

VENTURE CAPITAL, INNOVATION AND ECONOMIC DEVELOPMENT

A Report to the U.S. Department of Commerce,
Economic Development Administration

June 1990

Richard Florida

Associate Professor of Management and Public Policy
School of Urban and Public Affairs
Carnegie Mellon University
Pittsburgh, PA 15213
(412) 268 - 8784

Martin Kenney

Associate Professor
Department of Applied and Behavioral Sciences
University of California at Davis

and

Donald F. Smith, Jr.

School of Urban and Public Affairs
Carnegie Mellon University



U.S. DEPARTMENT OF COMMERCE
ECONOMIC DEVELOPMENT ADMINISTRATION

This research project was partially funded by the Economic Development Administration (EDA). The statements, findings, and conclusions in this report are the authors' and do not necessarily reflect the views of EDA.

ACKNOWLEDGEMENTS

This report was partially funded by a grant from the Economic Development Administration of the U.S. Department of Commerce. Thanks go to David Geddes and John Fieser of EDA for their help with both administrative and conceptual matters. Earlier funding was provided by Ohio State University; The Ohio Board of Regents. We owe a special debt of gratitude to the many venture capitalists and entrepreneurs we interviewed in conducting various phases of this study. We would also like to thank our colleagues Harvey Brooks, Gordon Clark, Sam Cole, and Bennett Harrison for their comments at various stages of this study, and Mark Clark and Elizabeth Sechoka for their work as research assistants. Of course, we alone remain responsible for any errors.

CONTENTS

	Executive Summary	iv
Chapter 1	Introduction	1
<u>Part I</u>	<u>Overview of Venture Capital Industry</u>	
Chapter 2	The Venture Capital Industry	12
Chapter 3	What Do Venture Capitalists Do?	22
Chapter 4	Venture Capital and Technological Innovation	31
<u>Part II</u>	<u>The Geography of Venture Capital</u>	
Chapter 5	Where is Venture Capital?	41
Chapter 6	Where Does Venture Capital Go?	60
<u>Part III</u>	<u>Venture Capital and Economic Development</u>	
Chapter 7	Venture Capital Complexes	95
Chapter 8	Policy Implications	139
 Appendices		

EXECUTIVE SUMMARY

Venture capital plays a critical role in technological innovation and economic development. Venture capitalists invest in new, unproven enterprises, exchanging their investment capital for an equity or ownership stake in the companies they finance. The venture capital pool has increased from approximately \$3 billion in the 1970s and most of the 1980s to more than \$30 billion by 1989. Venture capital investments also increased steadily over these years -- from \$1.1 billion in 1980 to \$3.9 billion in 1987 (all current dollars). Venture capitalists focus their investments in high technology industries; three-quarters of all venture investments between 1969 and 1987 went to high technology companies.

In recent years, a large number of states and localities have committed public funds to finance public venture capital programs. While Connecticut and Massachusetts were the only states with venture capital programs prior to 1980, the number increased to 28 by 1988. Much of this policy is premised on the notion that regional gaps exist in the distribution of venture capital, and that by alleviating such gaps, states and localities can stimulate technology and entrepreneurship.

The research undertaken for the study involved the development of a new database on the geographic distribution of venture capital funds, investments, and coinvestments, as well as site visits to and personal interviews with principals of leading venture capital funds. This research was organized around four main research questions. First, how specifically does the venture capital industry operate? Second, where is venture capital concentrated? Third, where is venture capital invested? Fourth, what is the effect of venture capital on the economic development of regions, states, and local areas?

The research informed five key findings, as follows:

1. Venture capital is extremely concentrated. The major centers of venture capital in the United States include California's Silicon Valley, New York City, and Route 128 around Boston. Less important, though still significant, concentrations of venture capital are found in Chicago, Texas, Connecticut, Minnesota, and Colorado.
2. Because of this, venture capital exhibits extreme "bi-coastalism" and is concentrated overwhelmingly in the Northeast and Pacific regions. Together, these two regions control 65% of U.S. venture capital firms, 78% of U.S. venture capital resources, and 74% of U.S. venture capital investment.
3. Venture capital investments flow mainly to established high technology centers such as Silicon Valley and Route 128. Other venture capital centers, which are not high technology centers, like New York and Chicago, primarily export their funds to technology regions like Silicon Valley and Route 128.

4. Venture capital's impact is context sensitive. In areas with an established high technology base (i.e., Silicon Valley) , venture capital fuels the growth of that sector. In areas without such a base (i.e., New York and Chicago), the presence of venture capital alone is not likely to stimulate innovation and high technology development. Venture capital is one element of a broad "social structure of innovation" composed of networks and linkages that connect a variety of actors.
5. Venture capital alone is not enough to generate high technology economic development. Public policies that seek to stimulate high technology by enhancing the growth of venture capital in an area, without influencing other structural elements of the region's economic infrastructure, will not succeed. In order to be successful, public risk capital programs will have to be part of a broader comprehensive and systematic effort to bolster an area's technological capacity.

CHAPTER 1

INTRODUCTION

Venture capital is the business of developing new businesses. Venture capitalists like to start things, to create something from nothing, to stimulate and encourage innovation (Burton McMurtry, Technology Venture Investors, a leading Silicon Valley venture capital fund).¹

I want to build great companies that's how I get my kick. I look for people who want to do the same thing (Arthur Rock, venture investor in Fairchild, Apple and Intel).²

It is not venture capital that is the start of entrepreneurial activity. You can't simply put six venture capitalists in Butte, Montana and expect that the availability of venture capital will engender a Route 128 (Daniel Holland, Morgan Holland one of Boston's leading venture capital funds).³

Introduction

Venture capital plays a critical role in technological innovation and economic development. California's Silicon Valley and Massachusetts' Route 128 area clearly owe much of their vibrant, rapidly growing economies and their development as high technology centers to the infusion of significant amounts of venture capital. The successful revitalization of these regions stands in sharp contrast to the stagnation and decline of the older, more traditionally oriented manufacturing regions. Venture capital has played a catalytic role in the formation of new technologies, and indeed entirely new industries. The revolutionary innovations and inventions of numerous venture capital-backed startups like Fairchild, Intel, DEC, Apple Computer, Cray Computer, Sun Microsystems, Genentech, and countless others have set in motion tremendous gales of industrial restructuring and economic renewal. Many of these companies would never have gotten off the ground at all, nor attained commercial success so quickly, without the financial backing and managerial expertise of venture capitalists. Three-quarters of all venture investments go to high technology companies.

¹ Burton McMurtry, personal interview, (December 1986).

² Arthur Rock, "Strategy and Tactics of a Venture Capitalist," Harvard Business Review, November-December 1987, p. 64.

³ U.S. Congress, Joint Economic Committee, Climate for Entrepreneurship and Innovation in the United States - Hearings August 30-31, 1984, p. 304.

4. Venture capital's impact is context sensitive. In areas with an established high technology base (i.e., Silicon Valley) , venture capital fuels the growth of that sector. In areas without such a base (i.e., New York and Chicago), the presence of venture capital alone is not likely to stimulate innovation and high technology development. Venture capital is one element of a broad "social structure of innovation" composed of networks and linkages that connect a variety of actors.
5. Venture capital alone is not enough to generate high technology economic development. Public policies that seek to stimulate high technology by enhancing the growth of venture capital in an area, without influencing other structural elements of the region's economic infrastructure, will not succeed. In order to be successful, public risk capital programs will have to be part of a broader comprehensive and systematic effort to bolster an area's technological capacity.

Venture capitalists invest in new, unproven enterprises, exchanging their investment capital for an equity or ownership stake in the companies they finance.⁴ Venture capitalists are active investors, providing a wide range of assistance that encompasses business, managerial, financial, and legal issues. Thomas Doerflinger and Jack Rivkin, prominent Wall Street analysts, characterize venture investing as " 'smart money' -- money that is imbued with the entrepreneurial savvy, business contacts, executive talent and patience of financiers with long experience in helping small companies succeed."⁵ And Venture Economics, the leading authority on the venture capital industry, describes venture capitalists as investors who seek "to add value through long term involvement with continuing business developments."⁶

Recent years have witnessed an explosion in the number of venture capital investments. As Figure 1.1 shows, the total venture capital pool increased over 1000 percent in absolute terms between 1969 and 1987 (a 400 percent increase in real dollars -- see Figure 1.2), with most of the increase occurring between 1980 and 1987, when the venture capital pool surged from \$4.5 billion to \$29 billion. Venture capital investments also increased steadily over these years -- from \$1.1 billion in 1980 to \$3.9 billion in 1987 (all current dollars).

Venture capital resources and investments are geographically concentrated. A few areas -- California's Silicon Valley, Boston's Route 128 area, New York City, and Chicago -- account for the majority of venture capital resources. Venture capital investments are even more concentrated than this: California's Silicon Valley and Boston's Route 128 are by far the largest attractors of venture capital.

Venture capitalists seldom invest alone. Instead, they participate in coinvestment syndicates that consist of two or more venture investors. Coinvestment provides access to a much wider range of investment possibilities, and enables venture capitalists to spread risk by investing in a larger number of deals.

Given these facts, it is not surprising that the public sector has become enamored with venture capital as a mechanism for generating technology-based economic development. Indeed, government now views venture capital investment as an essential ingredient of economic change. In recent years, a large number of states and localities have committed public funds to finance public venture capital programs. While Connecticut and Massachusetts were the only states with venture capital programs prior to 1980, the number increased to 28 by 1988.⁷ Much of this policy is premised on the notion that regional gaps exist in the distribution of venture capital, and that by alleviating such gaps, states and

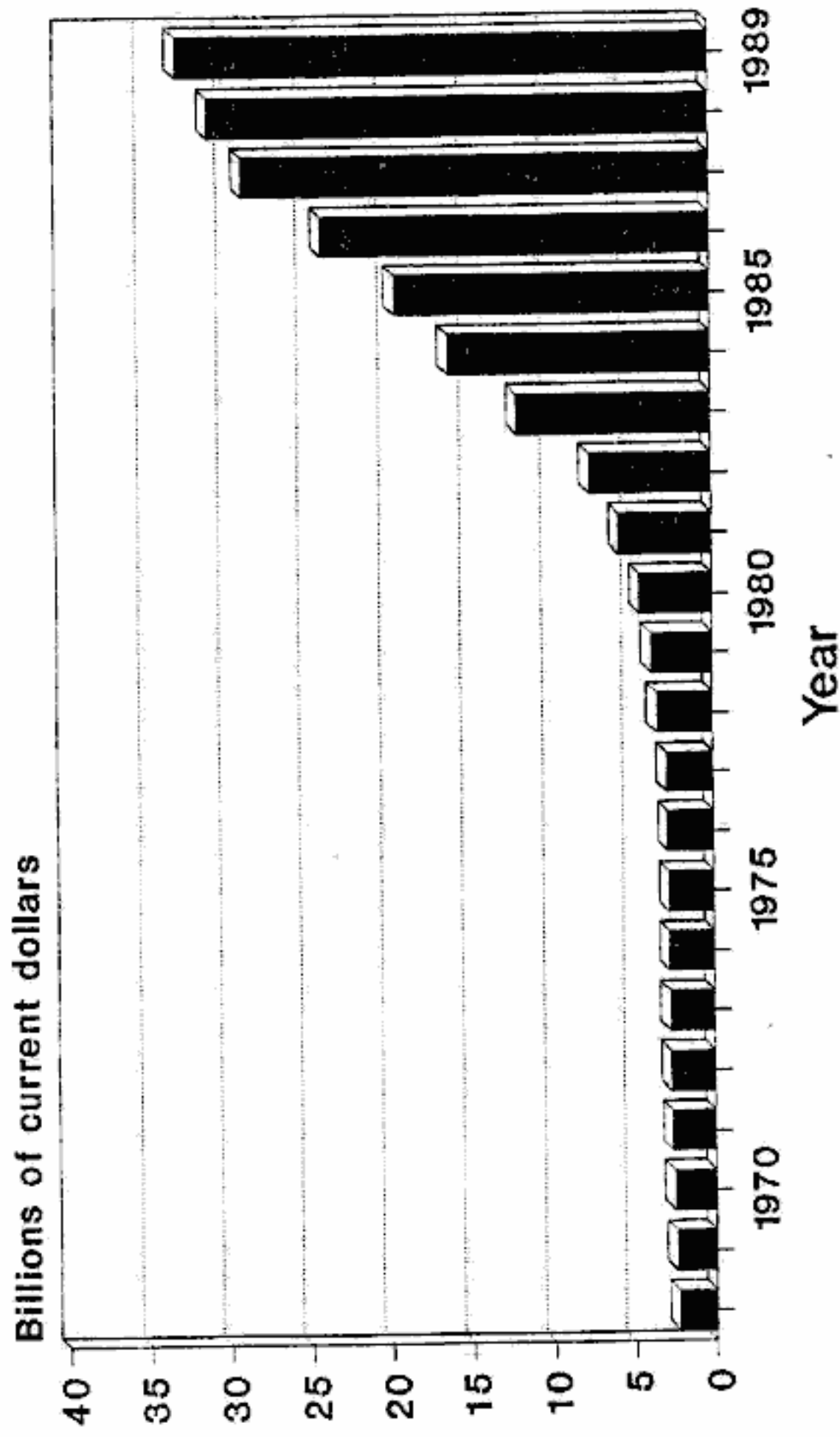
⁴ On venture capital as a form of investment see A. Bean, D. Schiffler and M. Moguee, "The Venture Capital Market and Technological Innovation," *Research Policy*, 1975, pp. 380-408.

⁵ Thomas M. Doerflinger and Jack L. Rivkin, *Risk and Reward*, Random House, New York, 1987, p. 16.

⁶ *Venture Capital Journal*, March 1987, p. 10.

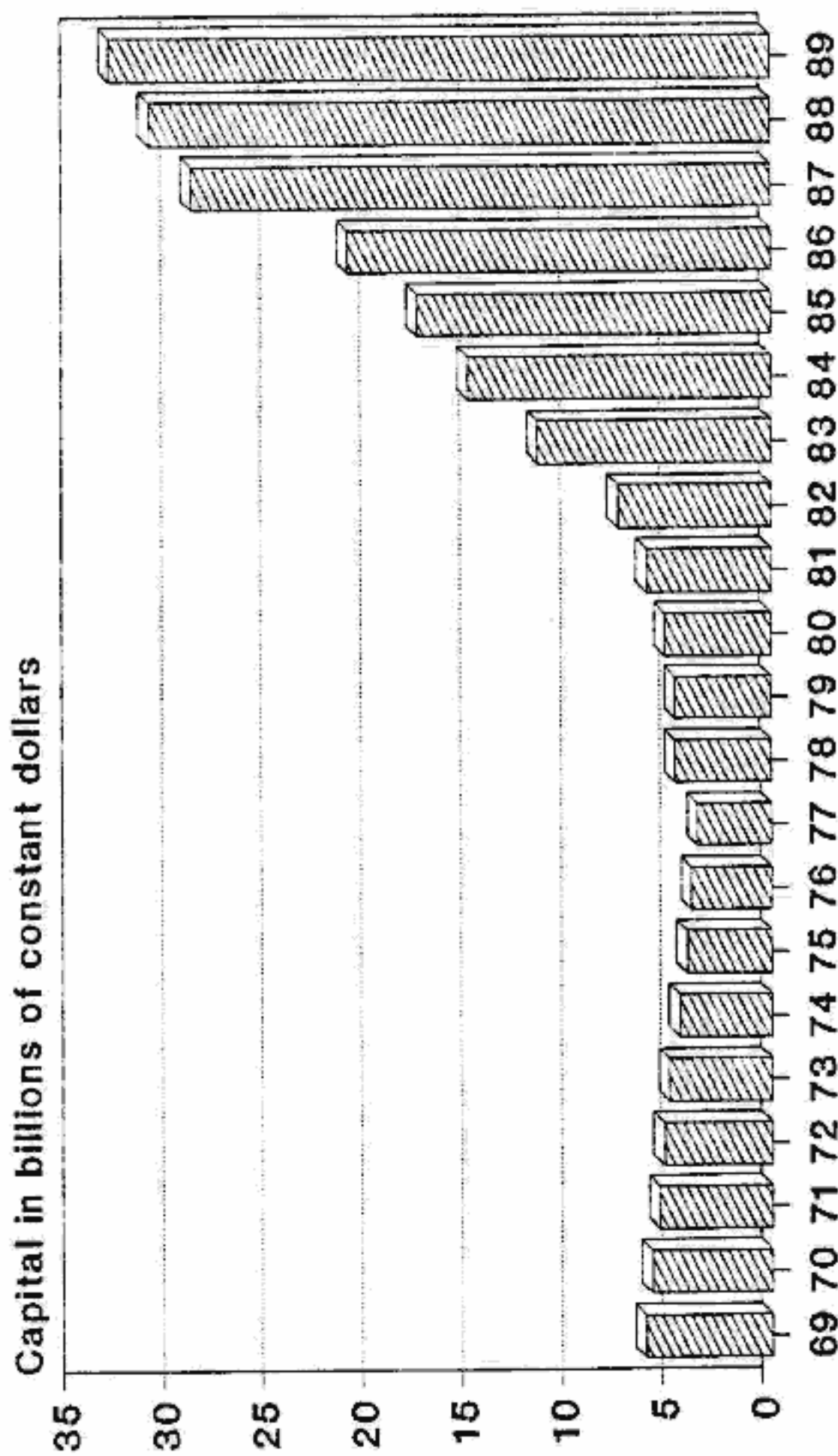
⁷ Edward J. Malecki, "Hope or Hyperbole? High Tech and Economic Development," *Technology Review*, October, 1987, v. 90(7), p. 50. Jack Lyne, "Numerous State, Provincial Incentives Pave the Road for High-Tech Facility Locations," *Site Selection Handbook*, 1987, v. 32, p. 582.

Figure 1.1
Growth of the Venture Capital Pool
1968-1989



Source: Venture Economics and authors' estimates.

Figure 1.2
REAL VENTURE CAPITAL POOL
1969 - 1989



Source: Venture Capital Journal, various issues.
 Figures adjusted to reflect constant 1982 dollars.

Figures for 1969-78 are based on an estimated
 nominal pool of \$2.5 billion.
 1989 Data from Venture Economics Estimates

localities can stimulate technology and entrepreneurship. Still, it remains to be seen precisely what role venture capital plays in stimulating new business formation, job creation, and economic development outside the primary regions of investment. And, it is unclear that simply closing capital gaps will generate technology-oriented economic development along the lines of a Silicon Valley.

Literature Review

There have been many articles written over the past several years devoted to the subject of the venture capital industry. This research remains limited both by unavailability of data and a lack of understanding of the micro-level workings of the venture capital industry. The literature to date has covered the subject of venture capital firm location in much greater detail than that of venture capital investment, mainly because data on venture capital firm location is easier to come by than data on venture capital investment (which is virtually unavailable). Most of the research that has been done relies heavily on aggregate data (available from Venture Economics) which give a grossly inadequate picture of investment flows at the state or metropolitan level and from which it is hard to generate generalizable findings. What's worse, most of this work is hampered by a poor understanding of how the venture capital industry operates, based upon anecdotes and "second-hand stories".

Although a great deal of research has been done on the location of high technology industry, this work neglects venture capital's role in high technology agglomerations. Recent work by Markusen, Hall, and Glasmeier⁸ attributes the regional agglomeration of high technology industry to a variety of attraction factors such as research universities, access to air transport, presence of high skilled labor, etc.). Unfortunately, this work does not include a venture capital variable. While many researchers have suggested that a technological infrastructure composed of high technology businesses, universities, specialized labor pools, suppliers, vendors, and consultants is an important prerequisite for high technology development, virtually no one has tried to determine venture capital's role in such an infrastructure.⁹ Recently, researchers like Allen Scott and Michael Storper have argued that high technology regions are new forms of "flexible production complexes" made up of tightly linked groups of small and medium-sized manufacturing firms.¹⁰ They argue that the high transaction costs and information-intensive nature of high technology activity require companies to locate close to one another and cooperate as a production complex. However, Scott and Storper neglect to consider the role played by venture capital in their account of high technology production complexes.

⁸ Ann Markusen, Peter Hall, and Amy Glasmeier. High Tech America. 1986.

⁹ Walter Stohr. 1986. "Regional Innovation Complexes." Papers of the Regional Science Association. 59: 29-44

¹⁰ Allan Scott and Michael Storper. 1987. "High Technology Industry and Regional Development: a Theoretical Critique and Reconstruction" in International Social Science Journal 112: 215-32.

The conventional wisdom assumes that the location of venture capital is a function of high technology industry. This is partly true, at best. On the one hand, some high technology centers, like North Carolina's Research Triangle, have very little in the way of venture capital (having invested mainly in high technology branch plant operations).¹¹ On the other hand (and more importantly), a number of venture capital centers, like New York and Chicago, have generated very little in the way of high technology development. The research described in this report was designed in large measure to shed light on the thorny issues of venture capital location and its relationship to high technology development.

Much less research has been done on the distribution of venture capital investments, perhaps the crucial dimension of venture capital. Here again, most of what has been done tends to be anecdotal or descriptive in nature. Good data on venture capital investment are virtually unavailable. Venture Economics, the main source of venture capital data, only publishes highly aggregate numbers for a few baseline states and regions; it is impossible to get any numbers on flows within or among states or at the substate level. Some researchers have simply relied on this aggregate data, while others have tried to surmount this problem by using data in venture capitalists' investment preferences (published in *Venture Economics, Guide to Venture Capital*).

Green and McNaughton have examined both interregional investment flows and interurban differences in investment patterns. They use investment preferences, supplied by venture capital firms to derive a set of preference indicators, from which they then constructed their model of venture capital investment. This is problematic at best, a fact the authors themselves acknowledge.¹² In fact, these preference data do not "pan out" when compared to our objective investment data. According to their findings, venture capital firms had no stated geographic preference beyond the entire U.S. This is directly contradicted by our findings, which show a distinct concentration of venture capital investment in Silicon Valley and Boston-Route 128. In another paper, Green and McNaughton used SBIC investment data to determine venture capital investment.¹³ While this avoids some of the earlier problems, it too suffers from bias. SBICs, a publicly-backed type of venture capital institution, are not representative of the venture capital industry. In fact, their conclusion that venture capitalists invest locally is incomplete at best. Our findings show that while some venture capitalists invest locally, others do not.

In a recent paper, Leinbach and Amrhein have examined the geographic location of venture capital investment. Their analysis suffers from overaggregation at the regional level and a highly insufficient time series. Leinbach and Amrhein used data on venture capital investments for one year, based on the Venture Economics database, to analyze regional

¹¹ Michael Luger. 1984. "Does North Carolina's High-Tech Development Program Work?". *APA Journal*, Summer 1984: 280-89.

