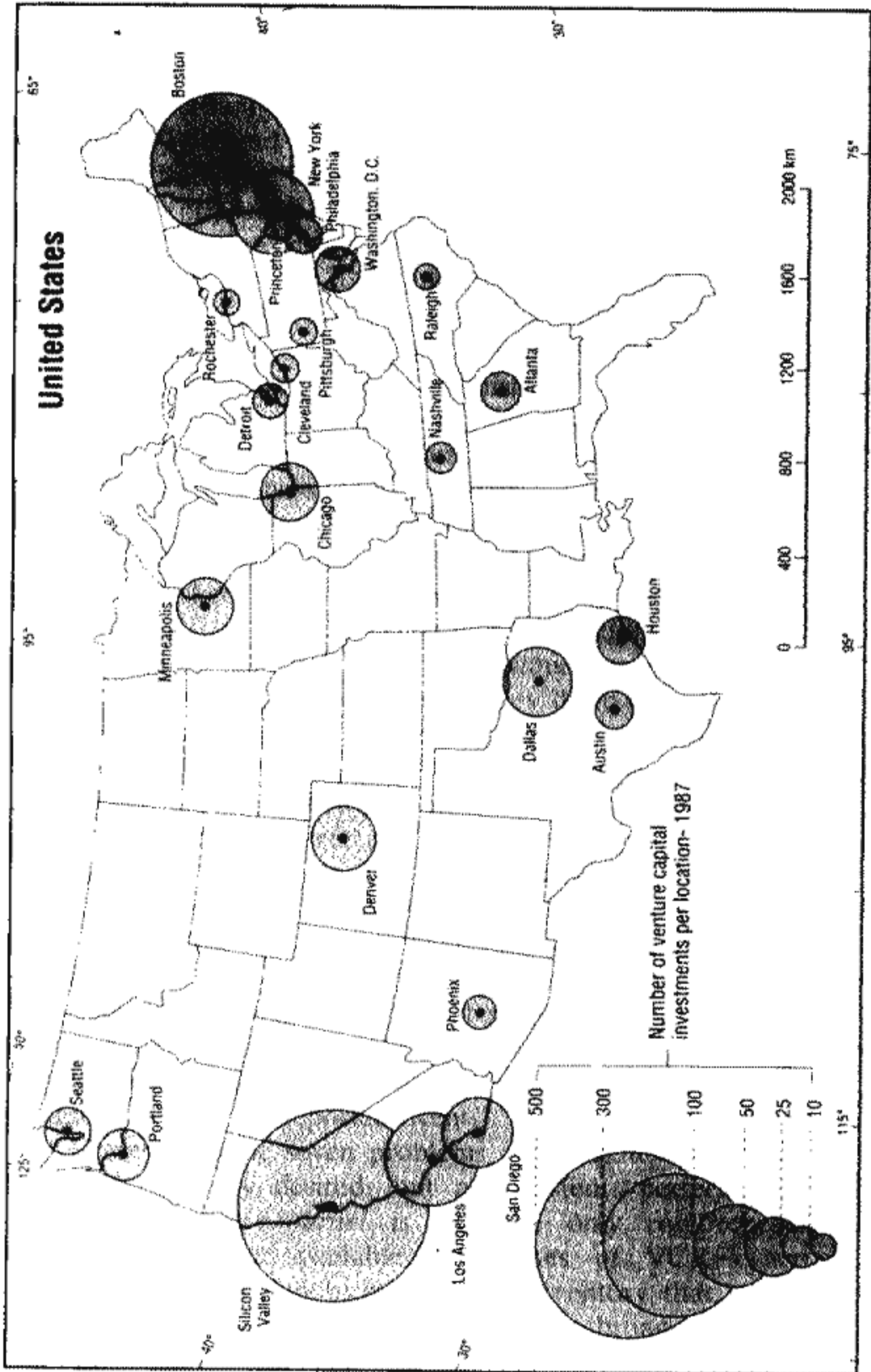
Together, these three findings lead us to conclude that venture capital investments flow to areas with established concentrations of high-technology businesses. Many researchers have explored the following ‘chicken or the egg’ question: Does venture capital attract high-technology industry or does high-technology attract the venture capital dollars? Our research supports the latter interpretation. An area is much more likely to be a recipient of venture capital if it is home to high-technology firms.

Although a logical assumption might be that venture capital investments tend to concentrate in areas that possess venture capital resources, our findings indicate that this is only partly true. Venture capital mainly flows to the nation’s premier high-technology centers, most notably California’s Silicon Valley and Route 128 around Boston. In contrast, venture capital centers like Chicago and New York City receive a relatively minor share of venture investments.

This chapter proceeds as follows. The first section explores the major trends in the concentration of venture capital investment. The second section provides detailed analyses of venture capital investments within regions at the level of state and metropolitan area. In this section we also present some rough comparisons between venture capital investments and the location of high-technology businesses.¹

CONCENTRATION OF VENTURE CAPITAL INVESTMENTS

The geographic distribution of venture capital investments is highly uneven and tightly clustered. As Table 4.1 illustrates, venture capital investment is concentrated at the regional level, exhibiting pronounced ‘bi-coastalism’. The Pacific and Northeast Regions together attracted almost three-fourths (74 per cent) of the \$2.9



Map 4.1 Venture capital investments, 1987

billion funds invested by the venture capital industry in 1986. The Pacific Region is led by California, which dominates the rest of the nation in its ability to attract venture capital. The Northeast Region is placed a distant second behind the Pacific. Within the Northeast Region, Massachusetts attracts the majority of this region's venture investments. However, its dominance over the rest of the Northeast Region is far less than that of California's in the Pacific Region.

The Midwest Region has seen a precipitous decline in venture capital investments. A report prepared for IBM by S.M. Rubel (Rubel and Company 1975) in the mid-1970s presented findings that, in the 1968-75 period, states in the Midwest had attracted almost 20 per cent of the total share of venture capital investments. By 1981, the Midwest's share had declined to a mere 8 per cent of the national total. For the past decade, the distribution of venture capital throughout the United States has remained relatively constant. The only possible exception is the South Region which has shown a steady increase, from 6 per cent in the early 1970 period to 9 per cent in 1986.

