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Financing Innovation

*Robert D. Pavey**

I am really excited to be a part of this program. When I was asked to come join a group of attorneys and talk about innovation, I did not quite know what I was going to get myself into. This has been an exciting program, and I am really enjoying being part of it. I hope to add a little bit to the process and to talk about some different thoughts.

I have listed (see chart #1) the six primary areas I am going to talk about in the area of financing innovation. You will notice, to follow on some of the comments that we just heard from Deborah Wince-Smith and Dr. Stuart Smith, I do not list banks on this list. In my judgment, banks are not a significant source of financing for innovation, certainly not in this country. In reality, innovation is financed either by grant or by equity. It is not financed by debt. Therefore, it is not realistic to expect banks to finance innovation by making loans to young innovative companies.

Banks can, however, be in the equity business. They are, effectively in many countries and, to a degree, in this country through Small Business Investment Company ("SBIC") programs in that aspect of financing innovation. In fact, many of our major banks have been significant investors in technology, which is a little different than the pictures that we got in the last session.

Citicorp in New York, First Boston in Boston, and in Cleveland, National City, Society and Ameritrust, all had venture capital funds and have been participants in financial innovation. This is through equity vehicles of the kind that I will be talking about today.

The next myth, from my own perspective anyway, is that we can decide whether we should have or should not have an industrial policy. We have got one folks. The government is a significant supporter of innovation today. Deborah mentioned a number of, I believe, sixty or seventy billion dollars of government support for Research & Development ("R&D"). In Cleveland alone, the Cleveland Clinic and University Hospitals combined receive about \$100 million dollars a year of support from the National Health Institute ("NHI") for medical research. The commercial spinoff from this research is significant.

So, direct support of research, not only through Small Business Innovative Research ("SBIR") programs already mentioned by others,

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The following text was compiled from the transcript of the presentation made by Mr. Pavey at the Conference.

but in a much more extensive way, through research support in the mental and health care environment, in the computer environment and otherwise, provides very important government support for innovation. We should not forget this as we look toward how to be more competitive in an international economy.

We have a system that works well, and a significant portion of the companies that we finance and that other venture capitalists support, have their roots in government research. It is not a coincidence that there is a major innovative and venture capital activity in the Boston area. The government financed a number of Boston research labs, several decades ago, in the electronics industry. Similarly, it is no coincidence that you have major venture capitalists that support the research out in California, where there is a very strong university environment. There would have been even more of this in other universities if we had not had, for many years, an unspoken rule that commercializing technology somehow was not good for the academic environment, i.e., got in the way of teaching. Fortunately, those barriers are now being torn down in many institutions where they did indeed exist.

The first chart lists universities as a second source of financing (see chart #1). That is stretching things a bit, admittedly, because the universities tend to be more of a vehicle. They tend to finance innovation and research through government support, or through corporate support. The incremental dollars that they are contributing to the process may be more modest, but their role is very important and I wanted to mention it following the government's role. I will come back to the importance of the government-university partnership as a critical part of research financing.

Ms. Wince-Smith also mentioned individuals as a critical source of support for innovation. I have not listed the individual sweat equity, which was her first category, although it probably should be on the list. It is hard to quantify. We do not quite know how much of entrepreneurs' money is invested, but it is an enormously important part of the formation of a lot of companies.

I have listed third what is typically referred to as "angel investing" or "wealthy individual investing". To put a little more context on this, let me show you the summary of some data that was generated for the Small Business Administration (see Summary of Informal Capital, chart #2). This relates to a period from 1982 to 1987. Ms. Wince-Smith informed me that there is a more recent report that has just come out on the financing of small business in the United States by the informal investor network. I am a venture capitalist and I do not think that what I do is unimportant. However, in terms of the amount of dollars we put out, it is significantly smaller than this financing network, and in terms of the number of companies, it is smaller still. The key numbers to which I refer demonstrate that a half a million compa-

nies raise money every year from this informal network. It may be down a bit now as the venture capital industry has fallen off, but that is a significant number. They raise on the order of fifty billion dollars. The last two numbers on chart #2 are a sort of multiplier kind of thing that the government always tries to do to build numbers up. But let us make the math simple. You have about fifty billion dollars going into about 500,000 companies, so about \$100,000 per company is invested. For companies that are raising that kind of money, the primary source of capital is the individual investor.