¹² Milford B. Green and Rod B. McNaughton, "Patterns of Venture Capital Investment in the United States." University of Western Ontario, Research Paper, 1986,

¹³ Milford B. Green and Rod B. McNaughton. "Interurban Variation in Venture Capital Investment Characteristics." University of Western Ontario.

and industry variations in venture capital investment. Based on this, they conclude that the Pacific Southwest, New England, and the Gulf Coast/Southwest regions attract the greatest volume of investment. Unfortunately, their analyses obscure many of the most interesting state and local differences in the venture capital industry. While Leinbach and Amrhein allude to the regional mismatch of venture capital investments as evidence of regional capital gaps or market imperfections, they offer only circumstantial evidence to support this claim. They end up recommending that government should act to establish information-oriented programs that "promote" the potential "good deals" available to venture capitalists in a region, but this may, in fact, be wasteful if there are no deals or very few deals in an area.

The research presented in this report overcomes the weaknesses of the previous literature by developing and analyzing a reliable data base on the venture industry, combining that with detailed case studies of leading venture capital complexes. Our work sheds new light on venture capital investment patterns and the relationship between venture capital and high technology. We find that there are various types of venture capital complexes, some that generate and support high technology, others that do not. Where it is important, venture capital functions as an integral component of a broad "social structure of innovation," that is comprised of a variety of institutions that support technology-based economic development.

Research Questions

After surveying the extant literature, we oriented our research around four over-arching research questions:

- (1) How specifically does the venture capital industry operate?
- (2) Where is venture capital concentrated?
- (3) Where is venture capital invested?
- (4) What is the effect of venture capital on economic development; specifically, under what conditions does venture capital enhance the economic development potentials of particular areas?

Research Design / Methodology

Our research design was organized to shed light on these four questions. The study was organized into four research tasks. The principal aim was to embed the empirical evidence within a broad, institutionally-oriented understanding of the venture capital industry.

and industry variations in venture capital investment. Based on this, they conclude that the Pacific Southwest, New England, and the Gulf Coast/Southwest regions attract the greatest volume of investment. Unfortunately, their analyses obscure many of the most interesting state and local differences in the venture capital industry. While Leinbach and Amrhein allude to the regional mismatch of venture capital investments as evidence of regional capital gaps or market imperfections, they offer only circumstantial evidence to support this claim. They end up recommending that government should act to establish information-oriented programs that "promote" the potential "good deals" available to venture capitalists in a region, but this may, in fact, be wasteful if there are no deals or very few deals in an area.

The research presented in this report overcomes the weaknesses of the previous literature by developing and analyzing a reliable data base on the venture industry, combining that with detailed case studies of leading venture capital complexes. Our work sheds new light on venture capital investment patterns and the relationship between venture capital and high technology. We find that there are various types of venture capital complexes, some that generate and support high technology, others that do not. Where it is important, venture capital functions as an integral component of a broad "social structure of innovation," that is comprised of a variety of institutions that support technology-based economic development.

Research Questions

After surveying the extant literature, we oriented our research around four over-arching research questions:

- (1) How specifically does the venture capital industry operate?
- (2) Where is venture capital concentrated?
- (3) Where is venture capital invested?
- (4) What is the effect of venture capital on economic development; specifically, under what conditions does venture capital enhance the economic development potentials of particular areas?

Research Design / Methodology

Our research design was organized to shed light on these four questions. The study was organized into four research tasks. The principal aim was to embed the empirical evidence within a broad, institutionally-oriented understanding of the venture capital industry.

The conventional wisdom assumes that the location of venture capital is a function of high technology industry. This is partly true, at best. On the one hand, some high technology centers, like North Carolina's Research Triangle, have very little in the way of venture capital (having invested mainly in high technology branch plant operations).¹¹ On the other hand (and more importantly), a number of venture capital centers, like New York and Chicago, have generated very little in the way of high technology development. The research described in this report was designed in large measure to shed light on the thorny issues of venture capital location and its relationship to high technology development.

Much less research has been done on the distribution of venture capital investments, perhaps the crucial dimension of venture capital. Here again, most of what has been done tends to be anecdotal or descriptive in nature. Good data on venture capital investment are virtually unavailable. Venture Economics, the main source of venture capital data, only publishes highly aggregate numbers for a few baseline states and regions; it is impossible to get any numbers on flows within or among states or at the substate level. Some researchers have simply relied on this aggregate data, while others have tried to surmount this problem by using data in venture capitalists' investment preferences (published in *Venture Economics, Guide to Venture Capital*).

Green and McNaughton have examined both interregional investment flows and interurban differences in investment patterns. They use investment preferences, supplied by venture capital firms to derive a set of preference indicators, from which they then constructed their model of venture capital investment. This is problematic at best, a fact the authors themselves acknowledge.¹² In fact, these preference data do not "pan out" when compared to our objective investment data. According to their findings, venture capital firms had no stated geographic preference beyond the entire U.S. This is directly contradicted by our findings, which show a distinct concentration of venture capital investment in Silicon Valley and Boston-Route 128. In another paper, Green and McNaughton used SBIC investment data to determine venture capital investment.¹³ While this avoids some of the earlier problems, it too suffers from bias. SBICs, a publicly-backed type of venture capital institution, are not representative of the venture capital industry. In fact, their conclusion that venture capitalists invest locally is incomplete at best. Our findings show that while some venture capitalists invest locally, others do not.

In a recent paper, Leinbach and Amrhein have examined the geographic location of venture capital investment. Their analysis suffers from overaggregation at the regional level and a highly insufficient time series. Leinbach and Amrhein used data on venture capital investments for one year, based on the Venture Economics database, to analyze regional

¹¹ Michael Luger. 1984. "Does North Carolina's High-Tech Development Program Work?". *APA Journal*, Summer 1984: 280-89.

¹² Milford B. Green and Rod B. McNaughton, "Patterns of Venture Capital Investment in the United States." University of Western Ontario, Research Paper, 1986,

¹³ Milford B. Green and Rod B. McNaughton. "Interurban Variation in Venture Capital Investment Characteristics." University of Western Ontario.

The Venture Capital Database: A major component of our research involved the development of a new database on the venture capital industry. The database was compiled from information reported in the Venture Capital Journal from January 1984 to December 1987, which represents roughly 40 percent to 45 percent of all venture investments made during that period. The database contains micro-level information on venture capital firms, venture capital investments, and the companies that received those investments. This enabled us to undertake detailed analyses of venture capital investment flows at the local, regional, and national levels.

Field Research: Intensive field research was conducted in Silicon Valley, the Boston Route 128 area, and other areas, to shed light on the dynamics of the venture capital industry. Oral interviews were conducted with key figures in the venture capital industry, as well as high technology entrepreneurs who had received venture capital investment. The interviews provided unique insight into the history and evolution of the venture capital industry, the nature of venture capital investment, and the role venture capital has played in both innovation and economic development. (A list of interviewees is attached as an appendix to this report.)

Archival research: Detailed archival research on the origin and history of the venture capital industry was conducted at the Harvard Business School, Stanford Business School, Silicon Valley Research Center, and other universities. The archival research included a comprehensive review of relevant business documents, trade materials, unpublished reports, newspapers, and periodicals.

Analysis and Synthesis: The final element of the research involved analyzing the empirical information generated from the database, field research, and literature search to provide what we believe to be a new perspective on the venture capital industry (especially in Chapter 7). Our perspective emphasizes venture capital's role in a social structure of innovation -- the relationship between venture capital and the broader institutional context of high technology development.

Major Findings

Based on our research, we came to ten major conclusions. These are as follows:

1. Venture capital is extremely concentrated. The major centers of venture capital in the United States include California's Silicon Valley, New York City, and Route 128 around Boston. Less important, though still significant concentrations of venture capital are found in Chicago, Texas, Connecticut, Minnesota, and Colorado.

2. Because of this, venture capital exhibits extreme "bi-coastalism" and is concentrated overwhelmingly in the Northeast and Pacific regions. Together, these two regions control 65% of U.S. venture capital firms, 78% of U.S. venture capital resources, and 74% of U.S. venture capital investment.
3. Venture capital investments flow mainly to established high technology centers such as Silicon Valley and Route 128. Other venture capital centers, which are not high technology centers, like New York and Chicago, primarily export their funds to technology regions like Silicon Valley and Route 128.
4. Interestingly, this pattern holds in areas that are minor venture capital centers. For example, the bulk of venture capital investments in Georgia are located in Atlanta, which possesses that state's largest concentration of high technology.
5. Venture capital complexes can be grouped according to a variety of economic and structural characteristics, into a three part typology: technology-oriented complexes, financial-oriented complexes, and hybrid complexes.
6. Technology-oriented complexes, typified by California and Colorado, have a significant base of high technology companies, invest a majority of their capital in-state, feature a higher proportion of independent limited partnership type venture capital firms, and attract more investment from other complexes than they make in those complexes.
7. Financial-oriented complexes, New York and Illinois, control large volumes of financial assets, have relatively more financial and corporate subsidiary venture capital firms, invest a majority of their capital out-of-state (primarily in technology-oriented complexes) and attract less capital from other states than they export to those states.
8. Hybrid complexes, Massachusetts, Minnesota, Texas, and Connecticut, possess features of both technology- and financial-oriented complexes. For example, Massachusetts has a large base of high technology companies and attracts significant amounts of investment from other complexes, but exports a roughly equal amount of its capital. Connecticut has investment patterns that place it squarely in the range of a financial complex, but ranks very highly in the high technology base indicators.
9. Venture capital's impact is context sensitive. In areas with an established high technology base (i.e., Silicon Valley) , venture capital fuels the growth of that sector. In areas without such a base (i.e., New York and Chicago), the presence of venture capital alone is not likely to stimulate innovation and high technology development. Venture capital is one element of a broad "social structure of innovation" composed of networks and linkages that connect a variety of actors.
10. Venture capital alone is not enough to generate high technology economic development. Public policies that seek to stimulate high technology by enhancing the growth of venture capital in an area, without influencing other structural elements of the region's economic infrastructure, will not succeed. In order to be successful, public risk capital programs will have to be part of a broader comprehensive and systematic effort to bolster an area's technological capacity.

PART I.

THE VENTURE CAPITAL INDUSTRY

Plan of the Report

The remainder of the report is divided into three major parts and eight chapters. Part I provides an overview of the venture capital industry. Chapter 2 discusses the evolution and the structure of the venture capital industry. Chapter 3 focuses on the various functions venture capitalists perform in the growth and development of new technology-intensive businesses. Chapter 4 reviews the role of venture capital in technological innovation.

Part II outlines the geographic dimensions of the venture capital industry. Chapter 5 examines the location of venture capital funds and resources. Chapter 6 explores the geographic distribution of venture capital investments. Part III provides a synthesis of the previous two sections, and explores the potential feasibility of public venture capital programs. Chapter 7 summarizes the differences between and among eight major venture capital complexes. Chapter 8, the final chapter, outlines the policy implications that flow from our research.

to promote "pioneering projects that with proper backing will encourage sound scientific and economic progress in new fields--fields that hold the promise of tremendous future development."¹⁵ The Rockefeller family made numerous risk investments in the immediate postwar era.

American Research and Development (ARD) was the first professional venture capital firm to raise funds from the sale of shares to private investors. ARD was founded in Boston in 1946 by Ralph E. Flanders, president of the Federal Reserve Bank of Boston, Merrill Griswold, head of Massachusetts Investors Trust, and Karl T. Compton, president of the Massachusetts Institute of Technology. These men then chose Georges Doriot, a former general and Harvard Business School professor, to serve as president of the company that sought to provide not only risk capital to technology-oriented businesses, but also "encouragement and advice... [through the] powerful team of financial experts, skilled business managers, and leading scientists" assembled by the founders of ARD.¹⁶ Under Doriot's leadership, ARD invested in such phenomenally successful firms as Digital Equipment Corp. and Teradyne, Inc. Surely, Doriot is the father of venture investing. The Venture Capital Journal said of Doriot that "His original concepts have remained. Long term development with active management assistance and support was the keystone of his investment philosophy."¹⁷

The Small Business Investment Act of 1958

A major impetus behind the rise of the modern venture capital industry was the Small Business Investment Act of 1958. The early 1950s witnessed increased concern over the financing of small businesses among business officials and public policy makers. Organizations like the Committee for Economic Development began to develop a variety of alternatives for public vehicles to provide entrepreneurial risk capital. In 1954, the Small Business Administration (SBA) was created, partly as a result of these efforts, to direct federal resources to aid small business development. The subsequent Small Business Investment Act of 1958 made federal long-term loans available for the formation of small business investment companies (SBICs). These companies in turn would invest in small, independent businesses via equity financing, debt issuance, or some combination of both. Many of the earliest venture capital funds began as either independent or bank-affiliated SBICs.

Recent Growth of the Venture Capital Pool

The development of what we now refer to as the venture capital industry has occurred mainly over the past three decades. A number of reasons have been offered to explain this dramatic growth in the venture capital pool. First, since the mid-1960s

¹⁵ Joe Alex Morris, Those Rockefeller Brothers. Harper Brothers, New York, 1953, p. 169.

¹⁶ Gene Bylinsky, "General Doriot's Dream Factory," Fortune, August 1967, p. 132.

¹⁷ Venture Capital Journal, "The Evolution of an Industry: Venture Capital Redefined for the 1980's," January 1980, p. 13.

CHAPTER 2

THE VENTURE CAPITAL INDUSTRY

Introduction

The venture capital industry has experienced tremendous growth over the past two decades. In 1969, the size of the venture capital pool was \$2.4 billion dollars. Today, it exceeds \$30 billion. This translates to a four-fold increase in constant 1982 dollars. As Figure 1.2 shows, most of the growth in the venture capital pool occurred after 1980. The number of venture capital firms also increased dramatically over the past two decades. There are over 625 professional venture capital firms in the U.S. These firms employ almost 2,400 professionals. These venture capital companies invested in approximately 4,400 companies in 1986 alone.¹⁴

There are a variety of types of venture capital firms: private limited partnerships, venture capital subsidiaries of industrial corporations, venture capital subsidiaries of financial institutions, federally-assisted Small Business Investment Companies (SBICs) and Minority Enterprise Small Business Investment Companies (MESBICs), and wealthy individuals. Private limited partnerships are currently the dominant type of venture capital firm, controlling both the largest share of venture capital resources and the greatest number of offices.

This chapter presents an overview of the historical development of the venture capital industry in the United States and then provides a more detailed discussion of the industry's current structure.

The Origins of Venture Capital

Venture capital, as an institutional form of investment, is a relatively new phenomenon. Prior to World War II, the functions of today's venture capitalists were performed by wealthy individuals and families on an ad hoc, informal basis. The economist Joseph Schumpeter used the term "entrepreneurial financiers" to refer to these early venture capitalists. More organized types of risk finance or venture capital emerged to finance our national railroad system and the American steel industry. This was especially important since traditional financial institutions were unwilling and/or unable to absorb the risk of investing in new industries during the late 19th century.

The Postwar Years

Venture capital emerged in its modern institutional form in the years following World War II. Wealthy individuals such as J.H. Whitney, Laurance Rockefeller, and others established private risk capital investment firms which, in the words of Rockefeller, sought

¹⁴ Spira and Haynes, "Historical and Program Highlights of the Small Business Investment Company Program and Private Venture Capital Investment," 1988, p. 15.

to promote "pioneering projects that with proper backing will encourage sound scientific and economic progress in new fields--fields that hold the promise of tremendous future development."¹⁵ The Rockefeller family made numerous risk investments in the immediate postwar era.

American Research and Development (ARD) was the first professional venture capital firm to raise funds from the sale of shares to private investors. ARD was founded in Boston in 1946 by Ralph E. Flanders, president of the Federal Reserve Bank of Boston, Merrill Griswold, head of Massachusetts Investors Trust, and Karl T. Compton, president of the Massachusetts Institute of Technology. These men then chose Georges Doriot, a former general and Harvard Business School professor, to serve as president of the company that sought to provide not only risk capital to technology-oriented businesses, but also "encouragement and advice... [through the] powerful team of financial experts, skilled business managers, and leading scientists" assembled by the founders of ARD.¹⁶ Under Doriot's leadership, ARD invested in such phenomenally successful firms as Digital Equipment Corp. and Teradyne, Inc. Surely, Doriot is the father of venture investing. The Venture Capital Journal said of Doriot that "His original concepts have remained. Long term development with active management assistance and support was the keystone of his investment philosophy."¹⁷

The Small Business Investment Act of 1958

A major impetus behind the rise of the modern venture capital industry was the Small Business Investment Act of 1958. The early 1950s witnessed increased concern over the financing of small businesses among business officials and public policy makers. Organizations like the Committee for Economic Development began to develop a variety of alternatives for public vehicles to provide entrepreneurial risk capital. In 1954, the Small Business Administration (SBA) was created, partly as a result of these efforts, to direct federal resources to aid small business development. The subsequent Small Business Investment Act of 1958 made federal long-term loans available for the formation of small business investment companies (SBICs). These companies in turn would invest in small, independent businesses via equity financing, debt issuance, or some combination of both. Many of the earliest venture capital funds began as either independent or bank-affiliated SBICs.

Recent Growth of the Venture Capital Pool

The development of what we now refer to as the venture capital industry has occurred mainly over the past three decades. A number of reasons have been offered to explain this dramatic growth in the venture capital pool. First, since the mid-1960s

¹⁵ Joe Alex Morris, Those Rockefeller Brothers. Harper Brothers, New York, 1953, p. 169.

¹⁶ Gene Bylinsky, "General Doriot's Dream Factory," Fortune, August 1967, p. 132.

¹⁷ Venture Capital Journal, "The Evolution of an Industry: Venture Capital Redefined for the 1980's," January 1980, p. 13.

traditional manufacturing industries have been beset by falling profits, making venture investments a more attractive investment option. Second, the high returns offered by new technology-intensive industries like semiconductors, computers, and biotechnology have tended to "pull" investments toward these new fields. Third, there was "escalating" stock market activity in the 1970s and 1980s, which made it easier to take new companies into the new issues market. And fourth, a series of changes in public policy--most notably reductions in the rate of taxation on capital gains and the liberalization of restrictions of public pension investments under ERISA statutes--helped to channel additional capital into the venture capital pool. A model developed by William Bygrave and Jeffrey Timmons¹⁸ shows strong positive correlations between the volume of new public offerings (IPOs), the liberalization of declining capital gains taxes, and the increase in the total venture capital pool.

Changes in the venture capital pool have closely followed changes in the tax rate on capital gains. As Figure 2.2 shows, the steady increase in the tax rate on capital gains from 25 percent in 1969 to 49 percent in 1976 was followed by a decline in the venture capital pool (measured in constant dollars) from \$6.1 billion in 1969 to \$4.3 billion in 1977. The lowering of the capital gains tax rate to 35 percent in late 1978 and then again to 28 percent in 1979, and 20 percent in 1981 has been followed by a dramatic increase in the venture capital pool.

We ran some simple correlations to gauge the relationship between venture capital and tax rates on the one hand, and venture capital and the IPO market on the other. The first correlation, which compares the percentage change in the real venture capital pool to the maximum capital gains tax rate, is -0.734, a strong negative relationship. The second correlation, which compares the net change in the venture capital pool (in constant 1982 dollars) to the total funds raised in the new issues market, is .884 indicating that increases in the venture capital pool are related to increased activity in the initial public offering market.

The Structure of the Venture Capital Industry

There is a variety of types of venture capital funds: private limited partnerships, bank related venture capital funds, corporate venture capital funds, Small Business Investment Corporations, and "angels." The following sections examine each of these in detail. Figure 2.3 shows the percent change of different types of venture capital companies between 1977 and 1987. Although all types of venture firms increased in actual number, private venture capital limited partnerships experienced the largest percentage gain, relative to the other types of venture capital firms.

¹⁸ William Bygrave and J. Timmons, "An Empirical Model of the Flows of Venture Capital," in J. Hornady et al., *Frontiers of Entrepreneurial Research*, Center for Entrepreneurial Research, Babson College, Wellesley, MA, 1985.