As Table 4.2 shows, among states, California attracted the 'lion's share' of the investment dollars, with \$1.1 billion or 38 per cent of the national total in 1986. Massachusetts was second, receiving approximately \$400 million or 14 per cent of the total venture capital invested, while New York, Texas, and New Jersey attracted \$200 million, \$170 million, and \$140 million respectively. No other state drew more than \$100 million in venture capital investments. Although in recent years California and Massachusetts have commanded the majority of the venture capital industry's disbursements, this pattern of investment did not always hold. In the period prior to the industry's boom of the late 1970s the combined share of investments for these two states was only 35 per cent.

Venture capital is also highly concentrated within states. Silicon Valley receives more than two-thirds of all venture capital investments made in California, with investments tightly clustered in the cities of Sunnyvale, Santa Clara, and San Jose. These cities received 30 per cent of the California total, and 12 per cent of total investments. Of the states, only Massachusetts received more venture capital investments than this three city area. A similar level of concentration is noticeable in the Route 128 area. The eighteen cities and towns along the Route 128 corridor received almost 75 per cent of that state's investments. And just three communities, Newton, Waltham, and Woburn, received 62 per cent of the Route 128 investments - almost 3 per cent of the national total of venture capital investments.

Table 4.1 Venture capital disbursements, by region, by total dollar amount (in millions), and by percentage of total

Region	1968-75	1980	1981	1982	1983	1984	1985	1986	1987
Pacific	213 (28)	365 (36)	648 (46)	875 (48)	1,071 (51)	1,035 (45)	1,118 (43)	1,066 (41)	1,638 (42)
Northeast	246 (28)	275 (27)	352 (25)	474 (26)	525 (25)	552 (24)	702 (27)	858 (33)	1,092 (28)
Midwest	154 (20)	92 (9)	113 (8)	146 (8)	147 (7)	184 (8)	234 (9)	182 (7)	312 (8)
South	46 (6)	92 (9)	71 (5)	91 (5)	147 (7)	184 (8)	182 (7)	234 (9)	468 (12)
Gulf Coast	57 (7)	133 (13)	155 (11)	146 (8)	105 (5)	230 (10)	208 (8)	156 (6)	234 (6)
Mountain	31 (4)	68 (7)	71 (5)	91 (5)	105 (5)	115 (5)	156 (6)	104 (4)	156 (4)
US total	747	1,025	1,409	1,822	2,100	2,300	2,600	2,900	3,900

Sources: 1968-75 data from Rubel (1975); 1980-2 data from OTA (1984); 1983 data from *Venture Capital Journal*, May 1984; 1984 data from *Venture Capital Journal*, May 1985; 1985-6 data from *Venture Capital Journal*, May 1987; 1987 data from *Venture Capital Journal*, May 1988.

Table 4.2 Venture capital disbursements - leading recipient states, by dollar amount (in millions), and by percentage of total

State	1968-75	1980	1981	1982	1983	1984	1985	1986	1987
California	201 (26)	345 (34)	587 (42)	829 (46)	987 (47)	1,012 (44)	1,014 (39)	988 (38)	1,521 (39)
New York	82 (11)	66 (7)	45 (3)	135 (7)	105 (5)	115 (5)	130 (5)	182 (7)	117 (3)
Massachusetts	66 (9)	123 (12)	180 (13)	224 (12)	252 (12)	322 (14)	338 (13)	364 (14)	429 (11)
Illinois	57 (7)	29 (3)	32 (2)	-	42 (2)	46 (2)	78 (3)	78 (3)	117 (3)
Texas	57 (7)	108 (11)	140 (10)	142 (8)	105 (5)	184 (8)	182 (7)	156 (6)	234 (6)
Colorado	25 (3)	54 (5)	44 (3)	67 (4)	63 (3)	69 (3)	78 (3)	78 (3)	117 (3)
Michigan	22 (3)	-	14 (1)	15 (2)	-	-	-	-	-
Minnesota	20 (3)	-	21 (1.5)	33 (2)	42 (2)	69 (3)	-	-	-
New Jersey	31 (4)	24 (2)	35 (2.5)	38 (2)	42 (2)	46 (2)	78 (3)	130 (5)	234 (6)
Ohio	24 (3)	-	37 (3)	-	-	-	-	-	-
Pennsylvania	23 (3)	42 (4)	30 (2)	30 (2)	42 (2)	46 (2)	52 (2)	52 (2)	78 (2)
State total	608 (79)	791 (77)	1,165 (80)	1,532 (84)	1,680 (80)	1,909 (83)	1,950 (75)	2,028 (78)	3,042 (78)
US total	747	1,025	1,409	1,822	2,100	2,300	2,600	2,600	3,900

Sources: 1968-75 data from Rubel (1975); 1980-2 data from OTA (1984); 1983 data from *Venture Capital Journal*, May 1984; data from *Venture Capital Journal*, May 1985; 1985-6 data from *Venture Capital Journal*, May 1987; 1987 data from *Venture Capital Journal*, May 1988

Interestingly, this pattern is also true of states that control only minor amounts of venture capital. Atlanta, Georgia, which was the leading recipient of venture capital in the South Region, has been evolving a high-technology industrial base in recent years. A similar trend was especially evident in Colorado where the distribution of venture financings went primarily to high-technology firms located along Interstate 25, a corridor that is becoming a well-known center for technology-intensive defense industries.

REGIONAL ANALYSES OF VENTURE CAPITAL INVESTMENTS

This section provides detailed analyses of venture capital investment in five major regions: the Northeast, Pacific, Midwest, Sunbelt, and Mountain Regions. It provides data on gross investment dollars adopted from *Venture Economics* sources and supplements this with data on the number of venture capital investments and coinvestments in each state of a region derived from our micro-level database.

The Northeast Region

The Northeast Region has long been recognized as one of the nation's premier centers of venture capital. During the 1970s it received almost 32 per cent of the nation's venture capital investments, the largest percentage of venture capital of any region. Since then, the Northeast has fallen to second place, behind the Pacific Region. Table 4.3 shows that the growth in venture capital dollars invested in the region increased 127 per cent from 1981 to 1986 in real dollar terms. In recent years the Northeast Region attracted roughly one-fourth of the venture capital industry's investments.

Venture capital in the Northeast is concentrated mainly in two states: Massachusetts and New York. Massachusetts accounted for \$406 million or 14 per cent of venture capital investments in 1986, while New York accounted for \$203 million or 7 per cent of the total. Here it is quite evident that New York fails to attract a level of venture capital investment. Clearly, New York is not a leading center of venture capital investment comparable with the level of venture capital resources it controls.