Now what is the role of the institutional venture capital firms such as mine? We get a lot more press than the individual investor does. When many people say venture capital they really mean us, and that is flattering, but our role is basically the provision of money to a thousand companies a year. While this is not really a large number of companies, it is a large number of the really important new companies that come out each year, and we provide a couple of billion dollars a year to those companies. Again, relatively small. I saw somebody a few minutes ago with an IBM name tag on. I think IBM's annual research budget is, or at least was, larger than that. By simple division, again we provide a couple of million dollars a year to each of about 1000 companies. Who comes to venture capitalists? It is the company that needs to raise several million dollars of capital to get going. It is not the restaurant next door, it is not the local store, it is the company that needs meaningful equity capital to finance innovation. I will get into more detail about what kinds of companies and what kinds of industries we finance. If you think about our economic role, which is the provision of millions of dollars to young companies to finance innovation, it will be pretty clear what kind of industries need that kind of capital.

The next thing I have listed is corporate R&D (see chart #1). That is an enormously important source of innovation; too bad some of our corporations are not more innovative in how they use that money. If you think about government-advantaged and government-supported investment, it is important to recognize that all corporate R&D is tax deductible. So starting day one, a new project within a large corporation in this country is spending cheaper dollars than a start-up. They get to deduct the cost as of day one whereas the start-up gets to deduct the cost later if they are successful, and, if they have any profits from which to deduct the investment costs.

So, indeed, we have a policy which encourages R&D in our U.S. corporations, and we get a fair amount of it, and it is very important, and we need more of it. I will talk a bit more about what sort of things we should do to stimulate more of that activity.

Finally, the sixth financing source is the public markets. Normally we think of the public markets as financing more mature companies. I need only point to the biotechnology industry today to emphasize how

important the public markets are for financing innovation. It takes a very large amount of money to get one drug to market today. Maybe more than it should take, but this is due to the time it takes to get through a lot of the government FDA regulatory processes. By different estimates, this is a \$100 million to \$250 million cost per drug. For a group of venture capitalists who usually invest a few million dollars into a typical company, that is an enormous amount of money. You would think we must be crazy to finance any biotechnology companies. Why do we do it? Well, because the process, that Ms. Wince-Smith described, is working in the biotechnology industry today, whereas, it is not working in some other industries. Virtually every biotechnology company that we have financed has not only has raised money from venture capitalists, in some cases up to forty million dollars, but they have also gone out and raised money from corporate investors. There is a partnership between the larger corporate firm and the smaller venture capital financed firm that is working in the biotechnology industry today. It is not just foreign companies. One of the sad facts we find in other industries is that it is very difficult to develop a corporate partnership with most U.S. companies. It is hard in the computer industry and even harder in the machine tool industry. I would argue that this is not a regulatory problem, but it is a capital availability problem that we need to address as much as, or more so than, any other issue.

Our large domestic pharmaceutical companies, at least until very recently, have been very successful. They have done very well. They have had very low cost of equity capital because they are so profitable, and they can take some risks with that capital. It is working. They are putting money into the companies that we finance. This does not happen often outside the pharmaceutical industry.

Even that is not enough for biotechnology. The amount of money pharmaceutical companies tend to put into one of these companies, in support of research and in equity, for a very large program, is maybe fifty million dollars, and for a more modest program, about ten million dollars. It is important money. However, it, too, is not enough.

The public market is the reason this whole process is working right now because the public is being a venture capitalist to our biotechnology companies. Heaven forbid that should end. It will, obviously, cycle up and down. Public markets always do. However, public support of innovation is enormously important. We need to think in terms of tax policies and other things that encourage more of it if you want the process to work in other industries.

One of the indicators we look at for support of the venture capital process recognizes that the public market is really the market for the companies that we build (see chart #3, T. Rowe Price). Eventually, the public market provides liquidity to us so we can keep doing what we do. The issue is what does it pay for our product? What does it pay for

these young companies that we build? What you can see from the T. Rowe Price charts (lower half of chart #3) is that very high prices were paid back in the late 1960s. We all know what happened during the 1970s when that fell down drastically. Valuations increased again to high levels in 1983, fell back again, and have been low for about seven years. They have now begun to work their way back moderately.

As venture capitalists, we all thought we were brilliant in 1969. I got in this business in 1969 and, you know, it was easy to make money then. By 1973, '74 and '75, we were sitting around in my partner's house saying "Are we crazy? — I don't know if we can make any money in this business." By 1983, we were, again, brilliant. People were paying nice prices for what we were doing. We made a lot of money. We felt prosperous. I added a swimming pool onto the house. Everything was wonderful.