Figure 2.2

Changes in the Real Venture Capital Pool and the Maximum Capital Gains Tax Rate

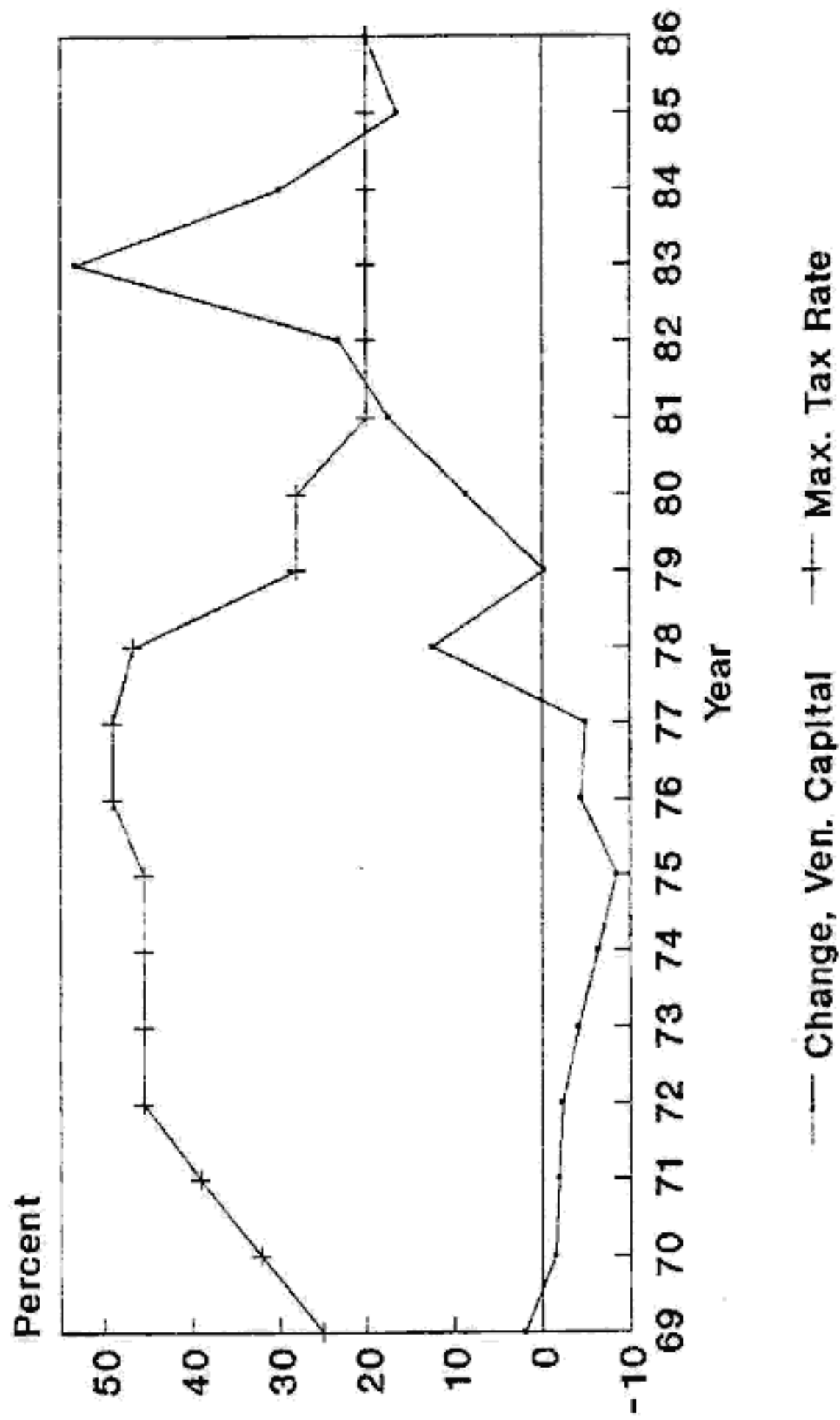
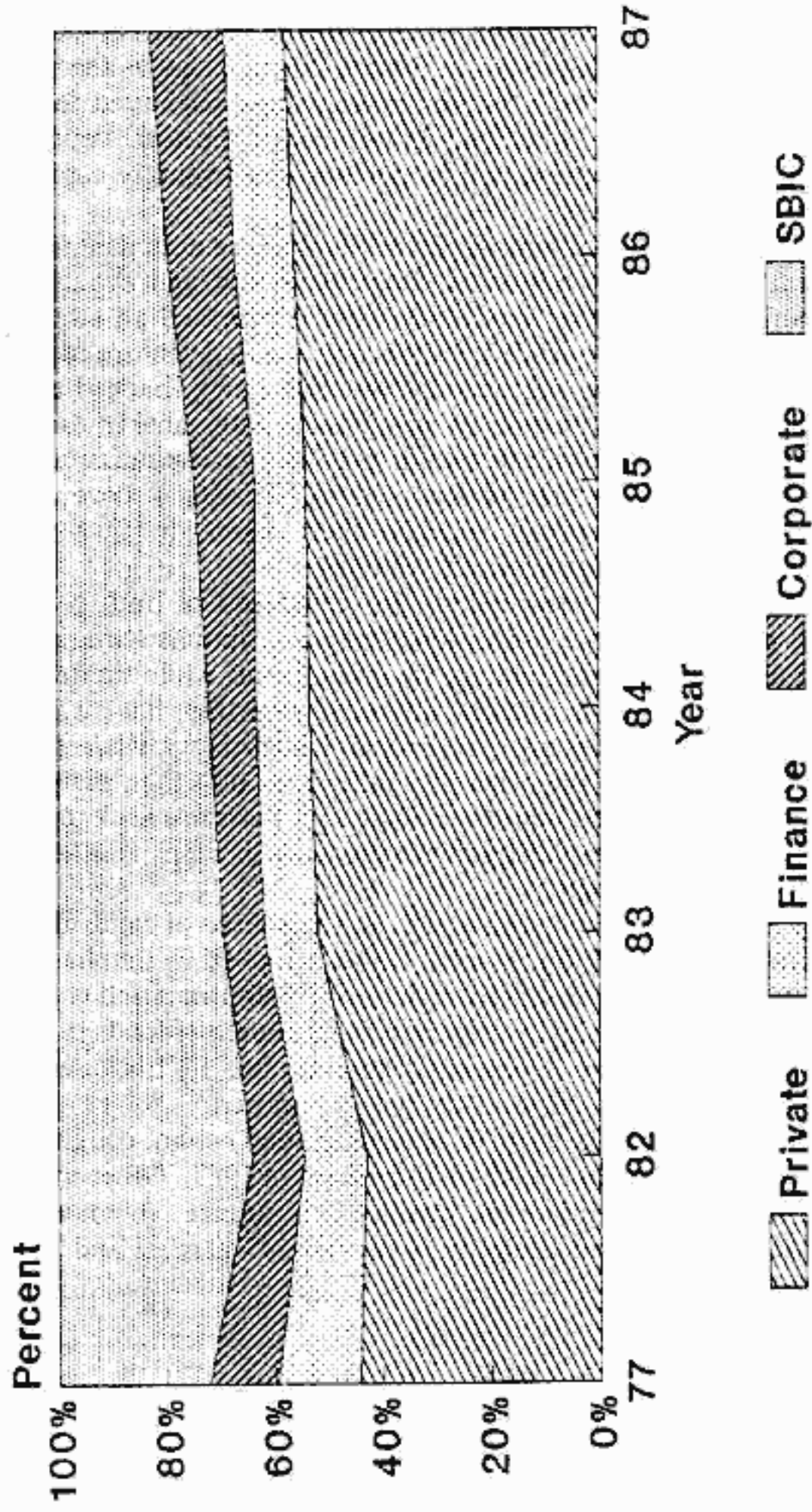


Figure 2.3
 Types of Venture Capital Firms
 Percentage of Total, 1977-1987



Source: Venture Capital Journal

Venture Capital Limited Partnerships

One of the most striking features of the venture capital industry over the past two decades is the dramatic growth in limited partnerships as the primary vehicle for venture capital investment. In 1977, limited partnerships accounted for 44 percent of all venture capital companies and controlled 35 percent of the total venture capital pool. By 1987, limited partnerships represented 58 percent of all venture capital firms and 70 percent of venture capital resources.

The emergence of limited partnerships as the dominant form of venture investing was the result of a lengthy period of experimentation and evolution. Basically, the limited partnership eclipsed other models because it provided an effective way to mobilize large amounts of funds from outside investors and enabled venture capitalists to realize significant financial gains. Today, partnerships are often piggy-backed one on top of one another, giving rise to the phenomenon of "megafunds" with value in excess of \$500 million. While early partnerships were run by one or two venture capitalists and a skeleton staff, modern partnerships may have five to ten general partners, a dozen associates, and a sizeable support staff. To effectively manage their assets, modern partnerships have adopted increasingly formal organizational schemes.

Private limited partnerships are composed of both general and limited partners. General partners are the professional venture capitalists who secure capital commitments for a fund and make and manage its investments, while limited partners are the financial investors in the fund. On average, limited partnerships have a fixed lifespan of seven to ten years. The first few years are ones of active investment, while the remaining period is used to build companies to the point of public stock offerings, mergers, or other forms of exit. Because of their limited life expectancies, partnerships seek to build companies rapidly, in order to realize large capital gains the proceeds of which are then invested into new venture funds or kept accordingly.

Recent years have seen a shift in the source of funds for limited partnerships. (See Figure 2.4) Between 1978 and 1984, capital supplied by families and individuals declined in importance relative to capital from financial institutions and corporations. By 1984, pension funds had become the single, most important source of funds to venture capital partnerships supplying \$1.1 billion or 35 percent of total capital. By 1987, that number had risen to \$1.57 billion or 40 percent of total capital committed.¹⁹ Over the same period, corporate commitments fluctuated from 10 percent of total capital commitments made in 1978, to 19 percent in 1980, and then back to 10 percent in 1987. Other major contributors to venture capital funds include foreign investors, insurance companies, and endowments and foundations, which accounted for 14 percent, 15 percent and 10 percent of commitments, respectively, in 1987.

¹⁹ Venture Capital Journal, July 1987, p. 9.

Venture Capital Limited Partnerships

One of the most striking features of the venture capital industry over the past two decades is the dramatic growth in limited partnerships as the primary vehicle for venture capital investment. In 1977, limited partnerships accounted for 44 percent of all venture capital companies and controlled 35 percent of the total venture capital pool. By 1987, limited partnerships represented 58 percent of all venture capital firms and 70 percent of venture capital resources.

The emergence of limited partnerships as the dominant form of venture investing was the result of a lengthy period of experimentation and evolution. Basically, the limited partnership eclipsed other models because it provided an effective way to mobilize large amounts of funds from outside investors and enabled venture capitalists to realize significant financial gains. Today, partnerships are often piggy-backed one on top of one another, giving rise to the phenomenon of "megafunds" with value in excess of \$500 million. While early partnerships were run by one or two venture capitalists and a skeleton staff, modern partnerships may have five to ten general partners, a dozen associates, and a sizeable support staff. To effectively manage their assets, modern partnerships have adopted increasingly formal organizational schemes.

Private limited partnerships are composed of both general and limited partners. General partners are the professional venture capitalists who secure capital commitments for a fund and make and manage its investments, while limited partners are the financial investors in the fund. On average, limited partnerships have a fixed lifespan of seven to ten years. The first few years are ones of active investment, while the remaining period is used to build companies to the point of public stock offerings, mergers, or other forms of exit. Because of their limited life expectancies, partnerships seek to build companies rapidly, in order to realize large capital gains the proceeds of which are then invested into new venture funds or kept accordingly.

Recent years have seen a shift in the source of funds for limited partnerships. (See Figure 2.4) Between 1978 and 1984, capital supplied by families and individuals declined in importance relative to capital from financial institutions and corporations. By 1984, pension funds had become the single, most important source of funds to venture capital partnerships supplying \$1.1 billion or 35 percent of total capital. By 1987, that number had risen to \$1.57 billion or 40 percent of total capital committed.¹⁹ Over the same period, corporate commitments fluctuated from 10 percent of total capital commitments made in 1978, to 19 percent in 1980, and then back to 10 percent in 1987. Other major contributors to venture capital funds include foreign investors, insurance companies, and endowments and foundations, which accounted for 14 percent, 15 percent and 10 percent of commitments, respectively, in 1987.

¹⁹ Venture Capital Journal, July 1987, p. 9.

Venture Capital Limited Partnerships

One of the most striking features of the venture capital industry over the past two decades is the dramatic growth in limited partnerships as the primary vehicle for venture capital investment. In 1977, limited partnerships accounted for 44 percent of all venture capital companies and controlled 35 percent of the total venture capital pool. By 1987, limited partnerships represented 58 percent of all venture capital firms and 70 percent of venture capital resources.

The emergence of limited partnerships as the dominant form of venture investing was the result of a lengthy period of experimentation and evolution. Basically, the limited partnership eclipsed other models because it provided an effective way to mobilize large amounts of funds from outside investors and enabled venture capitalists to realize significant financial gains. Today, partnerships are often piggy-backed one on top of one another, giving rise to the phenomenon of "megafunds" with value in excess of \$500 million. While early partnerships were run by one or two venture capitalists and a skeleton staff, modern partnerships may have five to ten general partners, a dozen associates, and a sizeable support staff. To effectively manage their assets, modern partnerships have adopted increasingly formal organizational schemes.

Private limited partnerships are composed of both general and limited partners. General partners are the professional venture capitalists who secure capital commitments for a fund and make and manage its investments, while limited partners are the financial investors in the fund. On average, limited partnerships have a fixed lifespan of seven to ten years. The first few years are ones of active investment, while the remaining period is used to build companies to the point of public stock offerings, mergers, or other forms of exit. Because of their limited life expectancies, partnerships seek to build companies rapidly, in order to realize large capital gains the proceeds of which are then invested into new venture funds or kept accordingly.

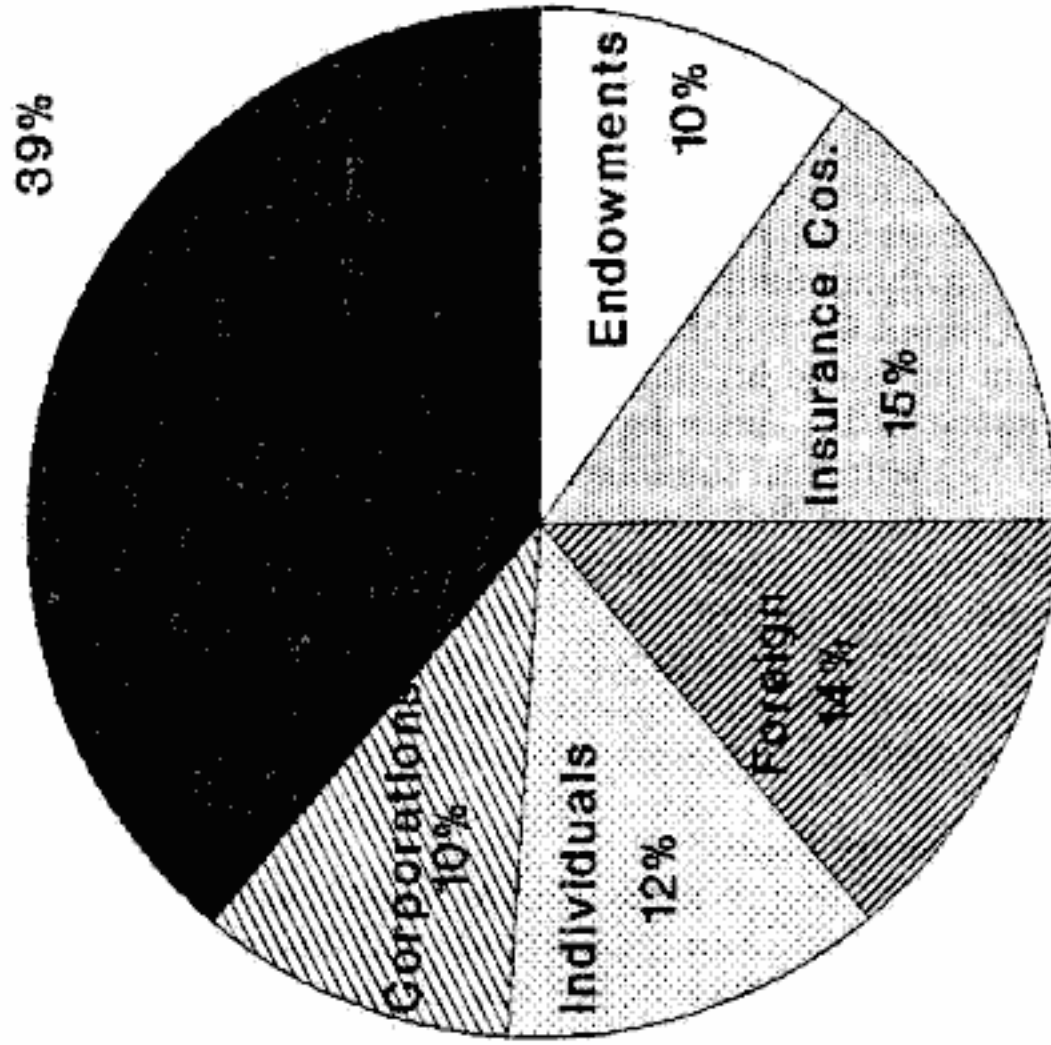
Recent years have seen a shift in the source of funds for limited partnerships. (See Figure 2.4) Between 1978 and 1984, capital supplied by families and individuals declined in importance relative to capital from financial institutions and corporations. By 1984, pension funds had become the single, most important source of funds to venture capital partnerships supplying \$1.1 billion or 35 percent of total capital. By 1987, that number had risen to \$1.57 billion or 40 percent of total capital committed.¹⁹ Over the same period, corporate commitments fluctuated from 10 percent of total capital commitments made in 1978, to 19 percent in 1980, and then back to 10 percent in 1987. Other major contributors to venture capital funds include foreign investors, insurance companies, and endowments and foundations, which accounted for 14 percent, 15 percent and 10 percent of commitments, respectively, in 1987.

¹⁹ Venture Capital Journal, July 1987, p. 9.

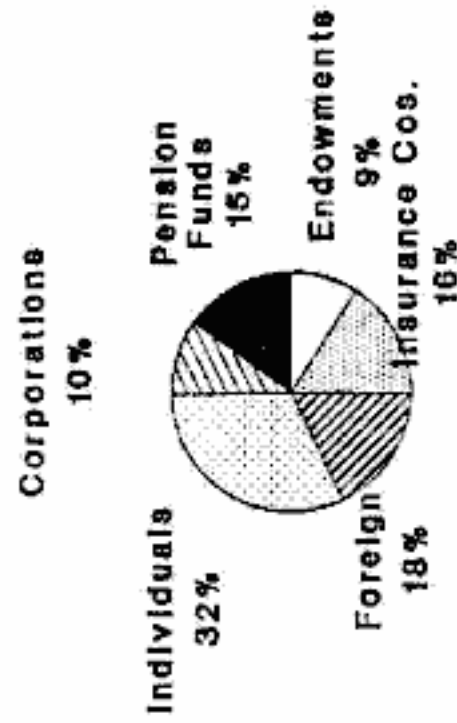
Figure 2.4

Sources of New Funds for Private Venture Capital Firms

Pension Funds



1987
\$4.02 bil.



1978
\$0.22 bil.

Source: Venture Capital Journal.

Bank Related Venture Capital Funds

A smaller group of venture capital funds are affiliated with banks and other financial institutions. In 1987, there were approximately 69 venture capital subsidiaries of financial institutions which controlled over \$3 billion in resources.²⁰ Examples of bank related venture capital funds include Citicorp and First National Bank of Chicago. Those affiliated with investment banks and brokerage firms include Merrill Lynch; Drexel, Burnham, Lambert (Lambda); Smith Barney (First Century Partnership); and Donaldson, Lufkin and Jenrette (Sprout Group). Many traditional financial institutions, such as commercial and investment banks and brokerage firms, helped establish the venture capital industry when they founded SBICs, in order to take advantage of the new investment opportunities provided by the federal subsidiaries.

Bank-related funds operate on different incentives than limited partnerships. Since they have access to significant blocks of capital, venture capital concerns tied to large commercial banks do not face competitive pressures to generate funds from external sources. In addition, sponsoring banks often encourage venture capital affiliates to commit capital which will generate rates of return in excess of that of the sponsor, but which may fall short of the rate of return achieved by preeminent venture partnerships.²¹

Corporate Venture Funds

As of 1987, there were 86 venture capital funds operating as subsidiaries of industrial corporations such as Xerox, Monsanto and Lubrizol. These venture funds controlled approximately \$1.9 billion in venture capital, or 6.5 percent of total venture capital resources. The objectives of corporate venturing are many. They range from pursuit of an attractive return on investment, to growth and diversification, to securing a "window on technology," to enhancement of entrepreneurial spirit within the corporation, to acquisition or development of a strategic partnership with a successful small company.²²

Generally speaking, the most successful venture capital subsidiaries, in terms of return on investment, are organizationally distinct entities from the parent organization. In addition, they closely resemble the structure of private venture capital firms, and therefore, are not subject to the same investment biases of their corporate parents. The success of corporate venturing for reasons other than strict financial return is the subject of on-going

²⁰ Venture Capital Journal, April 1988, p. 10.

²¹ This point was reinforced in our discussions with John Dougery, a former Citicorp employee who is now a member of the limited partnership Dougery, Jones and Wilder, and with David Wegman, who is currently with Citicorp Ventures in Palo Alto, California.

²² For further detail on venture capital subsidiaries of large industrial corporations, see An Analysis of Capital Market Imperfection, Charles River Associates, Inc., Cambridge, MA, 1976; W. Mears, Corporate Venture Capital: Can it be Successful, Master's Thesis, Sloan School of Management, MIT, Cambridge, MA, 1981; Venture Capital Journal, November 1985, pp. 6-13.

debate.²³ The successful acquisition and incorporation of previously independent, innovative firms into the corporate structure is particularly difficult because often the "entrepreneurial spirit" clashes with the more structured, rules and regulation-oriented mentality of most corporate managers.

The relative importance of corporate venture capital firms has decreased in recent years. Corporate firms, both financial and industrial, controlled the greatest portion of venture capital resources in 1977, 41 percent. However, by 1987 corporate venture capital firms controlled only 14 percent of the total. Between 1977 and 1987, the number of corporate venture capital firms almost tripled from 30 to 86 firms.

Small Business Investment Corporations(SBICs)

SBICs were created under the enabling legislation contained in the federal Small Business Act. SBICs are privately organized and managed investment firms, licensed by the Small Business Administration. These investment companies have access to long-term federal loans in return for their agreement to invest solely in small businesses. MESBICs arose following 1972 legislation which made available additional leveraged funds specifically for minority enterprises. In 1986, there were 333 active small business investment companies (SBICs) and 140 minority enterprise small business investment companies (MESBICs).

SBICs have access to federal leveraging funds under provisions of the 1958 Small Business Investment Act. SBICs and MESBICs provide a range of financing alternatives. These include: traditional venture capital funds, combined debt and equity, and long term loans. Between 1958 and 1968, SBICs were the primary financial resource for small business development. Today, even though there is a relatively large number of SBICs, they comprise only 8 percent of the venture capital resource base. SBICs are generally smaller than other types of venture capital funds having an average capitalization of just \$5.8 million in 1967, compared to \$64.5 million for independent private firms, \$45.1 million for corporate financial, and \$21.7 million for corporate industrial types of venture capital firms.

SBICs have been an important source of equity for smaller, moderate growth firms, such as those located in the service, manufacturing, and transportation and communication sectors.²⁴ SBICs' contribution to the total venture capital industry pool of capital declined from 24 percent in 1977 to 8 percent in 1987.

"Angels" and Other Types of Venturing

The discussion in this chapter has centered on the activities of formal, professional venture capital firms. Informal investors, known as "angels," provide an additional source of venture capital. Angels generally invest smaller amounts of capital in ventures with higher risks or lower rewards than traditional venture capital firms. Though the amount of individual angel investment is usually quite small, their aggregate contribution to the venture

²³ See, for example, Hardyman, DeNino and Salter, "When Corporate Venture Capital Doesn't Work," *Harvard Business Review*, May-June 1983.

²⁴ A thorough discussion of the early history of the SBIC program is provided in C. Noone and S. Rubel, "SBIC's: Pioneers in Organized Venture Capital," Capital Publishing, Chicago, 1970.

capital industry can be significant. In fact, it has been estimated that angels may account for one-half to two-thirds of all venture capital investment.²⁵ William Wetzel, a professor at the University of New Hampshire, has focused his research on the role of angel investments in the New England economy. Wetzel estimates that there are approximately 15,000 angel investments in New England. Wetzel's research has shown that angel investment patterns are more localized than professional venture capital firms. Angels are more likely to invest in a more restricted geographic region than professional venture capital firms. Wetzel believes that angels play an important role in localized economic development.

²⁵ "Angels Give Wing to Entrepreneurs," New England Business, 1 December 1986, p. 31.

CHAPTER 3

WHAT DO VENTURE CAPITALISTS DO?

Introduction

Venture capitalists are involved in a variety of tasks that are vital to technological innovation and economic development. Venture capitalists play an active role in the development of startup companies by lending substantial managerial, legal, marketing, and financial assistance to fledgling firms. This chapter explores the various functions performed by venture capitalists, tracing the nature of their involvement from the inception of a new business concept until a viable business is formed.

Venture Capital and the Stages of Business Development

Venture capitalists play a role at a number of different stages of a businesses development. As Figure 3.1 shows, venture capitalists invest primarily in the start-up and early stages of business development. Their role is to help new companies get off the ground, nurturing their firms' development until they are ready to enter the public offering market or become merger candidates. Venture capitalists typically target only a minor amount of their funding at the earliest stages of business development (i.e., the seed stage). Venture capitalists tend to increase their commitments over time.