It is slightly surprising that the remaining Northeast states have attracted so little in the way of venture capital investment. Even

Table 4.3 Venture capital investments in the Northeast

State	1968-75				1981				1986				Change 1975-86
	\$ million	% natl	% regional	\$ million	% natl	% regional	\$ million	% natl	% regional	\$ million	% natl	% regional	
Northeast	246.2	31.8		348.0	24.8		957	33		289			
New York	82.3	10.6	33.4	45.0	3.2	12.9	203	7	21.2	147			
Massachusetts	66.2	8.6	26.9	181.0	12.8	52.0	406	14	42.4	513			
Connecticut	-	-	-	38.0	2.7	10.9	87	3	9.1	-			
Pennsylvania	23.3	3.0	9.5	29.0	2.1	8.3	58	2	6.1	149			
New Jersey	31.1	4.0	12.6	35.0	2.5	10.1	145	5	15.2	366			
Rhode Island	5.2	.7	2.1	-	-	-	-	-	-	-			
Other	38.1	4.9	15.5	20.0	1.4	5.7	58	2	6.1	52			

though these states are located in relatively close proximity to two of the major venture capital centers, Boston and New York, and many boast research-oriented universities, they have not attracted a significant amount of venture capital. Our analysis does reveal that the distribution of venture capital investments in these states is concentrated in centers of high-technology businesses.

Massachusetts

The dramatic evolution of Route 128 as one of the premier high-technology centers in the world has thrust Massachusetts into the national limelight. The state's extraordinary rise from a period of prolonged economic decline in the 1970s to one of rapid growth and expansion has caught the attention of many of the country's leading economic development experts as they try to duplicate the 'Massachusetts Miracle' in other depressed regions.

The striking reversal in the economic fortunes of Massachusetts has been traced directly to its transformation into a center for high-technology industry. Venture capital has played a vital role in that transformation. Despite the bleak economic outlook during the last decade, venture capitalists have continued to invest much of their venture capital dollars in firms located in Massachusetts. In real dollar terms, Massachusetts has experienced a 71 per cent increase in venture capital investments from 1975 to 1981, and an 85 per cent increase from 1981 to 1986 (Table 4.3).

In recent years, Massachusetts has led the other states located in the Northeast Region in venture capital investments. In 1986, Massachusetts received 42 per cent of the Northeast Region's share of venture capital investments and 14 per cent of the US total. On a national level, Massachusetts ranked second behind California in the amount of venture capital investments received in the period from 1980 to 1986.

The distribution of venture capital investments in Massachusetts is mainly concentrated in the Route 128 complex, which accounted for a remarkable 95 per cent of the 282 venture capital financings we recorded for Massachusetts. Within this general area, the Boston-Cambridge area (which includes cities such as Somerville and Revere) accounted for 24 per cent of the state's total venture capital investments; the towns that lie directly along Route 128 accounted for roughly one-third of the state's venture investments (Newton, Woburn, and Waltham alone drew 20 per cent of the state's total); and the Route 495 area accounted for 18 per cent; communities that

fall between the Route 128 and Route 495 boundaries received 21 per cent. Other areas within Massachusetts received very little venture investment, despite the Dukakis administration commitment to dispersing economic development activity.

The distribution of venture capital investments in Massachusetts follows the distribution of high-technology companies. The Route 128 complex has 67 per cent of the state's high-technology companies. Newton, Waltham, and Woburn alone were home to 47 per cent of the high-technology firms located in the Route 128 complex, 13 per cent of the state total, and 1 per cent of the national total for high-technology firms.

New York

As we have seen, New York is a major center of venture capital resources. It would thus seem reasonable to expect New York to be a center for venture capital investments. This is not the case, however. New York has been unable to attract a large percentage of the venture capital industry's investment. In fact, in recent years New York's share of venture capital investments has hovered between 5 and 7 per cent of the national total (Table 4.3). Simply put, in recent years the state's own venture capitalists have chosen to invest their capital elsewhere.

Still, venture capital investments in New York State are quite concentrated, mainly around existing clusters of high technology. According to our database, New York City received 40 per cent of the state's venture capital investments. According to Sommerfield (1986), \$66.8 million of venture capital, half of the total invested, was placed in twenty-seven firms located within a 25-mile radius of the Statue of Liberty in 1985. When combined with its suburbs in Long Island and White Plains, the New York City Metropolitan Region received approximately 72 per cent of New York State's venture capital investment. This follows the pattern of the state's high-technology companies, of which 68 per cent are located in this area.

Rochester, Albany-Troy, and Buffalo attract a minor share of venture capital investment in New York. According to our database, the greater Rochester area received almost 9 per cent of New York's venture investments, and it is home to approximately 7 per cent of the state's high-technology firms. The Albany-Troy area accounted for almost 16 per cent of the state's venture capital investments, while the area's share of high-technology firms was

4 per cent. Finally, Buffalo's share of the state's venture capital investments was 3 per cent and its share of high-technology firms was 7 per cent.

New Jersey

During the 1940s and 1950s, New Jersey was considered a leading state for technological innovation. AT&T's Bell Labs can perhaps be considered primarily responsible for putting New Jersey on the map as a center for cutting-edge technology. With inventions like the transistor in the 1950s and fiber optics in the 1970s, Bell Labs has revolutionized the communications industry. But perhaps even more important than the inventions at Bell Labs was the development of a large number of scientists who spun off from Bell and went on to found their own, highly successful high-technology firms. Not least among these scientists was William Shockley, considered by many to be the father of Silicon Valley's semiconductor industry.

In recent years, New Jersey has regained some of its status as a high-technology state. For example, in 1985, over 10 per cent of the state's labor force was employed in the high-technology sector (Malecki 1985). And over the past decade New Jersey has experienced a dramatic increase in venture capital investments. Between 1981 and 1986, New Jersey's share of venture capital investments increased from 2.5 to 5 per cent of the national total, a real dollar increase of 250 per cent. At the same time, its regional share rose from 10.1 to 15.2 per cent (Table 4.3).

The northeast portion of the state received the major share of venture capital investments. According to our database, this region accounted for 55 per cent of the state's venture investments.² Princeton received 25 per cent of the venture capital investments for New Jersey. Princeton is home to Princeton University and to the Princeton University Forrestal Center, one of the most successful research parks in the United States. The Forrestal Center has over fifty tenants, including divisions of Xerox, IBM, and Siemens AG (Glazer 1987).