Since 1983, we have had a tough decade. The venture capital business has not been the best place to be. In part this is because we went through a period where even though our reputation was increasing as an asset class, and that is a term that the institutional investors who give us money use, we were not performing very well. During the 1980s, institutions could make more money in big cap stocks than they could make in venture capital. In addition, they invested in leverage buyouts where returns were better than in venture capital. The situation has not improved very much. The returns — relative multiples of young-growth stocks from the mid 1980s until 1993 — have bumped around one to one times the large-cap stock multiples. So the market is not willing to pay, and has not been willing to pay, any significant premium for growth over the last decade.

Now, I will try to give you a little more of a picture of how this venture capital group works, what kinds of things it does, and what has been going on in that market segment.

These are numbers that are well published but will give you a flavor of what has happened to venture capital in the environment that I just described. Referring to the Capital Commitments chart (see chart #4), in the 1970s, as venture capitalists, we raised very modest amounts of money, a couple hundred million dollars a year for the entire industry. This went up dramatically through 1983, stayed very high through 1987, and then started falling off and hopefully bottomed in 1991, and we may be ready for a few better years. What happened in this process? It is just what one would expect. All of this capital attracted lots more people in the venture capital business. It reduced returns. We began to look less brilliant than we looked earlier. The inevitable reaction was a downturn in the venture capital business.

Over this 1983-92 time frame we have, as an industry, received on the order of \$2.7 billion per year from institutions. What have we done with that \$2.7 billion per year? We put it back into young companies.

We financed innovation. Unfortunately, we do not have the final 1992 numbers for Venture Capital Disbursements (see chart #5), but the graph of disbursements by venture capital firms looks very similar to the graph of commitments to venture capital firms (see chart #4). I have broken the graph into two parts to show how much is invested in first-time raisers of venture capital versus companies that had already raised venture capital once and needed more. What you can see from this chart is what you would expect. When money was flowing into our industry at increasing rates, the majority of it was going into new investments. As it began to fall off after 1989, small amounts of it went into new investments and large amounts of it went into supporting existing portfolio companies. The sad fact is that in 1991, according to the Venture Economics data, only one hundred seventy-three companies nationwide raised money for the first time from a venture capital firm. That is about three and a half per state and less than one per venture capital firm. My firm did four or five. A lot of firms did not do any. So the venture capital industry has been trying to keep its current portfolio companies alive, and money has been very tight for innovation. That is what happens as you begin to squeeze down on the availability of capital from the venture capital industry.

To see more detail on that, look at Venture Capital Disbursements by Financing Stage (see chart #6). The black bar at the bottom of this exhibit is the seed and start-up capital. When you squeeze down on the venture capital process very small amounts of it go into what we call seed or start-up money. A bit more goes into early stage financing, and a fair amount of it goes into expansion financing and even into buyouts. The venture capital industry does the whole spectrum of this. These numbers relate to Venture Economics numbers which try to monitor what they call venture capital and try to exclude the firms which do exclusively a leverage buyout business. If buyouts are included, annual private equity investing averages ten billion dollars per year rather than \$2.5 billion for institutional venture capital alone. Today, most firms do some later stage and some earlier stage investing to have balance in their portfolio. If you are a seed company, a biotechnology company, a computer company, trying to raise seed capital from the venture capital industry, it is very tough. You are probably going to have to get started on a shoestring with individual capital unless you have a very special project. Hopefully, this will improve a bit as the venture capital environment continues to improve.

The next chart, Venture Capital Disbursements by Industry, is a fairly busy chart (see chart #7). I want to make a few points concerning what kind of industries are raising capital today. This will reinforce what you have heard and probably what you would expect. Four industries, Biotechnology, Medical Health Care, Computer Software, and Telecom & Datacom received over sixty percent of the money invested

by venture capitalists. That is not just in 1992, however, these have been big segments all along. On the other hand, we talked earlier about robotics, included in industrial automation, and how important that is to our society. The numbers are pretty sad. The number of dollars that have been invested by venture capital firms into industrial automation, have declined steadily — thirty-three million dollars in 1989, thirteen million dollars in 1990, three million dollars in 1991, and almost zero went into five companies in the first half of 1992. Why? It is because we have not made any money in that industry. My firm financed two robotics companies. I was on the board of both. I was a robotics and industrial automation specialist ten years ago. I worked nights and weekends and evenings to try to keep those companies alive and make them prosper. We had good technology. Yet, they both died, and they were not unique. There has not been one successful robotics company created in the United States.