A number of analysts like William Abernathy and James Utterback view the process of business development in terms of a lifecycle or "S-curve." A firm proceeds through three stages: emergence (initiation and rapid growth), consolidation (increasing economies of scale and steady expansion), and maturity (oligopoly and decline).²⁶ Figure 3.1 shows that venture capital is most important during the emergence stage which begins with a major breakthrough or innovation. This phase is marked by experimentation with new technology, uncertainty regarding future progress, wide open markets, low entry barriers, and diseconomies of scale. During this stage, venture capitalists evaluate the technological potentials, financial requirements, and organizational capabilities of new businesses and the products upon which they are based.²⁷ These firms are also assisted in their recruitment of management, location of production facilities, securing of legal counsel, and other services crucial to a young firm's survival and growth. As the business evolves, venture capitalists arrange additional rounds of financing, attract coinvestors, redefine corporate strategy, assist with production scale-up, target new markets, create a skilled marketing department, and

²⁶ W. Abernathy and J. Utterback, "Patterns of Industrial Innovation," *Technology Review*, June-July 1978, pp. 41-47.

²⁷ A. Bean, D. Schiffel and M. Mogue, "The Venture Capital Market and Technological Innovation," *Research Policy*, 1975, v.4 pp. 380-408.

FIGURE 3.1
Venture Capital in the Technology Cycle

Stages of Technology Cycle	EMERGENCE			CONSOLIDATION		
	CATALYST-ORGANIZATIONAL	ASSISTANCE	LICQUIDATION EXIT	ASSISTANCE	EXPANSION	EXIT
Role of Venture Capital						
Financial Functions	<ul style="list-style-type: none"> Provide initial capital. 	<ul style="list-style-type: none"> Locate co-investors Redefine corporate strategy Locate co-investors Assist with production scale-up, target new markets, create marketing team Locate additional managers, assemble sales force 	<ul style="list-style-type: none"> Investment bank for IPO Assist with upward merger 			
Non-Financial Functions	<ul style="list-style-type: none"> Review business plan Evaluate entrepreneurial group, perform "due diligence" Recruit management, locate production facility, secure loyal counsel 					
Financing Stage	Seed or Pre-venture	Start-up	Early	Expansion	Exit	
Capitalization	\$10,000-\$100,000	\$100,000-\$1,000,000	\$1,000,000-\$5,000,000	\$3,000,000-\$20,000,000		
Time Horizons**	1 to 3 years	1 to 3 years	2 to 3 years	1 to 3 years		

* Growth curve of a new technology intensive business.
** Average of 7 years.

CHAPTER 3

WHAT DO VENTURE CAPITALISTS DO?

Introduction

Venture capitalists are involved in a variety of tasks that are vital to technological innovation and economic development. Venture capitalists play an active role in the development of startup companies by lending substantial managerial, legal, marketing, and financial assistance to fledgling firms. This chapter explores the various functions performed by venture capitalists, tracing the nature of their involvement from the inception of a new business concept until a viable business is formed.

Venture Capital and the Stages of Business Development

Venture capitalists play a role at a number of different stages of a businesses development. As Figure 3.1 shows, venture capitalists invest primarily in the start-up and early stages of business development. Their role is to help new companies get off the ground, nurturing their firms' development until they are ready to enter the public offering market or become merger candidates. Venture capitalists typically target only a minor amount of their funding at the earliest stages of business development (i.e., the seed stage). Venture capitalists tend to increase their commitments over time.

A number of analysts like William Abernathy and James Utterback view the process of business development in terms of a lifecycle or "S-curve." A firm proceeds through three stages: emergence (initiation and rapid growth), consolidation (increasing economies of scale and steady expansion), and maturity (oligopoly and decline).²⁶ Figure 3.1 shows that venture capital is most important during the emergence stage which begins with a major breakthrough or innovation. This phase is marked by experimentation with new technology, uncertainty regarding future progress, wide open markets, low entry barriers, and diseconomies of scale. During this stage, venture capitalists evaluate the technological potentials, financial requirements, and organizational capabilities of new businesses and the products upon which they are based.²⁷ These firms are also assisted in their recruitment of management, location of production facilities, securing of legal counsel, and other services crucial to a young firm's survival and growth. As the business evolves, venture capitalists arrange additional rounds of financing, attract coinvestors, redefine corporate strategy, assist with production scale-up, target new markets, create a skilled marketing department, and

²⁶ W. Abernathy and J. Utterback, "Patterns of Industrial Innovation," *Technology Review*, June-July 1978, pp. 41-47.

²⁷ A. Bean, D. Schiffler and M. Mogue, "The Venture Capital Market and Technological Innovation," *Research Policy*, 1975, v.4 pp. 380-408.

work to maintain an effective management team. In these ways, venture capitalists add real value to new firms that transcends the provision of mere financial resources.

Narrowing the Field: Identifying Investment Opportunities

Venture capitalists select their investments from literally hundreds and, for some venture capital funds, thousands of business proposals each year. Only a fraction of these receive serious evaluation, and an even smaller percentage actually result in funding. For example, during 1987, the 100 most active venture capital firms received on average roughly 1,000 proposals each, with the actual number of proposals ranging from a minimum of 10 to a maximum of 6,500. Of these proposals, less than 4 percent received funding. When "follow-on" investments are excluded, this figure falls to only 2 percent.²⁸

Venture capitalists rely heavily on personal contacts in their search for and initial screening of quality venture opportunities. These referrals are a critical factor in venture capitalists' investment decisions. Survey research indicates that nearly two-thirds of all proposals are referrals from other venture capitalists, personal acquaintances, banks, or investment brokers. Executives of successful portfolio companies are particularly important to this referral process. Their industry experience and contacts afford them preferential access to high potential entrepreneurial groups and business proposals, which they, in turn, refer to venture capitalists. Law firms specializing in venture capital are also important; they provide a steady stream of referrals, match entrepreneurs to potential investors, and are involved in negotiations that are critical to forging new business alliances. Law firms that specialize in new venture activity are retained by both venture capitalists and high technology start-ups. For example, one of the top West Coast venture law firms, Wilson, Sonsini, Goodrich and Rosati, has a client list that includes venture capital firms such as Mayfield Fund, Hambrecht and Quist, and Sequoia Capital, as well as high tech companies like ROLM Corporation and Apple Computer.²⁹

"Cold calls" are less important than referral proposals. Though comprising an estimated 25 percent of the total number of proposals received,³⁰ unsolicited plans have a particularly poor chance of receiving funding. In fact, according to one recent survey, of 867 deals funded only 6 percent were over-the-transom deals.³¹

Venture capitalists evaluate business plans in light of a variety of criteria including: the originality of the proposed product or technology, its feasibility, market size, and projected sales, the availability of patent protection or other proprietary characteristics, the quality of the entrepreneurial group, and the options that are available. Donald Valentine

²⁸ Jim Judak et al, "Them That Got, Gets," *Venture*, June 1988, pp. 36-42.

²⁹ *Venture Capital Journal*, January 1987, pp. 48-54.

³⁰ T. Tyebjee and A. Bruno, "A Model of Venture Capitalist Investment Activity," *Management Science*, 30:9, 1984, pp. 1051-66.

³¹ *Venture Magazine*

of Sequoia Capital views the business plan as an introduction to the persons seeking funding. "We can't tell if the numbers are right, therefore we concentrate on how they reached the numbers, the thought processes that led them to conclude that their project was possible."³² Venture capital firms frequently use outside consultants or other venture capitalists to help evaluate business proposals.

Venture capitalists confer extensively with the management of potential start-ups. This is supplemented by a relatively formal process known as "due diligence" which involves a detailed search of references, the solicitation of outside information from potential customers, suppliers and competitors about the quality of the technology and the entrepreneurial group, and often lasts for several months.

Venture capitalists place different emphasis on the various risk components of a potential venture. These include the quality and experience of the management team, the quality and potential of the product and its market, and financial uncertainties. Most experienced venture capitalists view the people behind the business plan as the most critical factor in judging the potential success of a venture. Arthur Rock, a gray hair of the venture capital industry and backer of Fairchild, Intel, and many other companies states that: "Good ideas and good products are a dime a dozen. Good execution and good management--in a word, good people--are rare. ...That's why I generally pay more attention to the people who prepare a business plan than to the proposal itself."³³

A High Technology Orientation

Venture capitalists' invest primarily in high technology enterprises. This is illustrated in Table 3.1 which shows the industry orientation of actual venture capital investments between 1981 and 1985. During this period technology-intensive companies, in industries such as computers, software, telecommunications, etc., received between 53 and 66 percent of all venture capital investment. Computer hardware and systems have consistently received the greatest portion of venture capital financing, claiming, for example, one third of the total venture capital disbursed in 1983. In addition, the venture capitalists interviewed indicated a near unanimous preference for technology-intensive investments. Non-high technology companies (i.e., consumer-related products, services, and commercial communications) represent a minority of investments, although in recent years they have grown in significance, accounting for 22 percent of the total disbursements in 1985.

³² "Peaks and Valleys," INC., May 1985, p. 38.

³³ Arthur Rock, "Strategy vs. Tactics from a Venture Capitalist," Harvard Business Review, November-December 1987, p. 63.

TABLE 3.1

Venture Capital Disbursements by Industry
 Percentage of Total Dollars Invested
 1981-1985

<u>INDUSTRY</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>
Computers/Software	30	42	42	40	31
Telecommunications	11	10	10	11	14
Other Electronics	12	14	10	13	12
Medical	6	6	8	8	9
Other Products/Services	10	7	6	7	8
Consumer-related	5	5	9	7	7
Commercial Communications	-	-	3	4	7
Industrial Automation	4	3	3	3	4
Genetic Engineering	7	3	3	2	4
Industrial Products/Machines	5	4	3	3	3
Energy Related	10	6	3	2	1
TOTAL	100	100	100	100	100

SOURCE: Venture Capital Journal (various years)

The Startup Phase

Once the business plan is accepted, capital is infused into the new enterprise. In return, venture capitalists receive a significant ownership stake in the new company, ranging from 10 percent to 90 percent, though 51 percent is common. By opting for equity investment over traditional debt financing, venture capitalists and their portfolio companies eliminate the problem of scheduled repayment. Loans that are made to new businesses generally carry high interest rates and short terms. Repayment can be an onerous burden for young companies which require substantial inflows of capital during early growth stages and, therefore, cannot afford sizeable outflows to cover interest and principal payments. In addition, the loan officers employed by banks frequently do not understand the technical dimensions of high technology business formation.³⁴ In contrast, equity investment allows young companies to reinvest all earnings in the company and provides an asset base which can be used to attract outside capital and enhance a company's credibility with vendors, suppliers, and traditional financial institutions.

Equally as important as the funding provided by venture capitalists is the significant management assistance they render to small, technology-intensive businesses. Generally, venture capitalists attempt to foster the growth of new companies with advice rather than becoming actively involved in the time-consuming, daily management of the company. (Although if a venture capitalist believes that a venture is headed for disaster under the original founders, the venture capitalist will step in and assume control over a firm's operation.) Along with their equity in the corporation, venture capitalists commonly gain active representation on the corporate board of directors. Donald Valentine has termed venture capitalists' "managerial" contribution "intelligence equity," which he defines as "experience the companies don't have, contacts they don't have, perspectives they don't have."³⁵ Venture capitalists' substantial experience and extensive contacts help new companies secure legal counsel, patent attorneys, accounting services, outside technical experts, public relations consultants, and a wide variety of ancillary business services, as well as locate office or production facilities.

The provision of financing from a reputable venture firm in established technology regions, like Silicon Valley or Route 128, can function as a "seal of approval" for new companies which need to establish working relationships with suppliers, financial institutions and related businesses. Venture capitalists may also organize strategic partnerships between portfolio companies and larger corporations through technology exchanges, original equipment manufacturer, other customer agreements, and minority equity investments.

Perhaps the most crucial contribution to a new firm's development by a venture capitalist is its recruitment of managers for business start-ups. To assist with such efforts, most venture firms have executive search firms on retainer. A recent survey of 77 important venture capital firms indicates that the venture capital community views management

³⁴ U.S. Small Business Administration, The State of Small Business: A Report to the President, U.S. Government Printing Office, Washington, DC, 1986.

³⁵ "Peaks and Valleys," INC., May 1985, pp. 46-47.

recruitment as the single most important form of assistance provided to young companies.³⁶ Indeed, the Mayfield Fund has recently added a "recruiting partner" who specializes in filling management positions at portfolio companies.³⁷ Venture capitalists often lure top-level personnel from secure academic or corporate posts by offering them equity stakes in fledgling businesses and the concomitant possibility of realizing large capital gains, in return for their expertise.

Building a Business

The role of venture capitalists changes as new businesses and technologies proceed through the business development cycle (Figure 3.1). Over time, technological and entrepreneurial skills diminish in importance relative to managerial and marketing capabilities, and the young company establishes a more formal organizational structure. At this stage, the role of the venture capitalist shifts from active intervention to one of advice and assistance. The venture capitalist's expertise in particular industries and prior experience with business expansion provides a reservoir of knowledge which can be critical for the survival of a growing company. "Real value is added in a venture activity," according to Arthur D. Little, "not on the front or buy end and not on the back or sell end, but through working with people in the company in the middle."³⁸ At times, some venture capital funds may also encourage collective problem solving by managers of portfolio companies, creating an intensive information exchange among entrepreneurs which eliminates or diminishes the severity of many problems associated with new business development.

The relationship between venture capitalists and the companies they finance is not always devoid of conflict. Although venture capitalists and entrepreneurs typically work together to build new companies, the reasons that they do so are often quite different. Of primary importance to venture capitalists are the profits or capital gains made on investments. While entrepreneurs are also interested in financial gain, they are also likely to be driven by some combination of profit, long term economic security, sense of mission, and attachment to their enterprise. These differences may underscore more obvious disagreements which can at times lead to bitter confrontations over corporate policy. In such cases, venture capitalists can use their control of board positions or leverage over further rounds of financing to coerce management to make changes or to remove the founder or entrepreneurial group. If disagreements are serious enough, venture capitalists will endeavor to replace managers. In some instances, the venture capitalists may assume

³⁶ D. Case, "An Overview of Venture Capital," (unpublished paper, Hambrecht and Quist, San Francisco, 1986).

³⁷ T. Davis, General Partner in the Mayfield Fund, interview with authors, December, 1986.

³⁸ Claudia M. Christie, "Venture Capitalist as Private Detective," *New England Business*, March 18, 1985, p. 93.

direct operating positions themselves, though our interviews lead us to conclude that they will do so only in the most dire situations.

Investment Syndicates and Coinvesting

Venture capital-financed start-up investments increasingly occur with the involvement of multiple venture capital firms. Our interviews with venture capitalists suggest that the most highly regarded investments are "self-organizing"--that is, two or more venture capital firms will simultaneously evaluate a potential investment and mutually agree to invest and form a syndicate.³⁹

Investment syndication or "coinvesting" links venture capital firms together in local, regional and national networks. According to the Congressional Joint Economic Committee, approximately 90 percent of all venture capital investments involve syndicates. This process enables venture capitalists to pool expertise, diversify their portfolios, and share information and risk. Coinvestment is also a mechanism by which venture capital firms ensure themselves of a steady stream of quality investment opportunities, exchanging a portion of a current deal flow for consideration in future investments.

Venture capital firms use investment syndicates to secure additional rounds of financing for new companies. The original lead investor may arrange two or three investment syndications involving as many as 15 other investors. Lead investors typically use personal networks to secure coinvestors, trading opportunities to participate in each others investments. While investment syndications are primarily accomplished to provide capital, venture capitalists typically seek coinvestors with complementary skills and supplementary contacts.

Bringing Companies to Market and Other Forms of Exit

Venture capitalists' participation in new businesses culminates when they "exit" from their investments. This is typically accomplished through a public stock offering or upward merger that transforms investments into liquid capital. Between 1978 and 1984, nearly 300 venture backed companies were brought into the market for initial public offerings (or IPOs).⁴⁰ The push to go public is embedded in the very structure of the venture capital industry. The more quickly investment portfolios are liquidated (at high multiples of the original investment) and the limited partners receive their return, the sooner the venture capitalist can launch another fund.

There is a significant economic rationale for this. Venture capitalists usually receive a management fee of approximately 2 percent to 3 percent of paid-in capital per year. Since this management fee only covers salaries and business expenses, the payoff for the professional venture capitalist comes after returning an agreed upon percentage to the

³⁹ W. Burgin, General Partner of Bessemer Venture Partners, interview with authors, June, 1987.

⁴⁰ H. Soussou, "Note on the Venture Capital Industry -- Update," Harvard Business School, Cambridge, Mass., No. 0-286-060, 1985.

limited partners, at which point an override share of approximately 20 percent of further profit is retained by the general partner.

The large potential return provided by equity financing enables venture capitalists to assume substantial investment risks since one enormously successful investment can more than offset a series of break-even investments or outright losses. A study of the performance of 10 leading venture capital funds indicates that of 525 separate investments made during the period 1972-1983, just 56 "winners" (or 10.7 percent) generated more than half (\$450 million) of the total value held in portfolio (\$823 million), while roughly half (266) either broke even or lost money.⁴¹

Summary

The intervention of venture capitalists in the early life of a firm has proved essential to the success of new, technology-oriented companies. Venture capitalists provide managerial, marketing, legal, financial and other types of experience that most likely would be unavailable through conventional sources of funding. In doing so, venture capitalists function as catalysts in the evolution of new technologies, new businesses, and even entirely new industries. The next chapter elaborates on these themes, providing a conceptual basis from which to understand venture capital's role in technological innovation.

⁴¹ Unpublished study by the consulting firm Horsley, Keough and Associates.

CHAPTER 4

VENTURE CAPITAL AND TECHNOLOGICAL INNOVATION

Introduction

Venture capitalists play a critical role in the process of technological innovation by helping to organize embryonic technology. They sit at the center of multifaceted networks of financial institutions, large corporations, universities, and entrepreneurs, and in doing so, forge important linkages between large and small institutions. Venture capital serves in large measure to formalize the roles historically played by the entrepreneur and independent financier, and lend structure to the innovation process and attendant "gales of creative destruction" that are so vital to the wave-like expansions of capitalist societies.⁴²

This chapter provides a conceptual basis for thinking about how venture capital affects the process of technological innovation. Basically, we believe the rise of venture capital has transformed the innovation process, organizing and lending structure to the process of entrepreneurial innovation. We develop the concept of venture capital-financed innovation to explain how venture capitalists accelerate the process of entrepreneurial technological change and help to overcome the financial, technological and organizational barriers that often stymie innovation.

Entrepreneurial versus Corporate Innovation: The Schumpeterian Tradition

The rise of venture capital has dramatically transformed the way that innovation takes place. Economists working in the tradition of Joseph Schumpeter have traditionally made a distinction between entrepreneurial and corporate forms of innovation.⁴³ Under entrepreneurial innovation, individual entrepreneurs or entrepreneurial groups drive the innovation process. These actors either utilize ideas drawn from science or employ technical know-how to launch new products and forge new product markets. The technological and organizational changes brought about by these innovations generate strong bandwagon effects which lead to the creation of new industries, the revitalization of some older ones, and the disappearance of still others.

Under corporate innovation, large corporations organize R&D within specialized research laboratories, thereby internalizing innovation. These corporations use internal R&D to remain at the forefront of new technology and to generate successive waves of innovation.

⁴² The idea of "gales of creative destruction" is, of course, associated with Schumpeter. See J. Schumpeter, The Theory of Economic Development, Harvard University Press, Cambridge, MA, 1934; and J. Schumpeter as abridged by Reindig Fels, Business Cycles, McGraw-Hill, New York, 1964. A concise summary of the Schumpeterian schema is provided by N. Rosenberg and C. Frischtak, "Technological Innovations and Long Waves," Cambridge Journal of Economics 8, 1984, pp. 7-24.

⁴³ See C. Freeman, J. Clark, and L. Soete, Unemployment and Technical Innovation, Francis Pinter, London, 1982; R. Rothwell, "Venture Finance, Small Firms and Public Policy in the U.K.," Research Policy, v.4 1985, pp. 253-65.

According to Christopher Freeman and his colleagues at the Science Policy Research Unit, this creates "a strong positive feedback loop from successful innovation to increased R&D activity, setting up a virtually self-reinforcing circle."⁴⁴ The internalization of innovation within large corporations makes technological change a less sporadic, more continuous process.

Dynamic Complementarity

Recently, a number of analysts have advanced the idea that a complementarity exists between large and small institutions. According to this view, large corporations and universities establish the scientific and technological context necessary for innovation, functioning as "incubator organizations" for technological change. These technological opportunities are then exploited and commercialized by small entrepreneurial companies. Such interplay is facilitated by direct circulation of personnel and transfers of technological and managerial capabilities, as well as through indirect channels such as informal exchanges of information, research literature, and professional relations among manufacturers, suppliers, and vendors.⁴⁵ Large organizations and small firms thus act in a dynamic and complementary way as part of the innovation process.⁴⁶

Venture Capital-Financed Innovation: A New Conception

Our findings lead us to believe that the venture capital industry has given rise to a new model of innovation, which we refer to as venture capital financed innovation. This combines elements of both corporate and entrepreneurial innovation, fostering dynamic complementarities between the two. Networks are the critical element of venture capital-financed innovation. Venture capitalists are situated at the center of extended networks, where they forge connections among large corporations, universities, financial institutions, and a variety of other organizations. From this central vantage point, venture capitalists are

⁴⁴ C. Freeman, J. Clark and L. Soete, Unemployment and Technical Innovation, Francis Pinter, London, 1982.

⁴⁵ E. Roberts and O. Hauptman, "The Process of Technology Transfer to the New Biomedical and Pharmaceutical Firm," Working Paper, Sloan School of Management, MIT, Cambridge, Mass., 1985; T. Allen, D. Hyman and D. Pinckney, "Transferring Technology to the Small Manufacturing Firms: A Study of Technology Transfer in Three Countries," Research Policy 12, 1983, pp. 199-211.

⁴⁶ For discussion of strategic partnering, see D. Teece, "Capturing Value from Innovation: Integration, Strategic Partnering and Licensing Decisions," Working Paper, Center for Research Management, University of California, Berkeley, 1986. D. Teece, "Innovation, Trade and Economic Welfare: Contrasts Between Petrochemicals and Semiconductors," Center for Research Management, University of California, Berkeley, 1985. J. Friar and M. Horowitch, "The Emergence of a Technology Strategy: A New Dimension of Strategic Management," Technology in Society 7, 1986, pp. 143-78. H. Brooks, "Can Science and Technology Rescue the Faltering U.S. Economy," unpublished paper, Harvard University, Cambridge, Mass., 1986.

uniquely equipped to match personnel and resources drawn from various organizations in the formation of new enterprises.