Connecticut

For the past several years, Connecticut has received 2-3 per cent of venture capital investment dollars, and approximately 10 per cent of

the Northeast Region total (Table 4.3). The state experienced a 90 per cent increase in terms of real dollars invested during this period.

According to our database, 77 per cent of venture capital investments in Connecticut were located along the Route 95 corridor, and more specifically were to companies located between New Haven and the New York border. Stamford and its suburb Darien were the major focus. Together, they received almost 30 per cent of the state's venture capital investments. Coupled with the investments for Fairfield, Westport, and Norwalk (Stamford to Fairfield is a distance of 22 miles along Route 95), the percentage of investments received for this area increases to almost 50 per cent of the state total. The Waterbury-Hartford area received 13 per cent of the state's investments and, as such, was the only other section of Connecticut to receive a significant number of venture capital investments.

Venture capital investment follows the distribution of the state's high-technology companies. Almost 77 per cent of the state's high-technology firms are located in cities along the Route 95 corridor. The Stamford-Fairfield corridor contains one-fourth of the state's high-technology firms. In addition, one fourth of Connecticut's venture capital offices are located in Stamford, and another 13 per cent are in Hartford. The greater Waterbury-Hartford area housed approximately 15 per cent of the state's high-technology firms.

Pennsylvania

At one time, Pennsylvania was fairly successful in attracting venture investments. For example, during the period from 1968 to 1975, Pennsylvania received almost 10 per cent of the venture capital investments made in the Northeast Region, and 3 per cent of the national total. However, during the 1980s, the state's share of venture investments has declined to about 2 per cent of the national total (Table 4.3). Part of the reason for the lack of growth in venture investments in Pennsylvania is the investment orientation of the state's venture capitalists. For example, although the number of venture capital firms in Pittsburgh increased from four to seventeen between 1980 and 1987, almost 75 per cent of the capital invested by these firms in 1986 went to companies located outside the state (Enterprise Corporation of Pittsburgh 1987).

According to our database, the Philadelphia area received 44 per cent of the state total of venture capital investments, while firms in the Pittsburgh area received over 30 per cent. The Philadelphia and

Pittsburgh Regions were home to the majority of the state's high-technology firms. The greater Philadelphia Region has 50 per cent of the state's high-technology firms, while the greater Pittsburgh Region contains 35 per cent. Pennsylvania provides yet another example of the close association between existing high-technology centers and investments of venture capital.

Other Northeast States

New Hampshire, Vermont, Maine, and Rhode Island have all been generally overlooked by the venture capital industry, receiving only a minor portion of venture investments. Indeed, during the past decade, these states together received less than 2 per cent of the national total of venture investments, and only 6 per cent of the regional total. Rhode Island and New Hampshire each received somewhat more than 2 per cent of the region's financings, while Maine received slightly less than 1 per cent. These investments were primarily directed to the major city of each state. According to our database, over 60 per cent of Rhode Island's investments were in Providence, over 75 per cent of Maine's investments were in Portland, and close to 50 per cent of those for New Hampshire were in Manchester and Nashua. Comparing the areas of investments with the location of high-technology firms for these states, once again a close parallel can be found. A third of Rhode Island's high-technology firms are in the Providence area, one-sixth of Maine's high-technology firms are in Portland, and 25 per cent of the New Hampshire high-technology firms are in Manchester and Nashua.

The Pacific Region

The Pacific Region now accounts for the largest amount of venture capital investments (Table 4.4). In 1986, it received \$1.2 billion or 41 per cent of the national total. California is unquestionably the leading state in this region and in the nation as well, capturing a huge share of total venture capital investments. In 1986 California received 38 per cent of the total amount of the nation's venture capital investments, which was 93 per cent of the total amount invested in the Pacific Region.

Silicon Valley can claim responsibility for the unprecedented success of this region as one of the world's leading centers of high-technology and venture capital investment. It receives 23 per cent of the national total of venture investments. The success of Silicon

Table 4.4 Venture capital investments in the Pacific

State	1968-75				1981				1986				Change 1975-86
	\$ million	% natl	% regional	\$ million	% natl	% regional	\$ million	% natl	% regional	\$ million	% natl	% regional	
Pacific	213.2	27.5		621	44.1		1,189	41.0		1,189	41.0		458
California	201.3	26.0	94.4	588	41.7	94.7	1,102	38.0	92.7	1,102	38.0	92.7	447
Oregon	-	-	-	-	-	-	58	2.0	4.9	58	2.0	4.9	-
Other	11.9	1.5	5.6	33	2.3	5.3	29	1.0	2.4	29	1.0	2.4	144

Valley is regarded as a model for many other communities that hope somehow to duplicate its phenomenal rise from orchards to high-technology mecca.

As Table 4.4 shows, the Pacific Region has experienced tremendous growth in venture capital investment. During the early 1970s, it received 28 per cent of the venture industry's investment dollars, though it controlled only 10 per cent of the total amount of venture capital resources. By the end of the decade, it had taken over the lead as the leading recipient region in the country. In 1980, the Pacific Region laid claim to 36 per cent of the venture capital industry's investments and by 1986, its share was 41 per cent of national venture capital investments.

California

California is undeniably the major player in the Pacific Region. California has a long history as a home for high-technology and venture capitalists and their investment dollars. Even when its own venture capital industry was in its early development stages during the late 1960s and early 1970s, California still managed to attract significant amounts of venture capital. Between 1968 and 1975, California attracted over \$200 million in venture capital investments, an amount double that of its venture capital resources and two and a half times the amount of investments received by any other state. Since then, the state's ability to attract investments has only increased.

Venture capital investments are strikingly concentrated within California. Silicon Valley is the main center for venture capital investment. Twenty-three per cent of the venture capital investments in our database are in this region. Cities that lie just outside the Silicon Valley area attract much smaller amounts of venture capital. For example, the greater Oakland area (which lies just across the bay from San Francisco) received a mere 7 per cent of the California total of venture capital investments, while the Sausalito area managed to attract only 2 per cent of the state's total venture financings. This pattern of venture capital investments maps nicely onto the distribution of high-technology firms in the San Francisco area. The San Francisco Region contained 44 per cent of the state's high-technology firms, with the greater San Jose area accounting for roughly half this total.