I would venture to say that of those companies financed in 1989 and 1990, you would have trouble finding more than one or two that are even profitable. The primary problem we had was our domestic marketplace. Robotics, industrial automation, gets sold to big companies. The period of greatest investment in industrial automation occurred in the first part of the 1980s when our big companies, Caterpillar, International Harvester, and the automobile industry, were fighting enormous problems of international competitiveness. They just did not have the capital to invest. They come to these small companies and say you are our savior, put in this fancy equipment, and then they come back three weeks later and say it is not working come fix it.

Each of these companies with whom I was involved ended up shipping products, theoretically at best, with twenty or twenty-five percent gross margins. You cannot advance growth that way. By the time they had fixed problems with customers, they had negative gross margins. We were shipping dollars out with the product. That has happened throughout the industrial automation area.

So, it has been a tough business. Supplier/customer collaboration is essential in this industry and it did not exist. Some companies tried it. General Motors invested money in five machine vision companies, but then bought very little with them. The machine vision industry has done a little bit better than the robotics business. Most of these companies are still alive and struggling. A few are beginning to prosper, but it has been a very tough area. We need much more of that kind of collaboration, and we need our bigger businesses to have more capital to invest so that they can help these young companies survive. To restate the obvious, these companies have got to have customers. In Japan, by comparison, big companies had the capital to invest, and the result is a strong industrial automation industry. Today, new U.S. automation companies face tough international competition. That is why many fail.

Wrapping up, in my judgment there are three things that I would like to focus on to describe the way innovation advances (see chart #8). I think it is important to understand this process in our society in order to understand how to finance it. First, much of the innovation starts in universities. We have an enormously powerful asset in our university network in North America — in the United States, and in Canada, also.

The government should focus on financing more research in those universities. Today, university researchers are having trouble getting equipment, they have trouble getting capital. As capital gets tight, research funding gets squeezed.

Second, young growth companies are the best at commercializing that research. Entrepreneurs raise the capital from their own money and they raise it from venture capitalists. If you think of any significant new industry, in spite of the relatively small number of companies that we venture capitalists have financed, virtually every major company in these industries was financed by venture capital. I cannot go back to the beginning of the computer industry but, for example, virtually every mini-computer company raised venture capital, DEC, Data General, and all of those that followed. Certainly, every personal computer company or micro-computer company raised venture capital. My firm, for example, was lucky enough to be one of the investors in Apple. A very large number of the major software companies have raised venture capital. Certainly, biotechnology is venture capital financed.

Third, big business is best at developing technology. It is best at expanding technology, and using technology, but it also needs capital to do that.

It is clear to me that we need to focus in this country on the cost of capital, on more patient capital available at each of these three major steps in this process to make this whole process work. To me, that leads to tax policy and other things we're going to talk about more today. Tax policy impacts capital cost for the second and third stages of innovation while direct support from government is more important at the first stage — the university research stage. I agree with Ms. Wince-Smith, we do not need horizontal consortia. Virtually every time we try that, some other company that is not in the consortium comes up with the exciting and critical development.

T.J. Rogers is famous for his speeches on this subject. To some degree, I agree with him. He goes a little too far sometimes, but I fundamentally support his emphasis on the entrepreneurial process. That is the way the process works, with entrepreneurship, and if we think about it that way we are more likely to finance it correctly.

Chart #1

INNOVATION IS FINANCED BY

I. GOVERNMENT

- Direct Support of R&D
- Tax Incentives

II. UNIVERSITIES

III. VENTURE CAPITAL — INDIVIDUALS

- Reinvesting Personal Savings Without Liquidity
- \$25-\$50 Billion/year in U.S.A.
- 250,000-500,000 Companies/year

IV. VENTURE CAPITAL FIRMS

- Allocation of Institutional Capital
- \$2-\$4 Billion/year in U.S.A.
- 1,000 Companies/year

V. CORPORATION R&D

- Tax Deductible Expenditure

VI. PUBLIC MARKETS

- Reinvesting Personal Savings with Liquidity
- Determine Cost of Equity Capital

Chart #2

**Summary of Informal Capital
(U.S. Total)**

<u>Scale Measurement*</u>	<u>Estimated U.S. Total</u>
Firms with Investors	445,600
Number of Investors	719,600
Number of Annual Investments	489,000
Annual Value of Informal Equity Invested	\$32.7 billion
Annual Value of Informal Debt Capital	\$22.9 billion
Total Annual Value of Informal Capital Supply	\$55.6 billion
Annual National Informal Capital Supply	\$22.3 billion
Annual Pool of Informal Capital	\$77.9 billion