Venture Capital Networks

Venture capital's position within the innovation process can best be thought of in terms of four overlapping networks.⁴⁷ Figure 4.1 illustrates the role of venture capital in forging these networks. The first network is used to mobilize capital. This network consists of investors in the venture capital fund (i.e., institutional investors and wealthy individuals) and other venture capital firms that take part in investment syndicates. A second network is used to locate and review potential investments, and revolves around previously successful entrepreneurs, other venture capitalists, lawyers, and accountants, as well as contacts in large corporations and universities. The role of former entrepreneurs in this network is especially important since they have contacts that typically extend to the most promising potential start-ups. A third network cultivated by venture capitalists includes professional service firms such as law and accounting firms, as well as market research firms and consulting firms which serve as sources for industry relevant information. A final network is composed of sources of labor and other important inputs into the production process. It consists of contacts that are used to recruit management and other personnel for start-ups, as well as sources for inputs into the production process and possible outlets for finished goods.

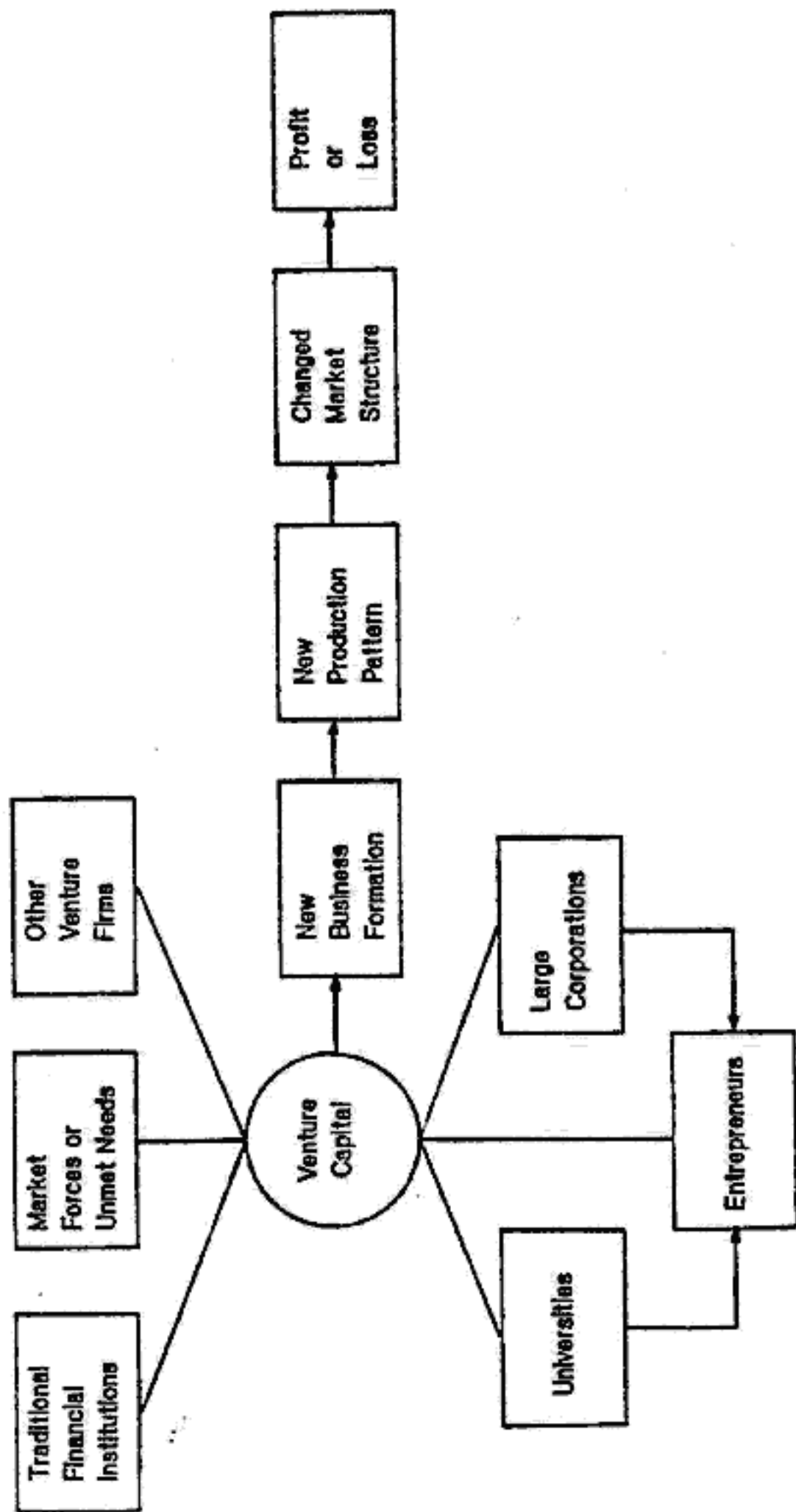
Venture capital-financed innovation overcomes many of the obstacles associated with the entrepreneurial and corporate models of innovation. Under entrepreneurial innovation, innovation occurs in an ad hoc and unorganized way. The individual entrepreneur is forced to organize the process of enterprise formation--locate financing, purchase supplies, obtain facilities, etc.--virtually singlehandedly. As we have seen, venture capitalists bring resources and contacts to this process which help reduce the information and opportunity costs associated with new business formation. And, by reducing the uncertainty involved in enterprise creation as well as providing the needed financial resources, they create a "spot market" of sorts for business formation and development.

Corporate innovation is often impaired by the organizational rigidity of large corporations--what Rosabeth Kanter refers to as "segmentalism."⁴⁸ Venture capital-financed innovation replaces the functional specialization and compartmentalized information flow characteristic of large corporations with a relatively fluid and flexible organizational environment. This flexible environment is characterized by frequent adjustment, decentralized decision making, and intense flows of information. This occurs both within and, to a lesser extent, between venture capital-backed companies, creating significant incentives for innovation. The emergence of venture capital-financed innovation represents

⁴⁷ The concept of venture capital in terms of networks has been suggested in L. Suran, M. Maidique, and D. Smith, "The Venture Capital Industry in Florida and the Southeast: In Search of the Seed," Research Paper, Innovation and Entrepreneurship Institute, University of Miami, Coral Gables, Florida, 1986.

⁴⁸ R. Kanter, *The Change Masters*, Simon and Schuster, New York, 1984.

FIGURE 4.1



Venture Capital in the Institutional Framework for Innovation

a partial response to the breakdown of innovation in large U.S. corporations. This breakdown is evident in the inability of large corporations to provide either the organizational flexibility or incentives necessary to stimulate internal innovation. It is perhaps most visibly reflected in the rise of self-contained "innovation complexes," such as California's Silicon Valley and Boston's Route 128, far afield from traditional sources of heavy industry.

Venture Capitalists as Technological Gatekeepers

In organizing many of the elements necessary for technological innovation, venture capitalists function to a large extent as "technological gatekeepers"--setting the direction of technological change.⁴⁹ The idea of "natural" or "technological" trajectories suggests that the given path of technological development both channels and constrains future technological progress.⁵⁰ The organizational and institutional context of society acts as an additional constraint on technological change.⁵¹ Since innovation and technological change take place largely within these relatively fixed constraints, only critical technological or organizational breakthroughs can disrupt existing socio-technical pathways and open up new technological frontiers. Robert Ayres makes this point quite succinctly:

Major new technological opportunities seem to occur, in general, when a critical barrier or constraint is breached..... Specifically, opportunities are greatest just after a "breakthrough" and smallest as a new barrier is approached. The territory beyond such a barrier is little known, at first, because either the means or the motives for exploring it were lacking. But once the barrier is surmounted all is changed, a "new" territory is suddenly open for exploration and dominion.⁵²

⁴⁹ A sizable body of neo-Schumpeterian research focuses on the relationship between innovation and economic expansion. See G. Mensch, Stalemate in Technology, Ballinger Press, Cambridge, MA, 1979; J. Van Dujin, "Fluctuations in Long Waves over Time," in Christopher Freeman (editor), Long Waves in the World Economy, Francis Pinter, London, 1984; S. Solomou, "Innovation Clusters and Kondratieff Long Waves in Economic Growth," Cambridge Journal of Economics v.10, 1986; and C. Freeman et al.

⁵⁰ On natural trajectories, see R. Nelson and S. Winter, An Evolutionary Theory of Economic Change, Harvard University Press, Cambridge, MA, 1982. On technological trajectories, see G. Dosi, "Technological Paradigms and Technological Trajectories," Research Policy v.2, 1982.

⁵¹ C. Freeman et al.; also, C. Freeman and C. Perez, "The Diffusion of Technological Innovation and Changes of Techno-Economic Paradigm," presented at the Conference on Innovation Diffusion, Venice, Italy, 17-22 March 1986. Recent work by the Marxist regulation school of political economy makes a similar point, see M. Aglietta, A Theory of Capitalist Regulation, New Left Books, London, 1979; P. Blackburn, R. Coombs and K. Green, Technology, Economic Growth and the Labor Process, St. Martin's Press, New York, 1985; A. Roobeek, "The Crisis in Fordism and the Rise of a New Technological Paradigm," Futures, forthcoming. Also, M. Piore and C. Sabel, The Second Industrial Divide, Basic Books, New York, 1984.

⁵² R. Ayres, "Technological Progress in Economics and Theories of Innovation," unpublished paper, Department of Engineering and Public Policy, Carnegie Mellon University, Pittsburgh, 1986, pp. 16-18.

Venture capitalists are a crucial part of the context within which such breakthroughs occur. Due to the intensive flows of information at their disposal, venture capitalists are well positioned to spot the opportunities that arise as critical barriers are breached. It is at these junctures that they perform a "gatekeeping" function, by intervening to help create new companies and actualize important breakthroughs. At the same time, they are able to capture the "economic rents" that come from being first across such boundaries. Although only a small subset of all venture investments ultimately pay off, the most important choices or "technological bets" made by venture capitalists in fields such as semiconductors, personal computers, and biotechnology have disrupted existing socio-technical trajectories and opened up whole new frontiers for technological progress, setting the stage for clusters of imitative activity and swarms of improvements and innovations.

This does not imply that large corporations are unimportant in placing technology bets. The historic role played by Bell Laboratories in pioneering a series of important innovations in the U.S. is exemplary. However, recent years have seen large corporations recede from directly innovative activity, although they certainly help to establish the technological base from which innovative activity can originate. This is in part the result of venture capital-based innovation which has generated increased incentives for employees to leave large corporations.

In short, venture capital-financed innovation is more than just a mid-point between entrepreneurial and corporate models of innovation. By organizing and capitalizing on the complementary strengths of a variety of organizations, venture capital-driven investment presents a new integrative model of innovation. In addition, venture capital-financed innovation plays an important technological gatekeeping function--moving the U.S. economy across new technological frontiers and setting in motion the "gales of creative destruction" which establish the context for economic restructuring.

Examples of Venture Capital-Financed Innovation

The operation of this new model of venture capital-financed innovation can be illustrated through some case examples.

The Semiconductor Industry

The linkage between large corporations and venture backed companies is clearly evident in the semiconductor industry. The basic technology used in semiconductors was developed at Bell Laboratories during the 1950s by William Shockley, Gordon Teal and their collaborators. In 1951, Teal left Bell Labs to join Texas Instruments, and in 1954 Shockley left to launch his own firm. The establishment of Fairchild Semiconductor in 1957 by Eugene Kleiner, Robert Noyce, and six other of Shockley's former employees catalyzed the nascent semiconductor industry. Fairchild was one of the first important venture capital backed start-ups. Its financing was arranged by Arthur Rock, who was then an investment

banker with a prominent New York city firm.⁵³ Fairchild laid crucial groundwork for the genesis of the Silicon Valley innovation complex, becoming an important "incubator organization" both for entrepreneurial spinoffs and venture capitalists. Fairchild alumnus Jerry Sanders launched Advanced Micro Devices on 1967. That same year Robert Noyce, Andy Grove, and Gordon Moore left Fairchild to found Intel with backing from Rock. Rock also provided venture capital for Intersil, Inc. which was started by Jean Hoerni, another of Fairchild's original founders.⁵⁴

In the early 1980s, another group of top Fairchild executives, led by then president Wilfred Corrigan, left Fairchild to launch LSI Logic, a leading producer of custom semiconductors. According to recent estimates, more than 80 semiconductor startups can trace their origin to Fairchild. Moreover, Fairchild alumni have also gone on to form prominent venture capital partnerships. Eugene Kleiner, one of Fairchild's founding eight, is a key principal in Kleiner Perkins, while Donald Valentine runs the Sequoia Partnership.

The Personal Computer Industry

Venture capital was of vital importance to the birth of the personal computer industry. Personal computers were virtually ignored by large companies as late as the mid-1970s, when only a handful of small entrepreneurial companies were in this embryonic market. At this point, the founders of Apple Computer, Steven Jobs and Stephen Wozniak, were building machines in a garage for sale to a small market composed mostly of acquaintances. In 1977, the venture capitalist Donald Valentine provided seed capital for the new company and used his connections to link the two entrepreneurs to "Mike" Markkula, a seasoned technology manager who had worked at both Fairchild and Intel.⁵⁵ Valentine then convinced the more prominent venture firm, Venrock, to invest in Apple and more investors were added at later stages. By linking entrepreneurs to financing sources and qualified managers, venture capital played an important role in opening the new market for personal computers.

The Biotechnology Industry

The biotechnology industry provides an example of the proactive role played by venture capital. Although a series of scientific breakthroughs occurred during the early 1970s, creating the possibility for commercial biotechnology, few actors realized the economic potential of this new technology. In 1976, the venture capitalist Robert Swanson

⁵³ For a history of Fairchild Semiconductor, see E. Braun and S. MacDonald, Revolution in Miniature: The History and Impact of Semiconductor Electronics, second edition, Cambridge University Press, New York, 1982. On venture capital role, see J. Wilson, The New Venturers, Addison-Wesley Publishing, Reading, MA, 1985, pp. 33-34.

⁵⁴ See Wilson, p. 38.

⁵⁵ On the personal computer industry, in particular Apple, see J. Friar and M. Horwitch. Also, see E. Rogers and J. Larsen, Silicon Valley Fever, Basic Books, New York, 1984, pp. 11-14; T. Forrester, High Tech Society, MIT Press, Cambridge, MA, 1987.

left his position at Kleiner Perkins to become a cofounder of Genentech with Dr. Herbert Boyer, a prominent molecular biologist from the University of California. Swanson had been involved with the biotechnology field as manager of Kleiner's investment in Cetus Corporation. In this capacity, he had learned about the important scientific breakthroughs in biotechnology. Swanson and Boyer received an initial \$100,000 from Kleiner Perkins to fund what could still be considered basic research and launch their new company.⁵⁶

The rapid success of Genentech and other small biotechnology companies provided the impetus for large chemical and pharmaceutical companies to enter the biotechnology field. Due to the small companies' lead and because most large companies were unable to recruit topnotch scientific talent, large companies were forced to establish "strategic partnerships" with small start-ups. Large companies also utilized venture capital subsidiaries to locate potential strategic partners. For example, Lubrizol made significant venture investments in both Genentech and Agrigenetics; Monsanto utilized its joint venture capital concern with Emerson Electric--Innoven Corporation--to invest in Biogen, Inc.; while Martin Marietta invested directly in Molecular Genetics and Chiron.

Currently, there are over 400 biotechnology firms operating in the United States, mostly new, venture capital-backed startups.⁵⁷ The rapid commercialization of biotechnology was due in large measure to the capacities of venture capitalists to recognize and capitalize on the economic potential of "breakthrough" innovations, based on the experience they had gained in investments in other high technology industries. In contrast to the semiconductor and personal computer industries where venture capital was essentially provided to embryonic enterprises after the basic technology had been proven, venture capital played a more formative role in the biotechnology industry--seizing the commercial opportunities opened up by developments in biochemistry, such as recombinant DNA. This is illustrative of a more general trend in the evolution of venture capital-financed innovation from a reactive to proactive role in the process of technological change.

Venture capital's "discovery" of biotechnology has meant that venture capitalists have been willing to assume a greater amount of risk and an even longer view of their investments. In other advanced technology industries, venture-backed companies usually succeed in commercializing a product within a few years of the initial investment, and may be expected to produce a return for the investor in 5 to 7 years. In contrast, development of commercial biotechnology products has proceeded much slower. This is in part because the science involved is at an early stage of development. Consequently, returns to the venture capitalists are more uncertain and more distant, and the risks greater.

Summary

⁵⁶ For further detail on the biotechnology industry, see M. Kenney, Biotechnology: The University-Industry Complex, Yale University Press, New Haven, 1986; M. Kenney, "Schumpeterian Innovation and Entrepreneurs in Capitalism: The Case of the U.S. Biotechnology Industry," Research Policy v.15, 1986, pp. 21-31.

⁵⁷ Mark Crawford, "Biotechnology's Stock Market Blues," Science v. 238, 11 December 1987, p. 1503.

The emergence of a formalized venture capital industry has transformed the nature of innovation. Venture capital-financed innovation overcomes a variety of barriers that obstruct technological progress including: the risk aversion of established financial markets, the organizational inertia of large corporations, and the multifaceted technological, organizational, and financial requirements of new business development. Generally speaking, venture capital-financed innovation accelerates the processes of technological innovation by combining resources and personnel drawn from a variety of organizations. In addition, venture capital-financed innovation occupies a particular niche in the technology cycle. It is of special importance during the early and chaotic stages of a technological thrust when the nature of nascent technology, its applications and market potentials are in flux.

Venture capitalists are agents of innovation, performing a technological gatekeeping function. They are not omniscient with regard to technological change but draw their power from the wide ranging contacts and networks at their disposal. As focal points of social structures of innovation, they organize the myriad transactions and reduce the uncertainty associated with new business formation. In doing so, they catalyze the dynamic complementarities which exist between large corporations, universities, small companies, and a variety of related organizations.

PART II.

THE GEOGRAPHY OF VENTURE CAPITAL

CHAPTER 5

WHERE IS VENTURE CAPITAL? THE LOCATION OF VENTURE CAPITAL RESOURCES

Introduction

Venture capital is tightly concentrated in a few, distinct pockets across the United States. Surprisingly, little research has been done either on the empirical dimensions of venture capital agglomeration or on the determinants of such clustering.⁵⁸ As noted in Chapter 1, the most recent geographic and regional development literature describes the clustering of venture capital activity; however, it provides little insight into or understanding of the differences among the various venture capital centers.⁵⁹ This lack of understanding of the regional dimensions of the venture capital industry extends well beyond academia. It is clearly reflected in the conventional wisdom that has informed public policy makers of late, i.e., the implication that high technology economic development can be achieved simply by overcoming the "regional gaps" in venture capital availability.

This chapter changes the focus of our analysis from venture capital's role in the overall process of technological innovation and new business formation to a detailed look at the geography of venture capital activity. In the following sections we provide a detailed examination of the places where venture capital is concentrated. This chapter uses two basic indicators of venture capital: (1) total dollar amount of active venture capital funds and (2) the number of venture capital offices within a given area. The first provides a measure of resource concentration, while the second provides a measure of the number of potential venture investors. Both indicators are adopted from data published in *Venture Economics' Venture Capital Journal* and other sources. The first part of the chapter summarizes our findings on the geographic concentration of venture capital at the regional, state, and metropolitan levels. The second part looks in detail at patterns within each region. A listing of our data is provided in the appendix following this chapter.

The major findings of this chapter are that venture capital is highly concentrated at the regional, state, and metropolitan levels. Figure 5.1 illustrates and compares the degree of industry concentration on three geographical levels: two prominent regions, the three leading states, and the leading metropolitan complexes. The Northeast and Pacific regions

⁵⁸ A. Bean, D. Schiffl, and M. Moguee, "The Venture Capital Market and Technological Innovation," *Research Policy* 4, pp. 380-408. G. Kozmetsky, M. McGill and R. Smilor, *Financing and Managing Fast-Growth Companies: The Venture Capital Process*. Lexington Books, Lexington, MA, 1985. J. Timmons, N. Fast, and W. Bygrave, "The Flow of Venture Capital to Highly Innovative Technological Ventures," *Frontiers of Entrepreneurship Research 1983*, J. Hornaday, J. Timmons, and K. Vesper, editors, Center for Entrepreneurial Studies, Wellesley, MA, 1983.

⁵⁹ M. Green and R. McNaughton, "Patterns of Venture Capital Investment in the United States," University of Western Ontario, Ontario, Canada, 1987. T. Leinbach and C. Amrhein, "A Geography of the Venture Capital Industry in the United States," *Professional Geographer* 39, May 1987, pp. 146-58.

together account for 78 percent of all venture capital resources. Furthermore, just three states--California, New York, and Massachusetts--control 70 percent of the national venture capital pool. Within these states, just three metropolitan areas (San Francisco, New York City, and Boston) are home to approximately 60 percent of the nation's venture capital resources. This is made clear in the national maps portrayed in Figure 5.2 and Figure 5.3 showing the location of venture capital resources and venture capital offices, respectively. The tight clusters or complexes of venture capital are readily apparent here, particularly in San Francisco/Silicon Valley and Los Angeles in the West, Chicago in the Midwest, and New York and Boston in the Northeast.

Regional Concentration of the Venture Capital Industry

Venture capital is concentrated in two broad regions of the country, the Northeast and Pacific. Over the past decade, the proportion of venture capital resources controlled by these two regions has remained fairly constant. In 1987, the Northeast and Pacific regions accounted for slightly more than three-quarters of all venture capital resources, and roughly two-thirds of all venture capital offices. During the past decade or so, there has been a definite shift in venture capital resources from the East to the West Coast. The Pacific increased its share of venture capital resources from 21 percent to 32 percent, while the Northeast's share declined from 55 percent to 46 percent (Table 5.1).

Since 1973, the Pacific increased its share of offices from 18 percent to 28 percent, while the Northeast's share declined from 49 percent to 37 percent.(Table 5.2) Most of the shift from the East to the West Coast is attributable to the dramatic rise of the Pacific region, especially California. Between 1977 and 1987, California increased its share of venture capital resources from 21 percent to 30 percent, while New York's share declined from 28 percent to 22 percent (see Table 5.3). This shift is further evidenced by West Coast branching activity of East Coast venture funds. New York venture capitalists have opened 34 branch offices in the United States, 19 of which are in California. Boston venture capitalists currently maintain 18 branch offices, 10 of which are located in California. In contrast, few California venture capitalists have established branch offices on the East Coast; in fact, most of their branch offices are within California itself.

It is also important to note that one or two states typically dominate their respective regions. California, for example, accounts for 94 percent of the Pacific region's venture capital resources and 90 percent of its offices. Similarly, New York and Massachusetts together control 80 percent of the Northeast region's venture capital resources and 68 percent of its offices. Texas is home to 93 percent of the venture capital resources in the Gulf Coast region; Colorado controls 80 percent of the Mountain region's resource base; and Illinois accounts for almost 50 percent of the Midwest's venture capital pool.