In recent years, California venture capitalists have shifted some of their investment focus to the greater Los Angeles and San Diego

areas. Both cities are home to major universities, have a growing number of venture capital offices, and contain a significant number of high-technology firms. Firms in the Los Angeles area received 18 per cent of the California venture capital investments, 7 per cent of the national total. San Diego attracted 9 per cent of the California investments. In short, 98 per cent of venture capital investments in California go to companies located in Silicon Valley, Los Angeles, or San Diego, areas that are home to 95 per cent of the state's high-technology firms.

Other Pacific States: Oregon, Washington, and Alaska

Oregon has increased its share of the venture capital industry's investments from 1.1 per cent in 1981 to 2 per cent in 1986 (Table 4.4). According to our database, roughly 90 per cent of Oregon's venture capital investments went to firms located in Portland and its suburbs. Portland is a growing high-technology center, home to Sequent, a top computer company, and other high-technology companies.

Washington has experienced a relative decline in its share of venture capital investment dollars. Its share of the regional total fell from 5.3 per cent in 1981 to 2.4 per cent in 1986 (Table 4.4). According to our database, almost 87 per cent of the venture capital investments in Washington went to the Seattle-Tacoma area, a region with 80 per cent of the state's high technology firms.

Alaska is perhaps an extreme example of the difficulties that an individual state faces as it explores the use of high technology as a way to diversify its economy. Like Texas, Alaska has been highly reliant on the oil industry for its economic base. It has received an extremely small number of venture investments. The *Corporate Technology Information Service Directory* (1987) counts only five high-technology firms in the entire state. Alaska has tried to address its weakness in high technology with a variety of programs. Between 1978 and 1985, the state sponsored Alaska Resource Corporation invested \$40 million, primarily in existing fishing and timber companies that were facing severe financial difficulties. The state corporation registered \$4.5 million in losses, and in 1984 the legislature ordered it to terminate its operations and phase out its equity investments by 1988 (Farrell 1985). Currently, the state is contemplating founding another investment corporation whose focus will be almost solely on financing high technology enterprises. Summing up Alaska's problems, one commentator noted that 'the

prospects for developing a "Silicon Tundra" on any large scale will remain bleak until the basic infrastructure required by high-technology industry is in place.' (Dixon 1985).

The Midwest Region

The Midwest has experienced a significant decline in venture capital investments over the past two decades. Between 1968 and 1975 the Midwest Region attracted 20 per cent of the venture capital investments, ranking third behind the Northeast and the Pacific Regions; the region also contained four of the top ten venture capital recipient states in the nation. By 1980, Illinois was the only Midwestern state to be listed among the top 10 states, ranking seventh. By 1986 the Midwest's share of venture capital investment had dropped further to 7 per cent (Table 4.5).

According to our database, venture capital investments in the Midwest are primarily concentrated in Chicago and the Minneapolis–St Paul area. Together, these areas accounted for almost 50 per cent of the Midwest's venture investments. These areas also have the region's highest concentrations of high-technology firms. Almost one-fourth of the Midwest's high-technology firms are found in Chicago or its suburbs, and over 12 per cent are in the Minneapolis–St Paul area (*Corporate Technology Information Service Directory 1987*).

Despite its reputation as a center for traditional manufacturing, the Midwest does possess something of a high-technology base. Nearly 20 per cent of the nation's high-technology firms are located there, and more than half of these companies are concentrated in Illinois, Ohio, and Minnesota (*Corporate Technology Information Service Directory 1987*). Illinois, Ohio, and Michigan also rank among the top 10 states for new business starts in 1987, according to the Dun and Bradstreet listings. The Midwest was responsible for almost 20 per cent of the nation's new business starts in 1987 (Dun and Bradstreet 1988). In addition, the region has a strong university base with six of the nation's top twenty universities in terms of corporate sponsored research and development (O'Connor 1988).

Illinois

Illinois, the leading center for venture capital in the Midwest, attracted just 3 per cent of all venture capital invested in 1986 (Table 4.5). This is a sharp drop from the 1960s and 1970s when

Table 4.5 Venture capital investments in the Midwest

State	1968-75			1981			1986			Change 1975-86
	\$ million	% nat	% regional	\$ million	% nat	% regional	\$ million	% nat	% regional	
Midwest	153.8	19.8		108.5	7.7		203	7.0		32
Ohio	23.7	3.1	15.4	36.0	2.6	33.2	-	-		-
Illinois	56.5	7.3	36.7	33.0	2.3	30.4	87	3.0	42.9	54
Michigan	22.3	2.9	14.5	-	-	-	-	-	-	-
Minnesota	19.8	2.6	12.9	-	-	-	-	-	-	-
Other	31.5	4.1	20.5	39.5	2.8	36.4	116	4.0	57.1	268

Illinois accounted for over 7 per cent of the national total. Like New York City – another major financial center – many of the state's venture investments went to areas outside the state and, indeed, outside the Midwest Region. The Chicago area is the leading site for venture capital investment in the Midwest Region. According to our database, the Chicago area accounted for 26 per cent of the region's investments, and 88 per cent of the Illinois total. The greater Chicago area accounts for 87 per cent of all high-technology firms in Illinois, and 22 per cent of those in the Midwest. However, according to a recent article, Chicago's high-technology and venture capital environments are in dismal shape (Moberg 1988). Moberg noted that 'the common complaint [about Chicago] is that there aren't enough like-minded people around to create a vibrant high-tech community – not just entrepreneurs and engineers, but also knowledge investors and venture capitalists and consultants who often help shepherd young companies through infancy' (Moberg 1988: 88).

Minnesota

Minnesota has a rather interesting pattern of venture capital investment. Although it is a small center, it tends to retain a large share of its venture capital, capturing roughly 25 per cent of the region's venture investments recorded in our database. Venture capital investments and high-technology firms are highly concentrated in the Minneapolis–St Paul area. All the venture capital investments that we recorded for Minnesota and 92 per cent of the state's high-technology companies were in this area. The twin cities are the national center for supercomputing with Control Data Corporation, Cray Computer, and a host of new start-ups. Of all the potential areas in the country, we believe that the Minneapolis–St Paul area has the best chance of duplicating the Silicon Valley–Route 128 experience – a belief echoed in numerous interviews with Silicon Valley venture capitalists and entrepreneurs.