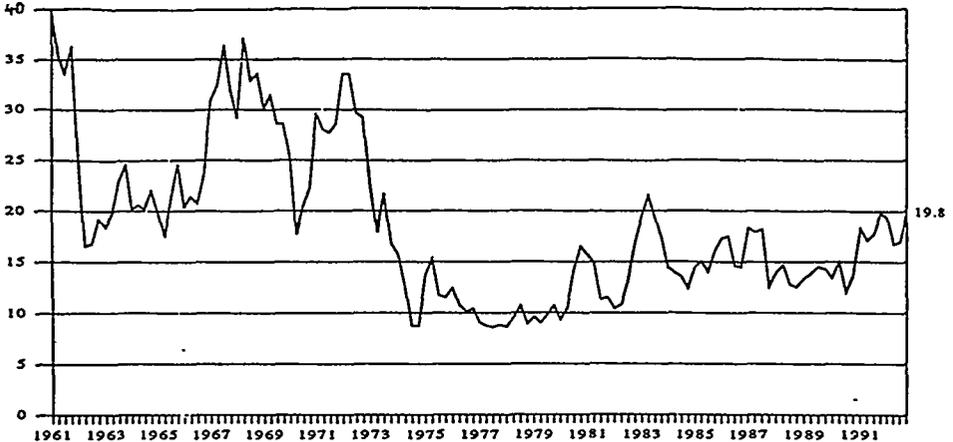
*Annual numbers reflect a composite yearly average over the period 1982 — 1987

SOURCE: Applied Economics Group, Inc.

Chart #3

T. ROWE PRICE NEW HORIZONS FUND, INC.

P/E Ratio Of Fund's Portfolio Securities
(12 Months Forward)
December 31, 1992

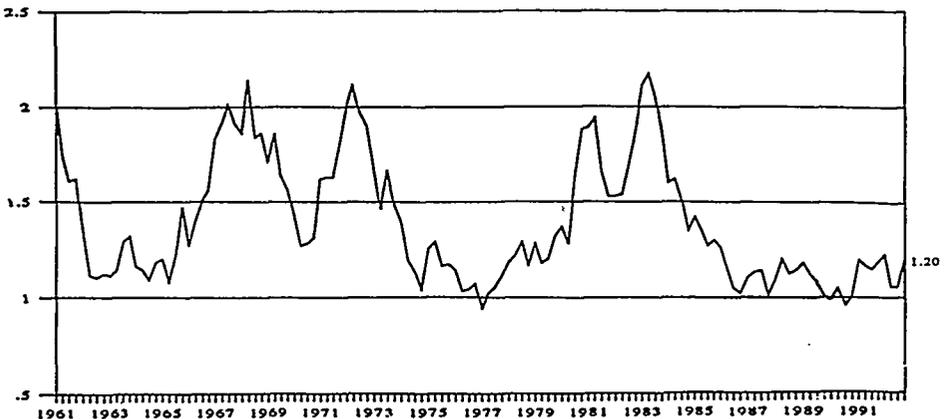


This chart is intended to show the history of the average (unweighted) p/e ratio of the fund's portfolio companies. Earnings per share are estimated by the fund's investment advisor from each quarter end.

T. Rowe Price Associates, Inc.

T. ROWE PRICE NEW HORIZONS FUND, INC.

P/E Ratio Of Fund's Portfolio Securities
Relative To The S & P "500" P/E Ratio
(12 Months Forward)
December 31, 1992