Concentration of Venture Capital in the States

The venture capital industry is extremely concentrated at the state level as well. Figure 5.2 is a map showing the state-by-state concentration of venture capital resources. California is the leading state for venture capital resources with \$8.7 billion in 1987,

together account for 78 percent of all venture capital resources. Furthermore, just three states--California, New York, and Massachusetts--control 70 percent of the national venture capital pool. Within these states, just three metropolitan areas (San Francisco, New York City, and Boston) are home to approximately 60 percent of the nation's venture capital resources. This is made clear in the national maps portrayed in Figure 5.2 and Figure 5.3 showing the location of venture capital resources and venture capital offices, respectively. The tight clusters or complexes of venture capital are readily apparent here, particularly in San Francisco/Silicon Valley and Los Angeles in the West, Chicago in the Midwest, and New York and Boston in the Northeast.

Regional Concentration of the Venture Capital Industry

Venture capital is concentrated in two broad regions of the country, the Northeast and Pacific. Over the past decade, the proportion of venture capital resources controlled by these two regions has remained fairly constant. In 1987, the Northeast and Pacific regions accounted for slightly more than three-quarters of all venture capital resources, and roughly two-thirds of all venture capital offices. During the past decade or so, there has been a definite shift in venture capital resources from the East to the West Coast. The Pacific increased its share of venture capital resources from 21 percent to 32 percent, while the Northeast's share declined from 55 percent to 46 percent (Table 5.1).

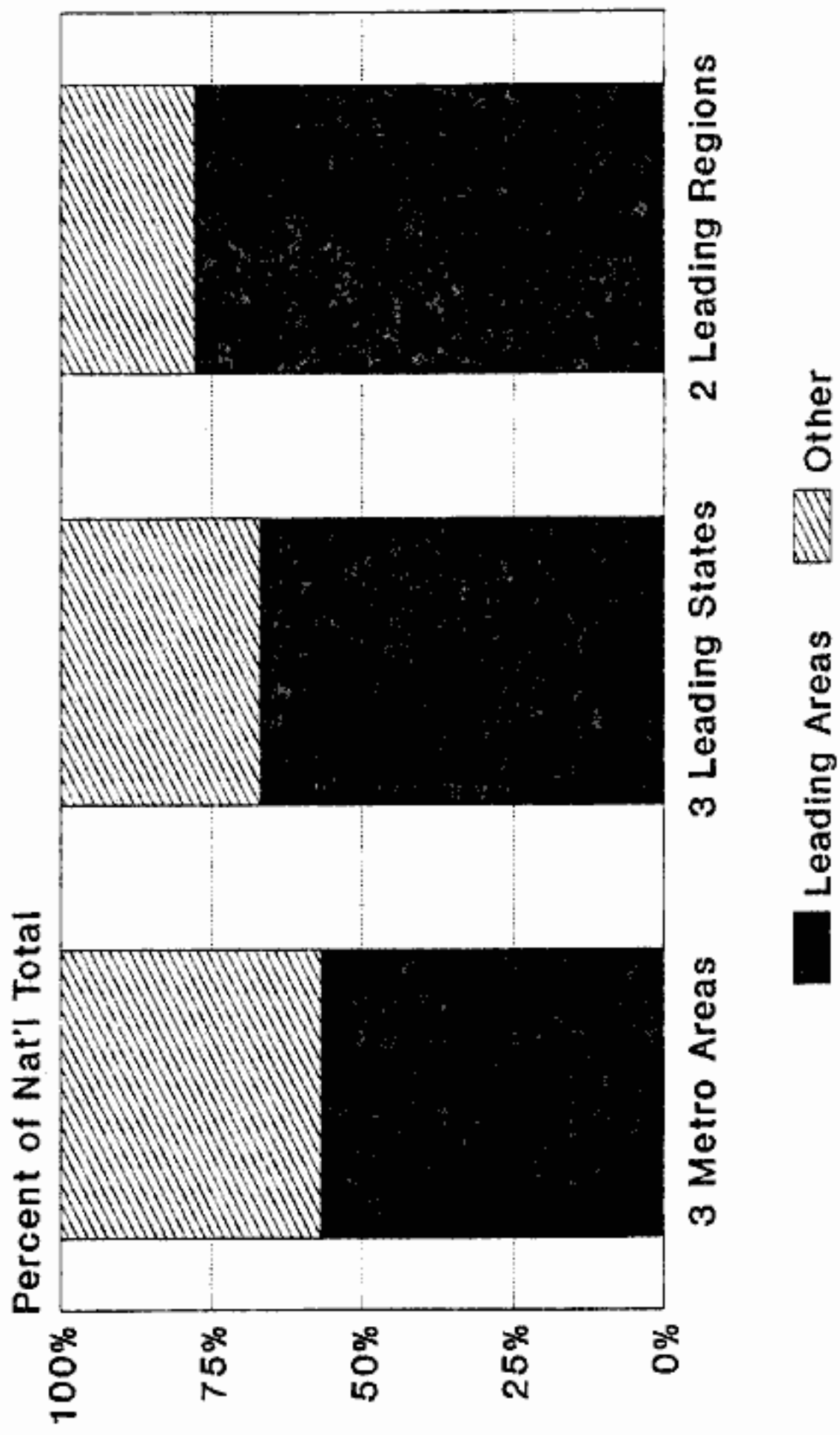
Since 1973, the Pacific increased its share of offices from 18 percent to 28 percent, while the Northeast's share declined from 49 percent to 37 percent.(Table 5.2) Most of the shift from the East to the West Coast is attributable to the dramatic rise of the Pacific region, especially California. Between 1977 and 1987, California increased its share of venture capital resources from 21 percent to 30 percent, while New York's share declined from 28 percent to 22 percent (see Table 5.3). This shift is further evidenced by West Coast branching activity of East Coast venture funds. New York venture capitalists have opened 34 branch offices in the United States, 19 of which are in California. Boston venture capitalists currently maintain 18 branch offices, 10 of which are located in California. In contrast, few California venture capitalists have established branch offices on the East Coast; in fact, most of their branch offices are within California itself.

It is also important to note that one or two states typically dominate their respective regions. California, for example, accounts for 94 percent of the Pacific region's venture capital resources and 90 percent of its offices. Similarly, New York and Massachusetts together control 80 percent of the Northeast region's venture capital resources and 68 percent of its offices. Texas is home to 93 percent of the venture capital resources in the Gulf Coast region; Colorado controls 80 percent of the Mountain region's resource base; and Illinois accounts for almost 50 percent of the Midwest's venture capital pool.

Concentration of Venture Capital in the States

The venture capital industry is extremely concentrated at the state level as well. Figure 5.2 is a map showing the state-by-state concentration of venture capital resources. California is the leading state for venture capital resources with \$8.7 billion in 1987,

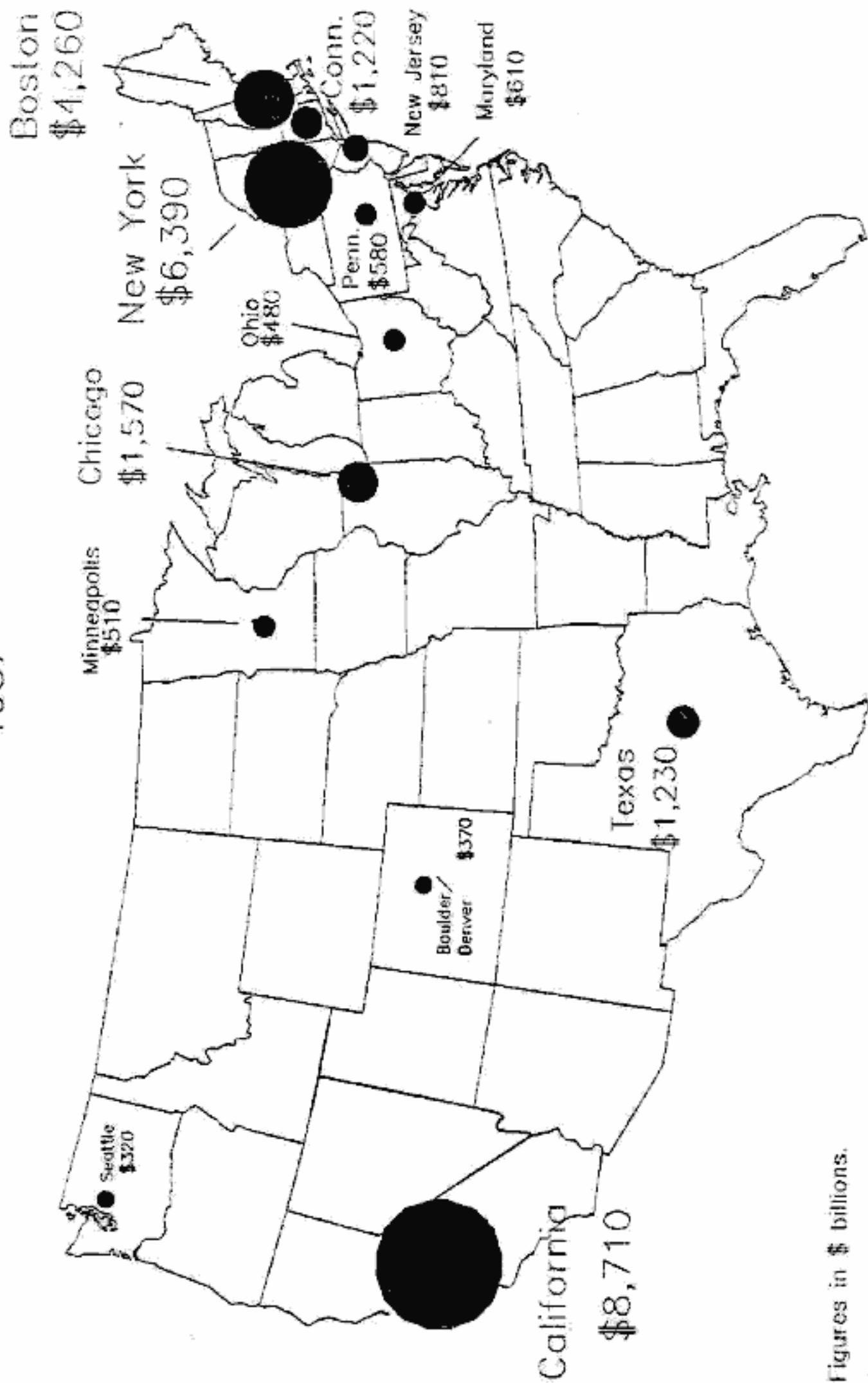
Figure 5.1
**Concentration of Venture Capital
 Leading Metro Areas, States, Regions**



Metro areas: San Fran/Silicon Valley, NYC, Boston.
 States: California, New York, Massachusetts.
 Regions: Northeast, Pacific.

FIGURE 5.2

VENTURE CAPITAL RESOURCES 1987



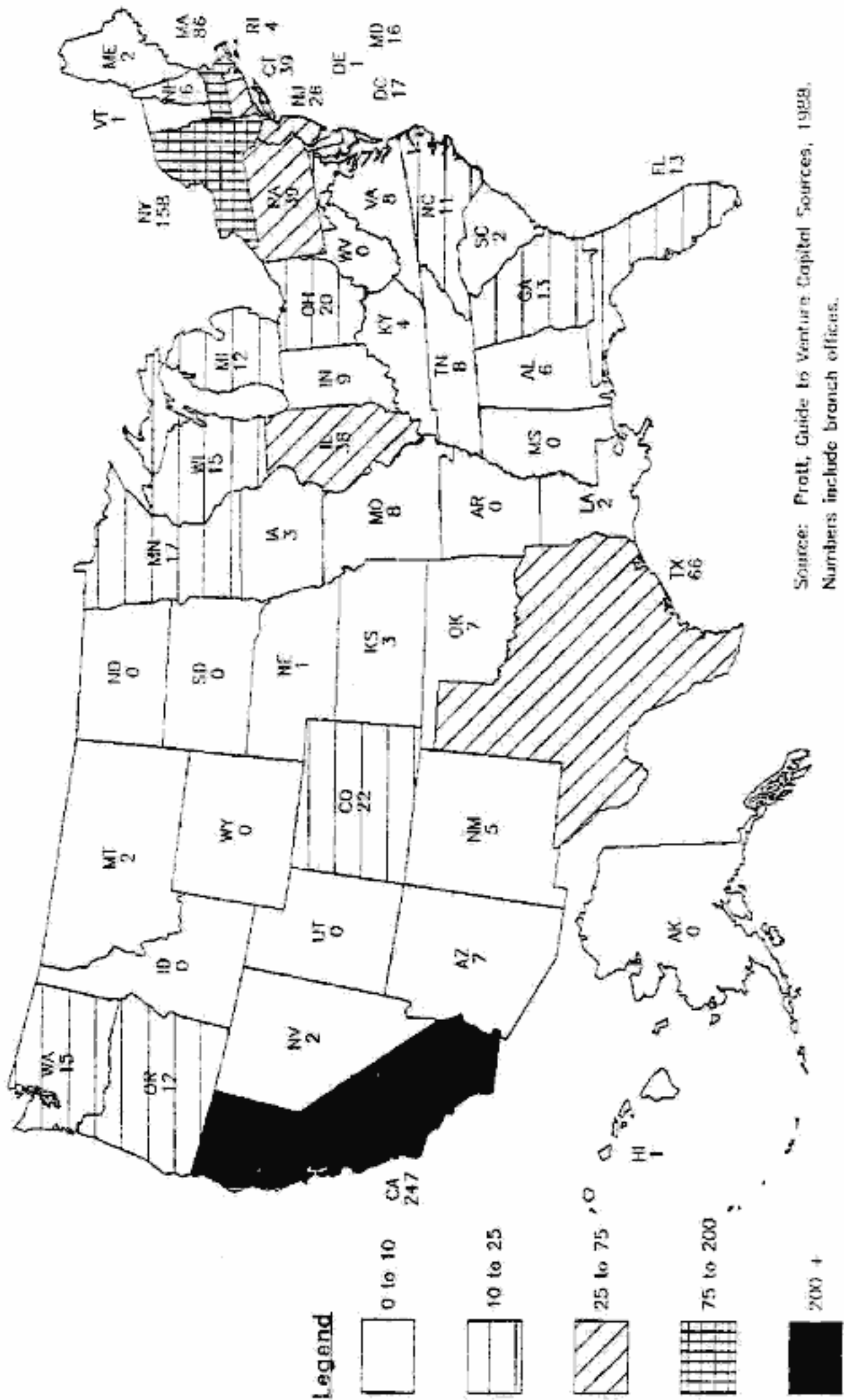
Figures in \$ billions.

Complexes shown have 1% or more of the national venture capital pool of \$29,020.

Source: Venture Capital Journal, April 1988.

FIGURE 5.3

VENTURE CAPITAL OFFICES, 1988



Source: Pratt, Guide to Venture Capital Sources, 1988. Numbers include branch offices.

Table 5.1
 VENTURE CAPITAL RESOURCES
 REGIONAL DISTRIBUTION

Region	MIL \$	1977 % Nat'l.	MIL \$	1982 % Nat'l.	MIL \$	1987 % Nat'l.	% Change 1977-1987
Northeast	1,391	55.2	3,324	49.5	13,330	45.9	858 %
Pacific	524	20.6	1,574	23.5	9,260	31.9	1,667 %
Midwest	398	15.8	1,179	17.6	3,200	11.0	704 %
South	95	3.8	237	3.5	1,450	5.0	1,423 %
Gulf Coast	98	3.9	328	4.9	1,320	4.5	1,246.9%
Mountain	15	.6	69	1.0	460	1.6	2,966.7%
Total	2,521	*100.1	6,711	100	29,020	*99.9	1,051.1%

* Total % is not equal to 100 due to rounding.

Table 5.2
 VENTURE CAPITAL OFFICES
 REGIONAL DISTRIBUTION

Region	1973		1987		% Change 1973-1987
	# Offices	% National	# Offices	% National	
Northeast	300	48.6	361	37.1	20.3%
Pacific	108	17.5	275	28.2	154.6%
Midwest	100	16.2	126	12.9	26.0%
South	56	9.1	99	10.2	76.8%
Gulf Coast	37	6.0	75	7.7	102.7%
Mountain	16	2.6	38	3.9	137.5%
Total	617	100.0	974	100.0	57.9%

Table 5.3

VENTURE CAPITAL RESOURCES AND OFFICES

LEADING STATES 1987

State	MIL \$ Resources	% National	% Change 1977-1987	# Offices	% National	% Change 1973-1987
California	8,710	32.6	1,562	247	32.6	152
New York	6,390	23.9	790	158	20.8	- 4
Massachusetts	4,260	15.9	1,175	86	11.3	51
Illinois	1,570	5.8	515	38	5.0	12
Texas	1,230	4.6	1,382	66	8.7	136
Connecticut	1,220	4.6	1,270	39	5.1	34
New Jersey	810	3.0	NA	26	3.4	30
Maryland	610	2.3	NA	--	--	220
Pennsylvania	580	2.2	NA	39	5.1	63
Minnesota	510	1.9	1,059	17	2.2	70
Ohio	480	1.8	1,070	20	2.6	11
Colorado	370	1.4	NA	22	2.9	214
Total	26,740	100		758	*99.7	

or 30 percent of the total venture capital pool. It is followed by New York with \$6.4 billion, or 22 percent of the venture industry's resources. Massachusetts is third with \$4.3 billion, or 15 percent. Together, these states control two-thirds of the \$29 billion U.S. venture capital pool.

Figure 5.4 shows the three-state concentration (California, New York and Massachusetts) of venture capital for the past decade or so. California, New York, and Massachusetts accounted for 63 percent of the nation's venture capital in 1977, 62 percent in 1982, and 67 percent in 1987. These three states are also leaders in terms of venture capital offices. Together they contained half of the nation's total of venture capital offices in 1987. Illinois, Texas, and Connecticut are the only other states that have more than \$1 billion in venture capital resources. These six states account for slightly more than 80 percent of the nation's venture capital resources in 1987.

Concentration of Venture Capital Within States

The venture capital industry is further concentrated within states at the metropolitan level. For example, two-thirds of the venture capital offices in California are located in the San Francisco Bay/Silicon Valley area, with the remaining one-third in the Los Angeles/San Diego area. In fact, the San Francisco/Silicon Valley area contains more venture capital offices than any other state--over 16 percent of the national total. More than 95 percent of New York's venture capital offices are concentrated in the New York City area, while Chicago is home to some 90 percent of Illinois' venture capital offices. Boston and its suburbs account for the vast majority of Massachusetts venture capital industry.

DETAILED REGIONAL ANALYSES OF VENTURE CAPITAL

The following sections provide more detailed analyses of the concentration of venture capital in six major regions: the Northeast, Pacific, Midwest, Sunbelt, Gulf, and Mountain regions.

The Northeast: The Traditional Center of Venture Capital

The Northeast region (New England, New York, New Jersey, and Pennsylvania) has historically possessed the greatest concentration of venture capital. However, the Northeast's relative dominance in these areas has diminished over the past two decades. As Table 5.4 shows, the Northeast controlled 55 percent of the industry's resources in 1977, but by 1987 its share of resources had fallen to 46 percent. The two largest centers of venture capital resources in the Northeast are New York (New York City) with 48 percent, and Massachusetts (the greater Boston area) with 32 percent of the region's resources. The relative decline in the Northeast region's share of the national venture capital pool can be attributed primarily to the decline of New York. In 1977, New York controlled 28 percent of the venture capital resources; by 1987, the state controlled only 22 percent.

The growth of venture capital in the Northeast has been slower than the national average. After compensating for the effects of inflation, venture capital resources in the

Figure 5.4
**Venture Capital Resources
 Percent in Three Leading States**

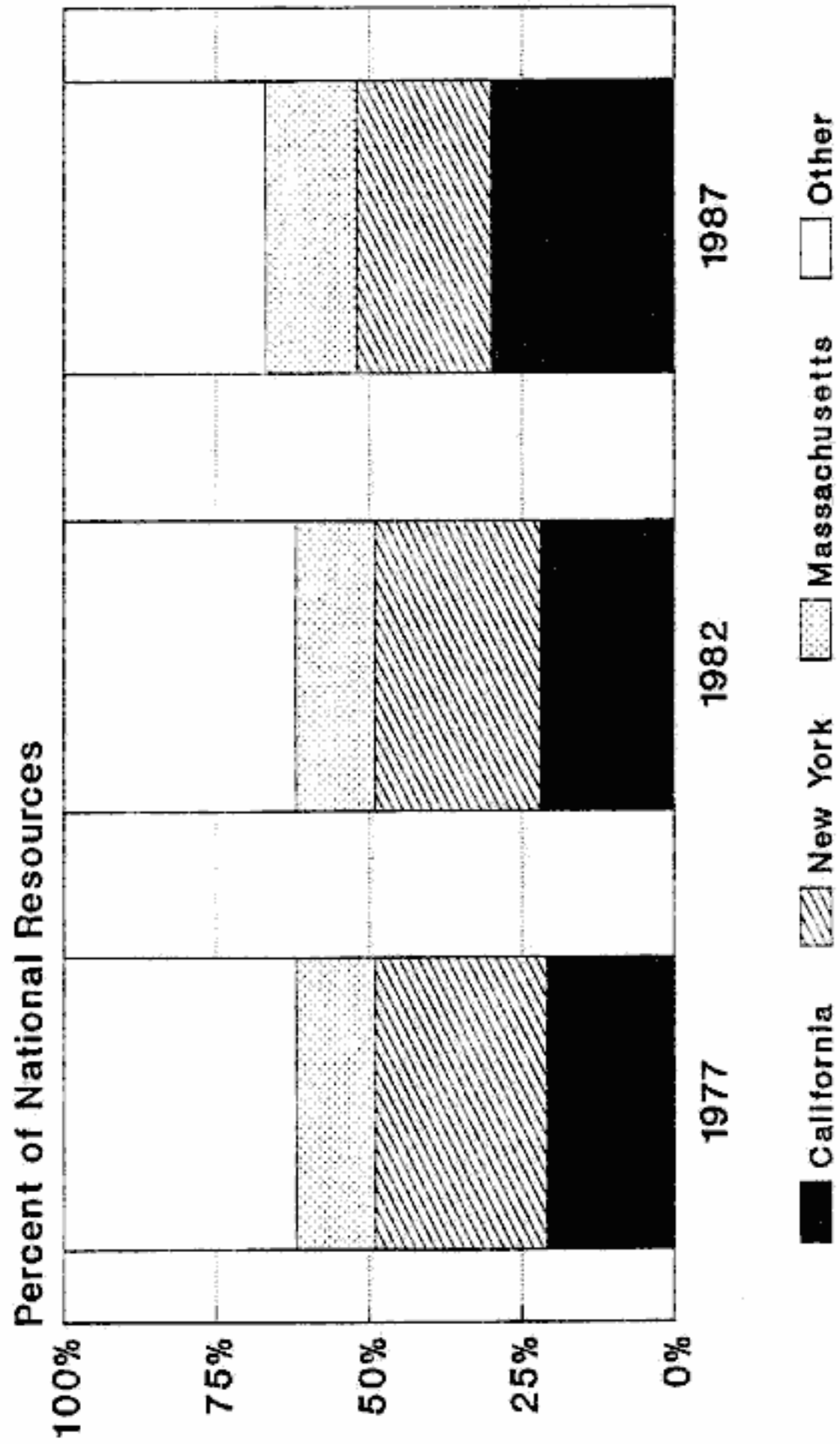


Table 5.4

NORTHEAST REGION

REGION, STATE	\$ (Mil)	% Nat'l.	% Region	\$ (Mil)	% Nat'l.	% Region	\$ (Mil)	% Nat'l.	% Region	% Change 1977-87
Northeast	1391	55.2	100.0	3324	49.5	100.0	13330	45.9	100.0	853.3%
NY	718	28.5	51.6	1835	27.3	55.2	6390	22.0	47.9	790.0%
MA	334	13.2	24.0	852	13.3	26.8	4260	14.7	32.0	1175.4%
CT	89	3.5	6.4	275	4.1	8.3	1220	4.2	9.2	1270.6%
PA	NA			NA			580	2.0	4.4	NA
NJ	NA			NA			810	2.8	6.1	NA
Other	250	9.9	18.0	321	4.8	9.7	70	0.2	0.5	-72.0%

Venture Capital Offices

REGION, STATE	# OFFICES	1973 % NAT'L.	% REGION	# OFFICES	1987 % NAT'L.	% REGION	% CHANGE
NORTHEAST	300	48.6	100.0	361	37.1	100.0	20.3
NY	164	26.6	54.7	158	16.2	43.7	-4.0
MA	57	9.2	19.0	86	8.8	23.8	50.9
CT	29	4.7	9.7	39	4.0	10.8	34.5
PA	24	3.9	8.0	39	4.0	10.8	62.5
NJ	20	3.2	6.7	26	2.7	7.2	30.0
NH	1	0.2	0.3	6	0.6	1.7	500.0
IL	4	0.6	1.3	4	0.4	1.1	0.0
ME	1	0.2	0.3	2	0.2	0.6	100.0
VT	0	0.0	0.0	1	0.1	0.3	--

Northeast region increased almost 450 percent between 1977 and 1987, only 80 percent of the national average. The slower than average growth rate in the New York venture capital pool is primarily responsible for this, as venture capital resources in both Massachusetts and Connecticut grew faster than the national average.