Michigan

Michigan ranked a distant third behind Illinois and Minnesota in venture capital investments in the Midwest. Michigan received almost 11 per cent of the Midwest Region's venture financings. The state is also home to 15 per cent of the region's high-technology firms. Over 75 per cent of Michigan's venture capital investments

were in the Detroit-Ann Arbor area, which also contains two-thirds of the state's high-technology firms. Not surprisingly, many of the high-technology companies in the Detroit-Ann Arbor area manufacture products that are of importance to the automobile industry (Glazer 1987).

Ohio

Ohio receives a small and declining fraction of venture capital investments. Its share of venture capital investment dollars has declined from 3.1 per cent of the total investments in the 1968-75 period to less than 2 per cent in 1986 (Table 4.5). According to our database, it received slightly over 8 per cent of the Midwest's total of venture investments in recent years. Venture investments in Ohio were distributed among several areas, following the distribution of the state's high-technology firms. The Cleveland area, which is home to one-third of the state's high-technology firms, had roughly 30 per cent of the state's venture investments. The Columbus area had 15 per cent of the state's high-technology companies, and received 20 per cent of Ohio's venture capital investments. Cincinnati was home to 12 per cent of the state's high-technology firms and received 18 per cent of the venture investments.³

The Sunbelt

The Sunbelt comprises two subregions: the South (that is, Delaware, Maryland, Virginia, West Virginia, Kentucky, Washington, DC, Tennessee, South Carolina, North Carolina, Georgia, Florida, Arkansas, and Mississippi); and the Gulf Coast area (that is, Texas, Louisiana, and Oklahoma). The Sunbelt accounts for roughly 15 per cent of all venture capital investments.

The South

The South is an 'up and coming' region for venture investments. Between 1981 and 1986, investments in the region increased 127 per cent, in real dollar terms. In 1986, the South accounted for \$261 million in venture capital investments, 9 per cent of the national total (Table 4.6).

Georgia has been the major recipient of the venture investments in the South. In 1986, the state received one-third of all Southern venture capital investment. Georgia is followed by Florida,

Tennessee, Virginia, Maryland, and North Carolina. The remaining states in the region have been far less successful in attracting venture capital investment funds. Delaware, Mississippi, Kentucky, West Virginia, and South Carolina each received less than 2.5 per cent of the South Region's venture capital investments. Again, the distribution of venture investments throughout the South Region is toward areas with high concentrations of technology-intensive businesses.

Georgia

In 1986, Georgia led the South in the dollar amount of venture capital investments received, attracting 3 per cent of the national total and one-third of the region's total (Venture Economics 1989c). Georgia's success has been a relatively recent phenomenon, and according to a 1987 article in *Datamation*, little of the increase in high technology and venture capital activity occurred before 1982 (Schatz 1987). Atlanta's first high-technology-oriented venture fund was not established until 1983.

A large part of Georgia's emergence can be directly attributed to Atlanta's recent rise as a center for high-technology. Our database provides evidence of the importance of Atlanta to Georgia's high-technology economy. Indeed, 96 per cent of the venture investments in Georgia were clustered in the greater Atlanta area, 71 per cent in the city itself. In addition, Atlanta is home to the state's ten venture capital firms (Morris 1988).

The geographic distribution of venture capital investment follows that of the high concentration of high-technology firms in the greater Atlanta area (*Corporate Technology Information Service Directory* 1987). More than 90 per cent of Georgia's high-technology firms are located in the Atlanta area, with almost 65 per cent situated in either Atlanta or Norcross, a northern suburb of the city. While Atlanta contains many of the elements that have been cited as crucial to the success of both Route 128 and Silicon Valley as high-technology centers, it remains to be seen whether it can emerge as a high-technology center itself.⁴

Florida

It is somewhat surprising that Florida has only about 1 per cent of national venture capital investment (Table 4.6). The geographic distribution of venture capital investments in Florida is less

concentrated than in other states. According to our database, venture capital investments were distributed across the Miami area and Tampa–St Petersburg area, which received 39 per cent and 17 per cent of Florida's venture investments respectively, and Orlando, Jacksonville, Titusville, and Melbourne. Once again, the distribution of venture capital investments follows that of the state's high-technology firms. The Miami area is home to 38 per cent of Florida's high-technology firms, Tampa–St Petersburg 23 per cent, and the greater Orlando Region 16 per cent. Florida trails Georgia in venture capital investment within the South Region, despite ranking well above Georgia in total number of high-technology companies and being one of the principal sites for new business start-ups, falling just behind California, Texas, and New York.

Florida has developed its active high-technology base with only a small contribution from the venture capital industry. According to a study by Maidique (Suran *et al.* 1986), this is due in large part to the sizable amount of government defense funding invested in the state, especially by NASA for the US space program based at Cape Canaveral. This study also cites the decision by IBM in 1981 to headquarter its personal computer business in Boca Raton as instrumental in the establishment of other non-defense related high-technology firms in the state, via the service and supplier networks (Suran *et al.* 1986).

Tennessee

Tennessee receives roughly the same number of venture capital investments as Florida, even though it has one-fifth the number of high-technology firms (*Corporate Technology Information Services Directory* 1987). Unlike most other states, the geographic distribution of venture capital investments in Tennessee does not closely follow that of the state's high-technology firms. According to our data, the Nashville area of Tennessee received the majority of Tennessee's venture capital financings (11 per cent of the South Region total). While Nashville is the primary recipient of venture capital investments in the state, it has only 25 per cent of the state's high-technology companies.

Virginia

The proximity of Virginia to Washington, DC, and therefore to the Pentagon and other federal agencies has enabled the state to

capture a respectable share of the venture capital investments. Virginia accounted for 12 per cent of the South's venture capital investments, with the greater Alexandria area responsible for almost three-quarters of those investments. The majority, 68 per cent, of Virginia's high-technology firms are also located in the greater Alexandria area. The greater Richmond area received 13 per cent of the state's venture financings, and is home to 11 per cent of Virginia's high-technology firms.

Maryland

Maryland also benefits greatly from its location near Washington, DC. The region of Maryland that borders Washington, DC, an area which contains 57 per cent of the state's high-technology firms, received almost 40 per cent of the state's venture capital investments. The greater Baltimore Region led the state in the total number of financings with 54 per cent of the state total. Baltimore has seven of the state's twelve venture capital funds.

North Carolina

North Carolina received 9 per cent of the venture capital investments made in the South Region (Table 4.6). According to our database, 64 per cent of these investments were located in the Raleigh-Durham (Research Triangle) area of the state, and 28 per cent in the Burlington-Greensboro region. This distribution follows the distribution of the state's high-technology firms. The Raleigh-Durham area has 39 per cent of North Carolina's high-technology firms, while the Greensboro region contains just 9 per cent of the state's high-technology firms. However, Charlotte, which has 26 per cent of the state's high-technology firms, received only a minor amount of North Carolina's venture capital investment. North Carolina has a long history of investment in high-technology industry, as evidenced by the state-supported Research Triangle Park which opened in 1959. Although many commentators point to the North Carolina Research Triangle as a potentially successful model for public policy aimed at stimulating high-technology development, we are less sanguine. As Luger (1984) has pointed out, many of the high-technology firms in the Research Triangle Park are divisions of larger corporations such as IBM and General Electric. In our own interviews, we came across one high-technology company which, in fact, had relocated from the Research Triangle to Silicon Valley (De Geus 1988).

Other Southern States

Alabama, Delaware, Mississippi, Kentucky, and West Virginia received the remaining 15 per cent of venture investments in the southeast region. Almost all the investments were to firms located in the major cities of those states. We recorded no venture capital investments for South Carolina in our database.

The Gulf Coast

The Gulf Coast Region was the only region to experience a negative growth rate in terms of real investment dollars between 1981 and 1986 (Table 4.7). This is especially interesting since, as late as 1980, the region appeared to be an up and coming site for venture capital investments, having received 13 per cent of the venture capital industry's investment dollars, ranking third behind the Pacific and the Northeast Regions.

Texas leads the Gulf Coast Region as its center for venture capital investment. As the economy of Texas has faltered in recent years with the declining price of oil, so did venture capital investments in the region. While prior to 1986 Oklahoma and Louisiana both received a small share of the industry's dollars, in 1986 Texas received all the investments for the region.

Texas

Venture capital investment in Texas peaked in 1980, when Texas received almost 11 per cent of the nation's investments, and has fallen off since then (Table 4.7). By 1986, the state's share was only 6 per cent of the total industry's investments. Still, Texas remained among the top five states for venture capital investments, receiving between 5 per cent and 8 per cent of the industry's investments between 1981 and 1986. Part of the reason for this is the decline in the oil-related economy in Texas. Still, Texas remains a center for high-technology. Texas Instruments, one of the foremost electronics companies in the country, was founded in Dallas. Compaq Computer, originally financed with venture capital funds, was founded in Texas and continues to manufacture there. Texas is also home to Sematech and the MCC research consortium. In addition, Texas has 5 per cent of the nation's high-technology companies, which places it among the top five states in the country (Corporate Technology Service Directory 1987).

Table 4.7 Venture capital investments in the Gulf Coast

State	1968--75			1981			1986			Change 1975--86
	\$ million	% natl	% regional	\$ million	% natl	% regional	\$ million	% natl	% regional	
Gulf Coast	56.9	7.3	--	162.0	11.5	--	174	6	--	206
Texas	56.9	7.3	100.0	139.0	9.9	85.8	174	6	--	206
Other	--	--	--	23.0	1.6	14.2	--	--	--	--

Within Texas, the Dallas–Fort Worth area was the major site for venture capital investments and high-technology companies. Dubbed ‘Silicon Prairie’, the Dallas–Fort Worth area contains over 50 per cent of the state’s venture capital investments and a similar 50 per cent share of its high-technology companies. The Houston area received 27 per cent of venture capital investments in Texas. Houston also accounts for 22 per cent of the high-technology firms in the state. The corridor between Austin and San Antonio was the third most popular area for venture capital investments in Texas, with 18 per cent of the state’s venture capital investments.

The Mountain Region

Of the six regions, the Mountain Region has consistently received the smallest share of venture capital investment dollars (Table 4.8). The Mountain Region has received on average 4 per cent of the venture capital industry’s investments over the past three decades. The region’s growth rate in real venture capital investment dollars was 45 per cent between 1981 and 1986. Only the Gulf Coast Region experienced a slower growth rate in investments. The rate of venture capital investment in the Mountain Region over the past decade has not even kept pace with the growth of venture capital resources there.

Most venture capital investment in the Mountain Region is concentrated in Colorado, which also controls the largest share of the region’s venture capital resources, and has the largest number of venture capital offices. Indeed, the combined share of venture capital investments for the other states in the Mountain Region has been less than 2 per cent of the venture capital industry’s investments.

Colorado

Colorado is a growing center for high-technology industry. In recent years, several Silicon Valley firms have located along ‘Silicon Mountain’, a corridor that stretches along Interstate 25 from Boulder to Colorado Springs (Malecki 1987). Part of this is clearly linked to Colorado’s standing as a center for the defense and nuclear industries. According to regional scientists and geographers, like Edward Malecki and Ann Markusen, defense spending is an important determinant of high-technology concentration. As Malecki has noted, ‘The second major influence on high-technology

Table 4.8 Venture capital investments in the Mountain Region

State	1968-75				1981				1986				Change 1975-86
	\$ million	% natl	% regional	\$ million	% natl	% regional	\$ million	% natl	% regional	\$ million	% natl	% regional	
Mountain	30.5	3.9	-	66.0	4.7	-	116	4	-	116	4	-	280
Colorado	24.5	3.2	80.3	43.0	3.1	65.2	87	3	75.0	87	3	75.0	255
Arizona	-	-	-	10.0	0.7	15.2	-	-	-	-	-	-	-
Other	6.0	0.8	19.7	29.0	1.0	25.0	29	1	25.0	29	1	25.0	383

geography is defense spending' (Malecki 1985). This has been especially true in recent years for the Mountain Region. Interstate 25, which winds through Colorado and New Mexico, is fast developing into a leading center for high-technology. Many of the high-technology firms have substantial ties with the defense industry. A complex composed of hundreds of high-technology companies, military installations, and government laboratories devoted to the Strategic Defense Initiative (SDI) and nuclear weapons research line Interstate 25. In 1987, 30 per cent of all US defense and energy dollars was spent on facilities located along this stretch of road. Half of this (\$4.3 billion) was spent in Colorado (Associated Press 1988).