The Northeast region has 361 venture capital offices, the largest number in the country. Of these, 158 are in New York, 86 in Massachusetts, and 39 each in Connecticut and Pennsylvania. While the number of offices increased 20 percent between 1973 and 1987, this increase lagged far behind the national average. In fact, the Northeast region experienced the slowest growth rate of all regions, as its absolute share of venture capital offices fell from 49 percent in 1973 to 37 percent in 1987.

The Pacific Region: The New Center of Venture Capital

The Pacific region (California, Washington, Oregon, Alaska, and Hawaii) has been the nation's fastest growing venture capital center over the past decade or so. In 1977, the Pacific region accounted for 21 percent of the total amount of venture capital resources, increasing to 23 percent in 1982, and to 32 percent in 1987. (See Table 5.5) Overall, the region witnessed a tremendous ninefold increase in venture capital between 1977 and 1987.

The Pacific region's share of venture capital offices has also increased dramatically. Between 1973 and 1987, the Pacific region increased its share of venture capital offices from 18 percent in 1973 to 28 percent. This represents a 150 percent increase, almost three times the national average. Not surprisingly, much of the increase has been accounted for by California, although both Washington and Oregon also increased their numbers of venture capital offices over this period.

The Midwest: A Declining Center of Venture Capital

The Midwest region (Ohio, Indiana, Illinois, Wisconsin, Michigan, Minnesota, the Dakotas, Missouri, Iowa, Nebraska, and Kansas) is a declining center of venture capital. The region's relative share of venture capital has declined significantly over the past decade, with the Midwest experiencing the slowest real growth rate in venture capital resources of any region. (see Table 5.6)

The Midwest's share of total venture capital funds rose slightly from 16 percent in 1977 to 18 percent in 1982; but then the region's share of venture capital resources declined significantly, to 11 percent in 1987. Much of the decline in the region's venture capital performance can be attributed to the relatively weak performance of Illinois, the region's traditional center for venture capital activity. While Illinois controlled 12 percent of all venture capital in the country in 1982, by 1987 it accounted for just 5 percent of the national total. Between 1977 and 1987, Illinois had a growth rate that was less than half the national average.

The Midwest share of venture capital offices has also declined. In 1973, the region had 16 percent of the industry's offices, but by 1987, its share had fallen to 13 percent. The Midwest experienced the second slowest increase in the number of venture capital offices in the nation (i.e., 45 percent of the national average). Although Minnesota increased its

Table 5.5

PACIFIC REGION

Venture Capital Resources

REGION, STATE	1977			1982			1987			% Change 1977-87
	\$ (Mil)	% Nat'l.	% Region	\$ (Mil)	% Nat'l.	% Region	\$ (Mil)	% Nat'l.	% Region	
PACIFIC	524	20.8	100.0	1574	23.5	100.0	9260	31.9	100.0	1667.2%
CA	524	20.8	100.0	1509	22.5	95.9	8710	30.0	94.1	1562.2%
WA	0	0.0	0.0	NA			320	1.1	3.5	NA
Other	0	0.0	0.0	65	1.0	4.1	230	.8	2.5	NA

Venture Capital Offices

REGION, STATE	# OFFICES	1973		# OFFICES	1987		% CHANGE 1973-87
		% NAT'L.	% REGION		% NAT'L.	% REGION	
PACIFIC	108	17.5	100.0	275	28.2	100.0	154.6
CA	98	15.9	90.7	247	25.3	89.8	152.0
WA	3	0.5	2.8	15	21.5	5.4	400.0
OR	3	0.5	2.8	12	1.2	4.4	300.0
HI	1	0.2	0.9	1	0.1	0.4	0.0
AK	3	0.5	2.8	0	0.0	0.0	-100.0

Table 5.6
MIDWEST REGION

Venture Capital Resources

REGION, STATE	1977			1982			1987			% Change 1977-87
	\$ (Mil)	% Nat'l.	% Region	\$ (Mil)	% Nat'l.	% Region	\$ (Mil)	% Nat'l.	% Region	
MIDWEST	398	15.6	100.0	1179	17.6	100.0	3200	11.0	100.0	704.0%
IL	256	10.1	64.1	808	12.0	68.5	1570	5.4	49.1	515.7%
MN	44	1.7	11.1	120	1.6	10.2	510	1.6	15.9	1059.1
OH	41	1.6	10.3	166	2.5	14.1	480	1.7	15.0	1070.7%
Other	58	2.3	14.6	85	1.3	7.2	640	2.2	20.0	1003.4%

Venture Capital Offices

REGION, STATE	1973			1987			% CHANGE 1973-1987
	# OFFICES	% NAT'L	% REGION	# OFFICES	% NAT'L	% REGION	
MIDWEST	100	16.2	100.0	126	12.9	100.0	26.0
IL	34	5.5	34.0	38	3.9	30.2	11.8
OH	18	2.9	18.0	20	2.1	15.9	11.1
MN	10	1.6	10.0	17	1.7	13.5	70.0
WI	13	2.1	13.0	15	1.5	11.9	15.4
MI	13	2.1	13.0	12	1.2	9.5	-7.7
IN	5	0.8	5.0	9	0.9	7.1	80.0
MO	2	0.3	2.0	8	0.8	6.3	300.0
KS	1	0.2	1.0	3	0.3	2.4	200.0
IO	3	0.5	3.0	3	0.3	2.4	0.0
NE	1	0.2	1.0	1	0.1	0.7	0.0
SD	0	0.0	0.0	0	0.0	0.0	-
ND	0	0.0	0.0	0	0.0	0.0	-

number of offices at an above average pace of 70 percent between 1973 and 1987, the number of venture capital offices in Illinois and Ohio increased only slightly, 20 percent and 19 percent, respectively, during this period.

The Sunbelt

Our analysis of the Sunbelt region is divided into two subregions--the South (Delaware, District of Columbia, Maryland, Virginia, West Virginia, the Carolinas, Georgia, Florida, Alabama, Mississippi, Tennessee, Kentucky, and Arkansas) and the Gulf Coast region (Texas, Oklahoma, and Louisiana). Together, these two regions account for roughly 10 percent of the national venture capital pool.

The South

The South controlled 5 percent of the nation's venture capital resources and 10 percent of the industry's offices in 1987. Although this represents a relatively minor share of the nation's venture capital activity, in recent years the South has seen higher than national average growth in venture capital.(Table 5.7)

In 1987, the South had 99 venture capital offices--10 percent of the national total. The District of Columbia and Maryland, Florida, Georgia and North Carolina were the major centers of venture capital offices in the South. Maryland accounted for the greatest concentration of capital in the South with 42 percent of the venture capital resources. Between 1977 and 1987, Maryland's venture capital resources increased almost eightfold in terms of real dollars, which was 38 percent higher than the national average.

The Gulf Coast

Venture capital resources in the Gulf Coast region (Texas, Oklahoma, Louisiana) are approximately equal to those in the South, about 5 percent of the national total. Between 1973 and 1987, the number of venture capital offices more than doubled as the Gulf region upped its share of venture capital offices from 6 to 8 percent of the national total.(see Table 5.8) The Gulf Coast has also witnessed a significant growth in venture capital resources. Real dollar increases in the region's venture capital pool were 20 percent above the national average between 1977 and 1987. The Gulf states are clearly dominated by Texas which controls over 90 percent of the region's venture capital resources and almost 90 percent of its venture capital offices.

The Mountain Region: Rapid Growth

Although the Mountain region (Colorado, New Mexico, Arizona, Utah, Nevada, Idaho, Montana, and Wyoming) has the smallest share of venture capital resources at 2 percent of the national total, the growth rate in real venture capital resources is almost three times the national average. As such, the Mountain region experienced the highest growth rate of any region in the country. The region also experienced the second largest increase in the number of venture capital offices, at more than twice the national average. The Mountain states, as depicted in Table 5.9, were home to 38 of the industry's offices in

Table 5.6
MIDWEST REGION

Venture Capital Resources

REGION, STATE	1977			1982			1987			% Change 1977-87
	\$ (Mil)	% Nat'l.	% Region	\$ (Mil)	% Nat'l.	% Region	\$ (Mil)	% Nat'l.	% Region	
MIDWEST	398	15.6	100.0	1179	17.6	100.0	3200	11.0	100.0	704.0%
IL	255	10.1	64.1	808	12.0	68.5	1570	5.4	49.1	515.7%
MN	44	1.7	11.1	120	1.8	10.2	510	1.8	15.9	1059.1
OH	41	1.6	10.3	166	2.5	14.1	480	1.7	15.0	1070.7%
Other	58	2.3	14.6	85	1.3	7.2	640	2.2	20.0	1003.4%

Venture Capital Offices

REGION, STATE	1973			1987			% CHANGE 1973-1987
	# OFFICES	% NAT'L	% REGION	# OFFICES	% NAT'L	% REGION	
MIDWEST	100	16.2	100.0	126	12.9	100.0	26.0
IL	34	5.5	34.0	38	3.9	30.2	11.8
OH	18	2.9	18.0	20	2.1	15.9	11.1
MN	10	1.6	10.0	17	1.7	13.5	70.0
WI	13	2.1	13.0	15	1.5	11.9	15.4
MI	13	2.1	13.0	12	1.2	9.5	-7.7
IN	5	0.8	5.0	9	0.9	7.1	80.0
MO	2	0.3	2.0	8	0.8	6.3	300.0
KS	1	0.2	1.0	3	0.3	2.4	200.0
IO	3	0.5	3.0	3	0.3	2.4	0.0
NE	1	0.2	1.0	1	0.1	0.7	0.0
SD	0	0.0	0.0	0	0.0	0.0	--
ND	0	0.0	0.0	0	0.0	0.0	--

number of offices at an above average pace of 70 percent between 1973 and 1987, the number of venture capital offices in Illinois and Ohio increased only slightly, 20 percent and 19 percent, respectively, during this period.

The Sunbelt

Our analysis of the Sunbelt region is divided into two subregions--the South (Delaware, District of Columbia, Maryland, Virginia, West Virginia, the Carolinas, Georgia, Florida, Alabama, Mississippi, Tennessee, Kentucky, and Arkansas) and the Gulf Coast region (Texas, Oklahoma, and Louisiana). Together, these two regions account for roughly 10 percent of the national venture capital pool.

The South

The South controlled 5 percent of the nation's venture capital resources and 10 percent of the industry's offices in 1987. Although this represents a relatively minor share of the nation's venture capital activity, in recent years the South has seen higher than national average growth in venture capital.(Table 5.7)

In 1987, the South had 99 venture capital offices--10 percent of the national total. The District of Columbia and Maryland, Florida, Georgia and North Carolina were the major centers of venture capital offices in the South. Maryland accounted for the greatest concentration of capital in the South with 42 percent of the venture capital resources. Between 1977 and 1987, Maryland's venture capital resources increased almost eightfold in terms of real dollars, which was 38 percent higher than the national average.

The Gulf Coast

Venture capital resources in the Gulf Coast region (Texas, Oklahoma, Louisiana) are approximately equal to those in the South, about 5 percent of the national total. Between 1973 and 1987, the number of venture capital offices more than doubled as the Gulf region upped its share of venture capital offices from 6 to 8 percent of the national total.(see Table 5.8) The Gulf Coast has also witnessed a significant growth in venture capital resources. Real dollar increases in the region's venture capital pool were 20 percent above the national average between 1977 and 1987. The Gulf states are clearly dominated by Texas which controls over 90 percent of the region's venture capital resources and almost 90 percent of its venture capital offices.

The Mountain Region: Rapid Growth

Although the Mountain region (Colorado, New Mexico, Arizona, Utah, Nevada, Idaho, Montana, and Wyoming) has the smallest share of venture capital resources at 2 percent of the national total, the growth rate in real venture capital resources is almost three times the national average. As such, the Mountain region experienced the highest growth rate of any region in the country. The region also experienced the second largest increase in the number of venture capital offices, at more than twice the national average. The Mountain states, as depicted in Table 5.9, were home to 38 of the industry's offices in

1987, or 4 percent of the national total. Colorado has emerged as the center of venture capital activity in the Mountain region, with 22 venture capital offices and 80 percent of the region's venture capital resources. Arizona and New Mexico account for most of the remainder of the region's venture capital.

Summary

The distribution of venture capital resources is highly concentrated at the national, state, and metropolitan levels. At the national level, venture capital resources and offices are distributed primarily in the Northeast and Pacific regions. At the state level, California, New York, and Massachusetts are responsible for the majority of venture resources. Finally, the venture capital industry is highly concentrated within states. Two-thirds of all venture capital resources are found in just three metropolitan areas --the Silicon Valley area of California, the Route 128 area around Boston, Massachusetts, and New York City.

Table 5.7
SOUTH REGION

Venture Capital Resources

REGION, STATE	\$ (Mil)	% Nat'l.	% Region	\$ (Mil)	% Nat'l.	% Region	\$ (Mil)	% Nat'l.	% Region	% Change 1977-87
SOUTH	95	3.8	100.0	237	3.5	100.0	1450	5.0	100.0	1426.31
MD	NA			NA			610	2.1	42.1	NA
Other	95	3.8	100.0	237	3.5	100.0	840	2.9	57.9	784.2%

Venture Capital Offices

REGION, STATE	# OFFICES	1973 % NAT'L.	% REGION	# OFFICES	1987 % NAT'L.	% REGION	% CHANGE 1973-87
SOUTH	58	9.1	100.0	99	10.2	100.0	78.8
DC	11	1.8	19.6	17	1.7	17.2	54.5
MD	5	0.8	8.9	16	1.6	16.2	220.0
FL	13	2.1	23.2	13	1.3	13.1	0.0
GA	9	1.5	16.1	13	1.3	13.1	44.4
NC	4	0.6	7.1	11	1.1	11.1	175.0
TN	4	0.6	7.1	8	0.8	8.1	100.0
VA	7	1.1	12.5	8	0.8	8.1	14.3
AL	0	0.0	0.0	6	0.6	6.1	-
KY	1	0.2	1.8	4	0.4	4.0	300.0
SC	1	0.2	1.8	2	0.2	2.0	100.0
DE	1	0.2	1.8	1	0.1	1.0	0.0
WV	0	0.0	0.0	0	0.0	0.0	-
MS	0	0.0	0.0	0	0.0	0.0	-

Table 5.8
GULF COAST REGION

Venture Capital Resources

REGION, STATE	1977			1982			1987			% Change 1977-87
	\$ (Mil)	% Nat'l.	% Region	\$ (Mil)	% Nat'l.	% Region	\$ (Mil)	% Nat'l.	% Region	
GULF COAST	98	3.9	100.0	328	4.9	100.0	1320	4.5	100.0	1246.9%
TX	83	3.3	84.7	259	3.9	79.0	1230	4.2	93.2	1381.9%
Other	15	0.5	15.3	69	1.0	21.0	90	0.3	6.8	500.0%

Venture Capital Offices

REGION, STATE	# OFFICES	1973		# OFFICES	1987		% CHANGE 1973-87
		% NAT'L.	% REGION		% NAT'L.	% REGION	
GULF COAST	37	6.0	100.0	75	7.7	100.0	102.7
TX	28	4.5	75.7	66	6.8	88.0	125.7
OK	4	0.6	10.8	7	0.7	9.3	75.0
LA	4	0.6	10.8	2	0.2	2.7	-50.0
AR	1	0.2	2.7	0	0.0	0.0	-100.0

Table 5.9

MOUNTAIN REGION

Venture Capital Resources

REGION, STATE	\$ (Mil)	% Nat'l.	% Region	\$ (Mil)	% Nat'l.	% Region	\$ (Mil)	% Nat'l.	% Region	% Change 1977-87
MOUNTAIN	15	0.6	100.0	69	1.0	100.0	460	1.6	100.0	2966.7%
CO	NA			NA			370	1.3	80.4	NA
Other	15	0.6	100.0	69	1.0	100.0	90	0.3	19.6	500.0%

Venture Capital Offices

REGION, STATE	# OFFICES	1973 % NAT'L.	% REGION	# OFFICES	1987 % NAT'L.	% REGION	% CHANGE 1973-87
MOUNTAIN	16	2.6	100.0	38	3.9	100.0	137.5%
CO	7	1.1	43.8	22	2.3	57.8	214.3
AZ	3	0.5	18.8	7	0.7	18.4	133.3
NM	0	0.0	0.0	5	0.5	13.2	--
MT	1	0.2	6.2	2	0.2	5.3	100.0
NV	0	0.0	0.0	2	0.0	5.3	--
ID	4	0.6	25.0	0	0.0	0.0	-100.0
UT	1	0.2	6.2	0	0.0	0.0	-100.0
WY	0	0.0	0.0	0	0.0	0.0	--

CHAPTER 6

WHERE DOES VENTURE CAPITAL GO? GEOGRAPHIC PATTERNS OF VENTURE CAPITAL INVESTMENT

Introduction

Venture capital investments are even more highly concentrated than venture capital resources--primarily flowing to a few limited areas. 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 supplements the previous one, providing a detailed examination of geographic patterns of venture capital investments.

Although investment is perhaps the critical dimension of venture capital activity, there is virtually no literature that examines venture capital investment in great detail. Largely because of unavailable or unreliable data, the academic literature has generally focused on the concentration and distribution of venture capital resources and firms. 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, conveying 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 comprehensive database on venture capital investment we compiled. Our database is derived from information published by Venture Economics' Venture Capital Journal over the three-year period 1984-1987, and provides a 40-45 percent 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 that inhibited previous studies.

The major findings of this chapter 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 percent of the venture capital invested in 1986. Second, at the state level, just two states--California and Massachusetts--accounted for over 50 percent 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 percent of all venture capital investments made in California, and 23 percent of all venture capital investments made nationwide; the Route 128 area around Boston received 95 percent of the venture capital investments in Massachusetts and 14 percent of the national total.(See Figure 6.1) 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 of 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.

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, setting the stage for further analyses along these lines in Chapter 7.⁶⁰

Concentration of Venture Capital Investments

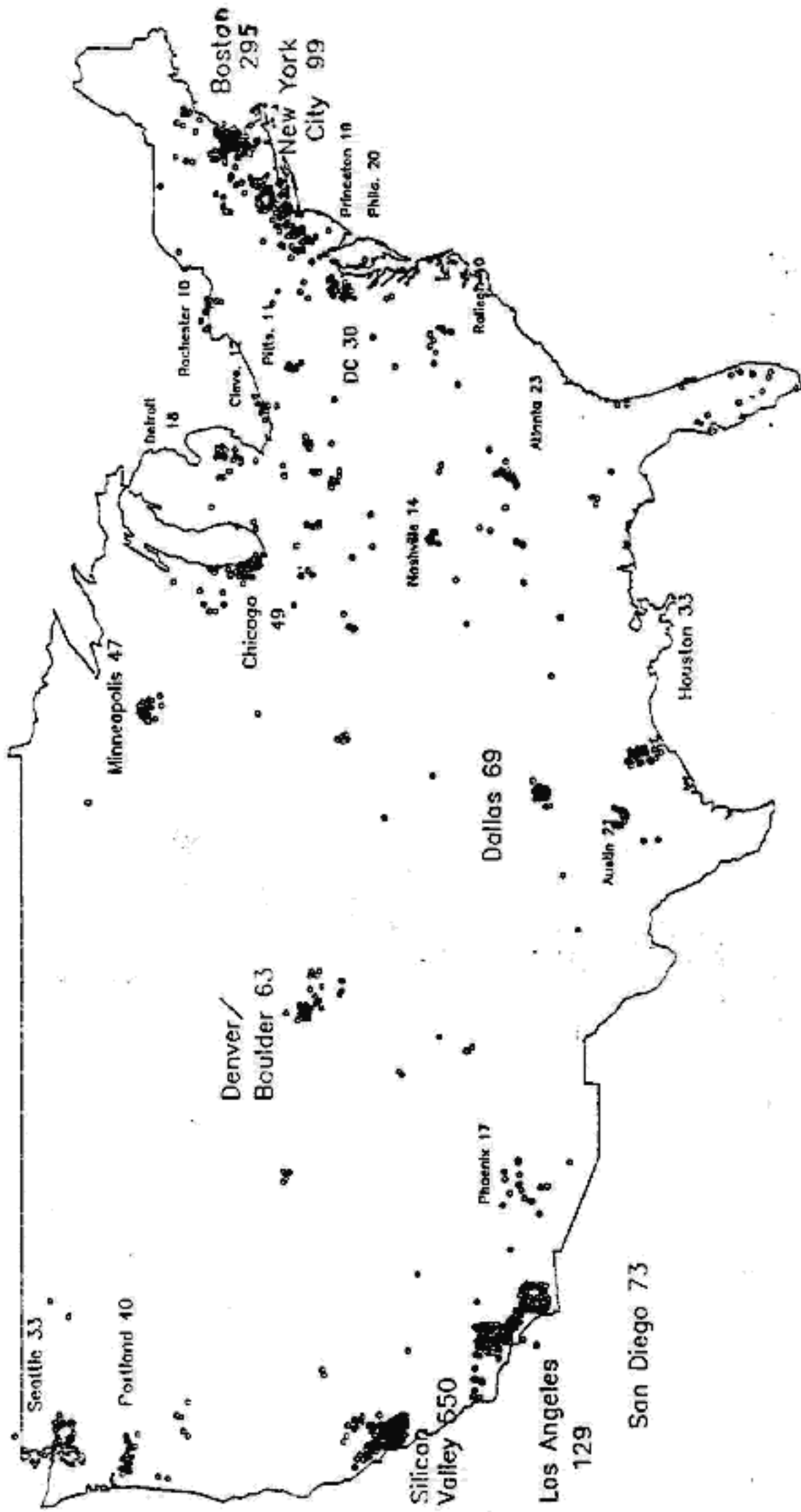
The geographic distribution of venture capital investments is highly uneven and tightly clustered. As Table 6.1 illustrates, venture capital investment is concentrated at the regional level, exhibiting even more pronounced "bi-coastalism" than the distribution of venture capital resources. The Pacific and Northeast regions together attracted almost

⁶⁰ Information on high technology firms is taken from the Corporate Technology Information Service Directory, trademark CorpTech. We used the 1987 CorpTech Directory because it 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 intensity (i.e., the amount of money spent on R&D or 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 U.S. Census of Manufacturers provides five-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 analytic purposes. Most analysts use a working definition based on research and development intensity (measured either as percent 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 one 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 the Office of Technology Assessment, Technology, Innovation and Regional Development (Washington, D.C., 1984) and Ann Markusen et al., High Tech America (Winchester, MA: Allen and Unwin, 1986).