In the past few years, Colorado has received a significant share of the venture capital industry's investments, averaging 3 per cent of total venture investments, placing it among the top five states in the country. Colorado received approximately 62 per cent of the Mountain Region's venture capital investments recorded in our database. Two-thirds of these were in the Boulder area and 91 per cent were in the Boulder-Denver complex. All of Colorado's venture capital offices are located in either Boulder, Denver, or Englewood (a suburb of Denver). Colorado is home to 41 per cent of the region's high-technology firms, the majority of which are located in the Boulder-Denver Region.⁵

Arizona

Arizona received 18 per cent of the total venture capital investments made in the Mountain Region (Table 4.8). Of these, 95 per cent were in the Phoenix-Scottsdale area, also known as 'Silicon Desert'. Ninety-six per cent of the state's high-technology companies are located in either the Phoenix-Scottsdale area or Tucson, once again demonstrating that venture capital investments tend to cluster in areas noted for high-technology activity. Bill McKee, president of FBS Venture Capital Company, notes the lack of a venture capital infrastructure linking entrepreneurs and venture capitalists as one of the major problems his company and other venture capitalists face in Arizona (Johnston 1985). According to McKee, 'One of our challenges is making contact with the entrepreneur. Phoenix is an early-stage economy with regard to venture capital. Venture capital is not particularly well-known or well-defined, and there aren't enough players in the market' (Johnston 1985).

New Mexico

Venture capital investments have been few in number in New Mexico. The majority of venture capital investments in New Mexico were located in Albuquerque, which accounts for roughly 75 per cent of New Mexico's high-technology firms, with a majority of the remaining high-technology companies located along Interstate 25 (*Corporate Technology Information Service Directory* 1987). Part of the reason for sluggish venture investment can be found in the defense orientation of the New Mexico economy. In 1987, the Sandia National Laboratory – a major nuclear weapons and energy research facility – spent \$280 million in the Albuquerque area, and \$575 million total in contracts with the private sector (Associated Press 1988). Some estimates suggest that the government has awarded almost \$1.6 billion in contracts for 'Star Wars' research to the state (Associated Press 1988). According to Brian McDonald, director of the University of New Mexico Bureau of Business and Economic Research, 'The federal government is the major industry in New Mexico. It accounts for 15 per cent of all jobs in the state' (Associated Press 1988). Although scores of private companies have spun out of the government nuclear weapons laboratories (Los Alamos and Sandia National Laboratories and the White Sands Missile Range, to name but a few), few have been backed by venture capital, since they have had sizable defense grants and contracts.

SUMMARY

The distribution of venture capital investments closely follows that of high-technology firms, on regional, state, and intra-state levels. The Pacific and Northeast Regions capture over 50 per cent of total venture capital investments and high-technology firms. Among states, California and Massachusetts were the leaders. And within states, the distribution of venture investments was again concentrated, flowing mainly to areas with large concentrations of high-technology businesses. This is true for the major recipient states of venture capital, such as California and Massachusetts, and for states that receive only a minor share of the venture industry's investments, like Georgia. Technology-oriented businesses are the primary factor that draws venture capital investment. The geographic distribution of venture capital investments is extremely concentrated. Places like Chicago and New York City, which are major financial centers for

venture capital resources, are relatively minor centers of venture capital investment.

NOTES

- 1 Information on high-technology firms is taken from the *Corporate Technology Information Service Directory* (1987). This directory isolates firms by high-technology product classification, and thus includes only those firms that make what most of us consider leading-edge high-technology products. In this regard, it overcomes some of the shortcomings of other databases which define high technology by research and development (R&D) intensity (that is, the amount of money spent on R&D or the share of scientists engaged in R&D) and therefore end up with companies producing guided missiles, airplanes, and even oil refineries in their listings.

One of the major problems in analyzing the high-technology industrial structure in general is the quality of the data. There is an absence of adequate longitudinal information. The US Census of Manufacturers provides 5-year totals of companies and establishments, but does not allow one to get a handle on how many plants opened and closed during those intervals. While the firm level information based on Dun and Bradstreet files available from the Small Business Administration provides a way around this, it does not provide an adequate time series.

In addition, there is little consensus on how to define 'high technology' companies for analytical purposes. Most analysts use a working definition based on R&D intensity (measured either as percentage of revenues directed to R&D or share of employees engaged in R&D). But this kind of definition aggregates a wide variety of types of companies, and therefore makes it impossible to isolate the small entrepreneurial companies that are so much a part of the Silicon Valley/Route 128 phenomenon. We do not wish to get involved in the debate over these thorny statistical and analytical issues. We have pointed them out to make the reader aware of the inherent limits of the data. We believe that we can get a reasonable picture of high technology industrial organization by drawing from a range of data sources, and this is basically how we proceed. Good discussions of the way high technology companies are defined can be found in OTA (1984) and Markusen (1986).

- 2 However, unlike some of the other states that we examined, these investments showed no clear pattern of clustering, but instead were distributed fairly evenly throughout the region. This portion of New Jersey also accounted for almost 65 per cent of the state's high technology firms, according to the *Corporate Technology Service Directory* (1987). The high technology firms within this area were also distributed fairly evenly throughout the region. Clifton, Englewood, Parsippany, Secaucus, and Newark, which together accounted for one-fourth of the area's high technology companies, provide the only example of concentration. The remaining 75 per cent of the high-technology companies in this area are distributed among more than 100

other cities and towns.

- 3 Ohio's Thomas Edison Program is geared to generating new innovations and stimulating high technology development. See Malecki (1987a).
- 4 According to Schatz (1987) much of Atlanta's recent rise as a high technology center can be attributed to the strong ties that industry has established with the Georgia Institute of Technology.

Evidence of Atlanta's close business-university association can be found in a recent National Science Foundation study which showed that in 1986 Georgia Technology ranked second only to MIT in the amount of industry sponsored R&D expenditures for all universities and colleges in the United States. (In comparison, Stanford ranked a surprising sixteenth in corporate sponsored R&D spending, although it ranked sixth in total R&D expenditures.) According to Said Mohammadioun, who founded his own office automation manufacturing firm in Atlanta in 1982, 'Technology is the catalyst in making Atlanta a high-technology center . . . Technology brings students to Atlanta and creates engineers. Atlanta keeps them' (O'Connor 1988: 600).

- 5 Most of these companies are found along Interstate 25, two-thirds of which are in the Boulder-Denver area. Another 10 per cent were located in Colorado Springs, which is currently constructing a \$100 million center for SDI research and was recently selected by Cray Research Inc. as the production site for Cray-3, the next generation of supercomputers. Fort Collins, which is also located along Interstate 25, is home to 8 per cent of the state's high-technology firms.

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