FIGURE 6.1
VENTURE CAPITAL INVESTMENTS, 1987



1 Dot = 1 Investment

Investments shown are from the years 1982 to 1987.

TABLE 6.1

VENTURE CAPITAL DISBURSEMENTS - BY REGION
 BY TOTAL DOLLAR AMOUNT (in millions) and BY PERCENT OF TOTAL

REGION	1968-1975*	1980	1981	1982	1983	1984	1985	1986	1987
PACIFIC	213 (28)	365 (36)	648 (46)	875 (48)	1071 (51)	1035 (45)	1118 (43)	1066 (41)	1638 (42)
NORTHEAST	246 (28)	275 (27)	352 (25)	474 (26)	525 (25)	552 (24)	702 (27)	658 (33)	1092 (28)
MIDWEST	154 (20)	92 (9)	113 (8)	146 (8)	147 (7)	184 (8)	234 (9)	182 (7)	312 (8)
SOUTH	46 (5)	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)
U.S. TOTAL	747	1025	1403	1822	2100	2300	2600	2900	3900

three-fourths (74 percent) of the \$2.9 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 places 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 in the mid-1970s presented findings that in the 1968-1975 period, states in the Midwest had attracted almost 20 percent of the total share of venture capital investments.⁶¹ By 1981, the Midwest's share had declined to a mere 8 percent of the national total. For the past decade, the distribution of venture capital throughout the U.S. has remained relatively constant. The only possible exception is the South region which has shown a steady increase, from 6 percent in the early 1970 period to 9 percent in 1986.

As Table 6.2 shows, among states, California attracted the "lion's share" of the investment dollars, with \$1.1 billion or 38 percent of the national total in 1986. Massachusetts was second--receiving approximately \$400 million, or 14 percent of the total venture capital invested, while New York, Texas, and 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 percent.

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 percent of the California total, and 12 percent 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 18 cities and towns along the Route 128 corridor received almost 75 percent of that state's investments. And, just three communities, Newton, Waltham, and Woburn, received 62 percent of the Route 128 investments--almost 3 percent of the national total of venture capital investments.

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.

⁶¹ Rubel, S.M.

TABLE 6.2

VENTURE CAPITAL DISBURSEMENTS - LEADING RECIPIENT STATES
 BY TOTAL DOLLAR AMOUNT (in millions) and BY PERCENT OF TOTAL

STATE	1968 - 1975	1980	1981	1982	1983	1984	1985	1986	1987
CALIFORNIA	201 (26)	345 (34)	587 (42)	829 (46)	987 (47)	1012 (44)	1014 (39)	988 (36)	1521 (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)	79 (3)	117 (3)
TEXAS	57 (7)	108 (11)	140 (10)	142 (8)	105 (5)	184 (6)	162 (7)	156 (6)	234 (6)
COLORADO	25 (3)	54 (5)	44 (3)	67 (4)	63 (3)	69 (3)	78 (3)	78 (3)	78 (2)
MICHIGAN	22 (3)	-	14 (1)	35 (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)
11 STATE TOTAL	608 (79)	791 (77)	1165 (80)	1532 (84)	1680 (80)	1909 (83)	1950 (75)	2028 (78)	3042 (78)
U.S. TOTAL	747	1025	1409	1822	2100	2300	2600	2600	3900

1968-1975 Data from S.M. RUBEL REPORT To I.E.M.

1980-1982 Data From 1984 OTA REPORT

1983 Data from Venture Capital Journal, May 1984

1984 Data from Venture Capital Journal, May 1985

1985-1986 Data from Venture Capital Journal, May 1987

1987 Data from Venture Capital Journal, May 1988

three-fourths (74 percent) of the \$2.9 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 places 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 in the mid-1970s presented findings that in the 1968-1975 period, states in the Midwest had attracted almost 20 percent of the total share of venture capital investments.⁶¹ By 1981, the Midwest's share had declined to a mere 8 percent of the national total. For the past decade, the distribution of venture capital throughout the U.S. has remained relatively constant. The only possible exception is the South region which has shown a steady increase, from 6 percent in the early 1970 period to 9 percent in 1986.

As Table 6.2 shows, among states, California attracted the "lion's share" of the investment dollars, with \$1.1 billion or 38 percent of the national total in 1986. Massachusetts was second--receiving approximately \$400 million, or 14 percent of the total venture capital invested, while New York, Texas, and 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 percent.

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 percent of the California total, and 12 percent 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 18 cities and towns along the Route 128 corridor received almost 75 percent of that state's investments. And, just three communities, Newton, Waltham, and Woburn, received 62 percent of the Route 128 investments--almost 3 percent of the national total of venture capital investments.

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.

⁶¹ Rubel, S.M.

DETAILED REGIONAL ANALYSES OF VENTURE CAPITAL INVESTMENTS

This section provides more detailed analysis of venture capital investment in 5 major regions: the Northeast, Pacific, Midwest, Sunbelt, and Mountain regions.

The Northeast Region

The Northeast region has long been recognized as one of the nation's premier centers of venture capital. During the 1970s, the Northeast region received almost 32 percent 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. As Tables 6.3 and 6.4 show, the growth in the venture capital dollars invested in the region increased 127 percent 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 percent of venture capital investments in 1986, while New York accounted for \$203 million or 7 percent of the total. Here it is quite evident that New York fails to attract a level of venture capital investment comparable to the level of venture capital resources it controls.

It is a bit surprising that the remaining Northeast states have attracted so little in the way of venture capital investment. Even 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, these states 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 Massachusetts' economic fortunes 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 1975-1985 period, 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 percent increase in venture capital investments from 1975 to 1981, and an 85 percent increase from 1981 to 1986.

In recent years, Massachusetts has led the other states located in the Northeast region in venture capital investments. Although Massachusetts has only 12 percent of the Northeast region's population (and only 2 percent of the nation's), it received 42 percent of the Northeast region's share of venture capital investments, and 14 percent of the U.S. total,

Table 6.3

Venture Capital Investments in the Northeast

REGION, STATE	1968-1975			1981			1986			% Change 1975-1986
	\$ (Mil)	% National	% Region	\$ (Mil)	% National	% Region	\$ (Mil)	% National	% Region	
NORTHEAST	246.2	33.0	100.0	348.0	24.8	100.0	967.0	33	100.0	289%
NY	82.3	11.1	33.4	45.1	3.2	12.9	203	7	21.2	147%
MA	66.2	8.9	26.9	180.4	12.6	52.0	406	14	42.4	513%
CT	NA			38.0	2.7	10.9	87	3	9.1	--
PA	23.3	3.1	9.5	29.6	2.1	8.3	58	2	6.1	149%
NJ	31.1	4.2	12.6	35.2	2.5	10.1	145	5	15.2	366%
RI	5.2	0.7	2.1	NA			NA			--
Other	38.1	5.1	15.5	19.7	1.4	5.7	58	2	6.1	52%

Table 6.4

SUMMARY OF INVESTMENT AND COINVESTMENT DATA
FOR STATES IN THE NORTHEAST REGION
(from author's database)

Region/State	# of Investments Received	# of Coinvestments Participated In
Northeast	2169	K-21945
Massachusetts	1258	6705
New York	259	9649
New Jersey	178	861
Pennsylvania	163	826
Connecticut	158	3618
New Hampshire	56	49
Maine	47	60
Rhode Island	43	177
Vermont	7	0

in 1986. On a national level, Massachusetts has 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 percent 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 percent of the state's total of 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 percent of the state's total); and the Route 495 area accounted for 18 percent; communities that fall between the Route 128 and Route 495 boundaries received 21 percent. Other areas within Massachusetts received very little venture investment, despite the Dukakis administration's 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 percent of the state's high technology companies. Newton, Waltham, and Woburn alone were home to 47 percent of the high technology firms located in the Route 128 complex, 13 percent of the state total, and 1 percent 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, however, not the case. New York has been unable to attract a large percentage of the venture capital industry's investment. In fact, New York's share of venture capital investments has hovered between 5 percent and 7 percent of the national total, in recent years. 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 percent of the state's venture capital investments. According to Crain's New York Business, \$66.8 million of venture capital, half of the total invested, was placed in 27 firms located within a 25-mile radius of the Statue of Liberty in 1985.⁶² When combined with its suburbs in Long Island and White Plains, the New York City metropolitan region received approximately 72 percent of New York State's venture capital investment. This follows the pattern of the state's high technology companies, of which 68 percent are located in this area.

Rochester, Albany-Troy, and Buffalo attract a minor share of venture capital investment in New York. The greater Rochester area received almost 9 percent of New York's venture investments, and it is home to approximately 7 percent of the state's high technology firms. The Albany-Troy area accounted for almost 16 percent of the state's venture capital investments, while the area's share of high technology firms was 4 percent.

⁶² Frank Sommerfield, "Few funds venture into New York companies, Crain's New York Business," 24 March 1986, p. 15.

Table 6.4

SUMMARY OF INVESTMENT AND COINVESTMENT DATA
FOR STATES IN THE NORTHEAST REGION
(from author's database)

Region/State	# of Investments Received	# of Coinvestments Participated In
Northeast	2169	K-21945
Massachusetts	1258	6705
New York	259	9649
New Jersey	178	861
Pennsylvania	163	826
Connecticut	158	3618
New Hampshire	56	49
Maine	47	60
Rhode Island	43	177
Vermont	7	0

Table 6.4

SUMMARY OF INVESTMENT AND COINVESTMENT DATA
FOR STATES IN THE NORTHEAST REGION
(from author's database)

Region/State	# of Investments Received	# of Coinvestments Participated In
Northeast	2169	K-21945
Massachusetts	1258	6705
New York	259	9649
New Jersey	178	861
Pennsylvania	163	826
Connecticut	158	3618
New Hampshire	56	49
Maine	47	60
Rhode Island	43	177
Vermont	7	0

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

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 Bell Labs inventions was its 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 percent of the state's labor force was employed in the high technology sector.⁶³ And over the past decade, New Jersey has experienced a dramatic increase in the amount of venture capital investments. Between 1981 and 1986, New Jersey's share of venture capital investments increased from 2.5 percent to 5 percent of the national total, a real dollar increase of 250 percent. At the same time, its regional share rose from 10.1 percent to 15.2 percent.

The northeast portion of the state received the major share of venture capital investments. According to our database, this region accounted for 55 percent of the state's venture investments.⁶⁴ Princeton received 25 percent 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 U.S. The Forrestal Center has over 50 tenants, including divisions of Xerox, IBM, and Siemens AG.⁶⁵

Connecticut

For the past several years, Connecticut has received 2 to 3 percent of the national total of venture capital investment dollars, and approximately 10 percent of the Northeast regional total. Although Connecticut's overall share of venture capital's financings was

⁶³ Edward J. Malecki, "The Geography of High Technology", *Focus* 35(4), October 1985, p. 3.

⁶⁴ 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 percent of the state's high technology firms, according to the *1987 CorpTech Directory*. The high technology firms within this area also were 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 percent of the high technology companies in this area are distributed among more than 100 other cities and towns.

⁶⁵ Sarah Glazer, "Research Parks Plug into the electronics industry," *Electronic Business*, 15 March 1987, pp. 100-101.

relatively constant during this period, the state experienced a 90 percent increase, in terms of real dollars invested.

According to our database, 77 percent of venture capital investments in Connecticut were located along the Route 95 corridor, and more specifically to companies located between New Haven and the New York border. Stamford and its suburb Darien were the major focus for venture investment in Connecticut. Together, they received almost 30 percent 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 percent of the state total. The Waterbury-Hartford area received 13 percent of the state's investments and 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 percent 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 percent are in Hartford. The greater Waterbury-Hartford area housed approximately 15 percent 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 percent of the venture capital investments made in the Northeast region, and 3 percent of the national total. However, during the 1980s, the state's share of venture investments has declined to about 2 percent of the national total. 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 4 to 17 between 1980 to 1987, almost 75 percent of the capital invested by these firms in 1986 went to companies located outside the state.⁶⁶

The Philadelphia area received 44 percent of the state total of venture capital investments, while firms in the Pittsburgh area received over 30 percent. The Philadelphia and Pittsburgh regions were home to the majority of the state's high technology firms. The greater Philadelphia region has 50 percent of the state's high technology firms, while the greater Pittsburgh region contains 35 percent. 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 all have been generally overlooked by the venture capital industry, receiving only a minor portion of venture investments. Indeed, during the past decade, together these states received less than 2

⁶⁶ The Enterprise Corporation of Pittsburgh, A survey of venture capital in Pittsburgh, June 1987.

Rhode Island and New Hampshire each received somewhat more than 2 percent of the region's financings, while Maine received slightly less than 1 percent. These investments were primarily directed to the major city of each state. Over 60 percent of Rhode Island's investments were in Providence, over 75 percent of Maine's investments were in Portland, and close to 50 percent 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 in Portland, and twenty-five percent 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. In 1986, it received \$1.2 billion or 41 percent 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 percent of the total amount of the nation's venture capital investments, which was 93 percent 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 percent of the national total of venture investments. The success of Silicon 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 Tables 6.5 and 6.6 show, the Pacific region has experienced tremendous growth in venture capital investment. During the early 1970s, the Pacific region received 28 percent of the venture industry's investment dollars, though it controlled only 10 percent of the total amount of venture capital resources. By the end of the decade, the Pacific region had taken over the lead as the leading recipient region in the country. In 1980, the Pacific region laid claim to 36 percent of the venture capital industry's investments and by 1986, its share was 41 percent 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 one-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 the state of California. While the northern sections of the state have been virtually ignored by the venture capital community, Silicon Valley has become a world-renowned center and the premier location

Table 6.6

SUMMARY OF INVESTMENT AND COINVESTMENT DATA
FOR STATES IN THE PACIFIC REGION

Region/State	# of Investments Received	# of Coinvestments Participated In
Pacific	4,891	23,259
California	4,362	22,197
Oregon	282	125
Washington	192	912
Hawaii	5	8
Alaska	0	17

for venture capital investment. Twenty-three percent of the venture capital investments in our database are in this region. Within this region, the greater San Jose area received 67 percent of investments.

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 percent of the California total of venture capital investments, while the Sausalito area managed to attract only 2 percent 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 percent of the state's high technology firms, with the greater San Jose area accounting for roughly half this total.

In recent years, 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. Los Angeles area firms received 18 percent of the California venture capital investments, 7 percent of the national total. San Diego attracted 9 percent of the California investments. In short, 98 percent of venture capital investments in California go to companies located in Silicon Valley, Los Angeles, or San Diego, areas that are home to 95 percent 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 percent in 1981 to 2 percent in 1986. Roughly 90 percent 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.

Washington has experienced a relative decline in its share of venture capital investment dollars. Its share of the regional total fell from 5.3 percent in 1981 to 2.4 percent in 1986. According to our database, almost 87 percent of the venture capital investments in Washington went to the Seattle-Tacoma area, a region with eighty percent 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. In 1973, Alaska had 3 venture capital offices; by 1987, the number had dropped to zero. Because of this, Alaska has received an extremely small number of venture investments, and Alaska has only 5 high technology firms. The state 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 1988.⁶⁷ 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, Robert Dixon 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."⁶⁸

The Midwest Region

The Midwest has experienced a significant decline in venture capital investments, paralleling the decrease in venture capital resources discussed in the previous chapter. Between 1968 and 1975, the Midwest region attracted 20 percent of the venture capital investments, ranking third behind the Northeast and the Pacific regions. (See Tables 6.7 and 6.8) The region also contained 4 of the top 10 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 percent.

Venture capital investments in the Midwest are primarily concentrated in Chicago and the Minneapolis-St. Paul area. Together, these areas accounted for almost 50 percent 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 percent are in the Minneapolis-St. Paul area.⁶⁹

Despite its reputation as a center for traditional manufacturing, the Midwest does possess something of a high technology base. Nearly 20 percent of the nation's high technology firms are located there, and more than half of these companies are concentrated in Illinois, Ohio, and Minnesota.⁷⁰ 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 percent of the nation's new business starts in 1987.⁷¹ In addition, the region has a strong university base with 6 of the nation's top 20 universities, in terms of corporate-sponsored R&D.⁷²

⁶⁷ Kevin Farrell, "The States Enter the Venture Capital Game," The New York Times, 27 January 1985, p. 12F.

⁶⁸ Robert Dixon, "In search of the Silicon Tundra," Alaska Business Monthly, November 1985, p. 29.

⁶⁹ 1987 CorpTech Directory.

⁷⁰ 1987 CorpTech Directory

⁷¹ Economic Analysis Dept., Business Starts Record, 1986/1987, Dun and Bradstreet Corporation, 1988, p. 4.

⁷² Michael O'Connor, "Increase in High-Tech Locations Influenced by University/Corporate R&D Link," Site Selection Handbook, June 1988, p. 600.

Table 6.7

Venture Capital Investments in the Midwest

REGION, STATE	\$ (Mil)	1968-1975		1981		1986		% Change 1975-1986
		% National	% Region	\$ (Mil)	% National	\$ (Mil)	% National	
MIDWEST	153.8	20.6	100.0	108.5	7.7	203.0	100.0	32%
OH	23.7	3.2	15.4	36.0	2.6	NA		--
IL	50.5	7.6	36.7	33.0	2.3	87	42.9	54%
MI	22.3	3.0	14.5	NA		NA		--
MN	19.8	2.6	12.9	NA		NA		--
Other	31.5	4.2	20.5	39.5	2.8	116	57.1	268%

Table 6.8

SUMMARY OF INVESTMENT AND COINVESTMENT DATA
FOR STATES IN THE MIDWEST REGION
(from author's database)

Region/State	# of Investments Received	# of Coinvestments Participated In
Midwest	555	4,298
Minnesota	210	1,485
Illinois	130	1,572
Ohio	96	817
Indiana	44	152
Wisconsin	40	151
Missouri	22	100
Kansas	6	21
North Dakota	6	0
Iowa	1	0
Nebraska	0	0
South Dakota	0	0

Illinois

Illinois, the leading center for venture capital in the midwest, attracts just 3 percent of all venture capital invested in 1986. This is a sharp drop from the 1960s and 1970s when Illinois accounted for over 7 percent 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 percent of the region's investments, and 88 percent of the Illinois total. The greater Chicago area accounts for 87 percent of all high technology firms in Illinois, and 22 percent of those in the Midwest. However, according to a recent article in *INC.* magazine, Chicago's high technology and venture capital environments are in dismal shape.⁷³ It 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."⁷⁴

Minnesota

Minnesota has a rather interesting pattern of venture capital investment. Although it is a small center, it retains a large share of its venture capital, capturing roughly 25 percent of the region's venture investments recorded in our database. Venture capital investments and high technology firms are highly concentrated in the Minneapolis area. All of the venture capital investments that we recorded for Minnesota and 92 percent of the state's of 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 startups. 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 percent of the Midwest region's venture financings. The state is also home to 15 percent of the region's high technology firms. Over 75 percent 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.⁷⁵

⁷³ David Moberg, "Can Chicago Be Saved?", *INC.*, March 1988, pp 84-89.

⁷⁴ *Ibid.*, p. 88.

⁷⁵ Sarah Glazer, "Research parks plug into the electronics industry," *Electronic Business*, 15 March 1987, p. 102.

Ohio

Ohio receives a small and declining fraction of venture capital investments. Its share of venture capital investment dollars has declined from 3.1 percent of the total investments in the 1968-1975 period to less than 2 percent in 1986. According to our database, Ohio received slightly over 8 percent 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 percent of the state's venture investments. The Columbus area had 15 percent of the state's high technology companies, and received 20 percent of Ohio's venture capital investments. Cincinnati was home to 12 percent of the state's high technology firms, and 18 percent of the venture investments.⁷⁶

The Sunbelt

The Sunbelt is composed of two subregions: the South, which consists of Delaware, Maryland, Virginia, West Virginia, Kentucky, Washington D.C., Tennessee, South Carolina, North Carolina, Georgia, Florida, Arkansas, and Mississippi; and the Gulf Coast area made up of Texas, Louisiana, and Oklahoma. The Sunbelt accounts for roughly 15 percent 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 percent, in real dollar terms. In 1986, the South accounted for \$261 million in venture capital investments, 9 percent of the national total. (See Tables 6.9 and 6.10)

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 percent of the South's venture capital investments. Again, the distribution of venture investments throughout the South 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 percent of the national total, and one-third of the region's total.⁷⁷ Georgia's success has been a relatively recent phenomenon, and according to a 1987 article

⁷⁶ Ohio's Thomas Edison Program is geared to generating new innovations and stimulating high technology development. See Edward J. Malecki, "Hope or Hyperbole? High Tech and Economic Development," *Technology Review*, October 1987, p. 49.

⁷⁷ Venture Economics