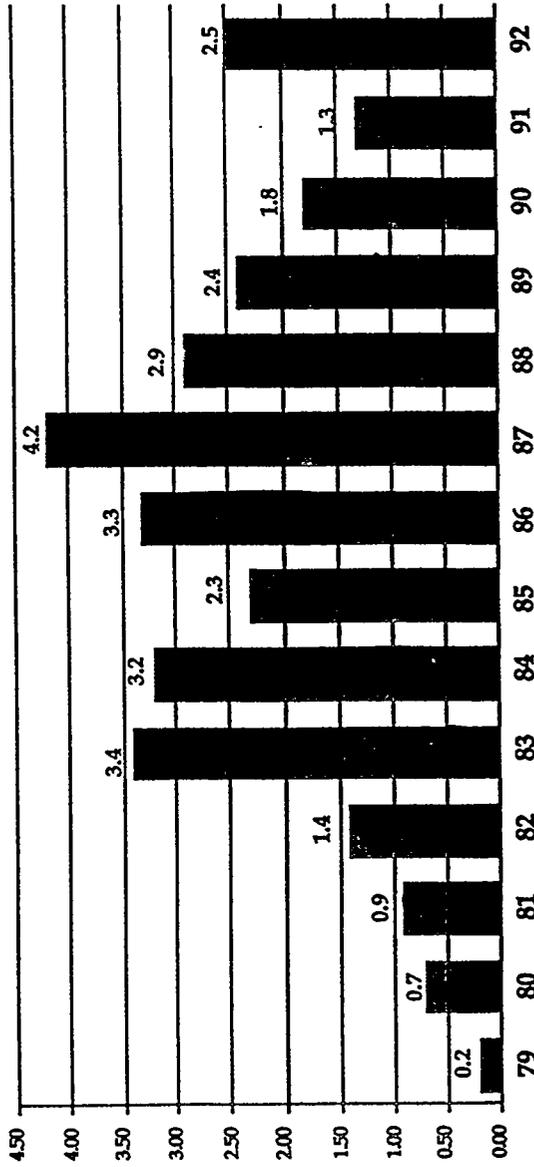
This chart is intended to show the history of the average (unweighted) p/e ratio of the fund's portfolio companies compared with the p/e ratio of the S & P "500" index. Earnings per share are estimated by the fund's investment advisor from each quarter end.

T. Rowe Price Associates, Inc.

Chart #4

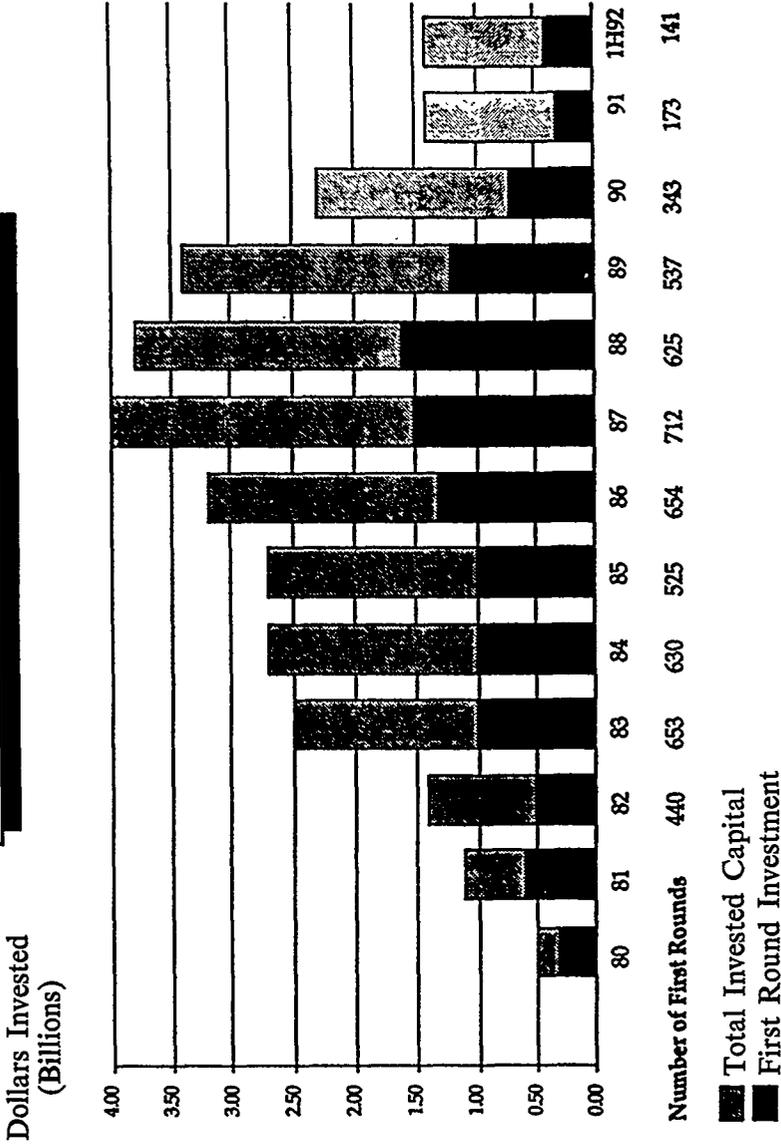
Capital Commitments to Independent Private Venture Capital Firms

Dollars Received (Billions)



SOURCE: Venture Economics

Chart #5
Venture Capital Disbursements

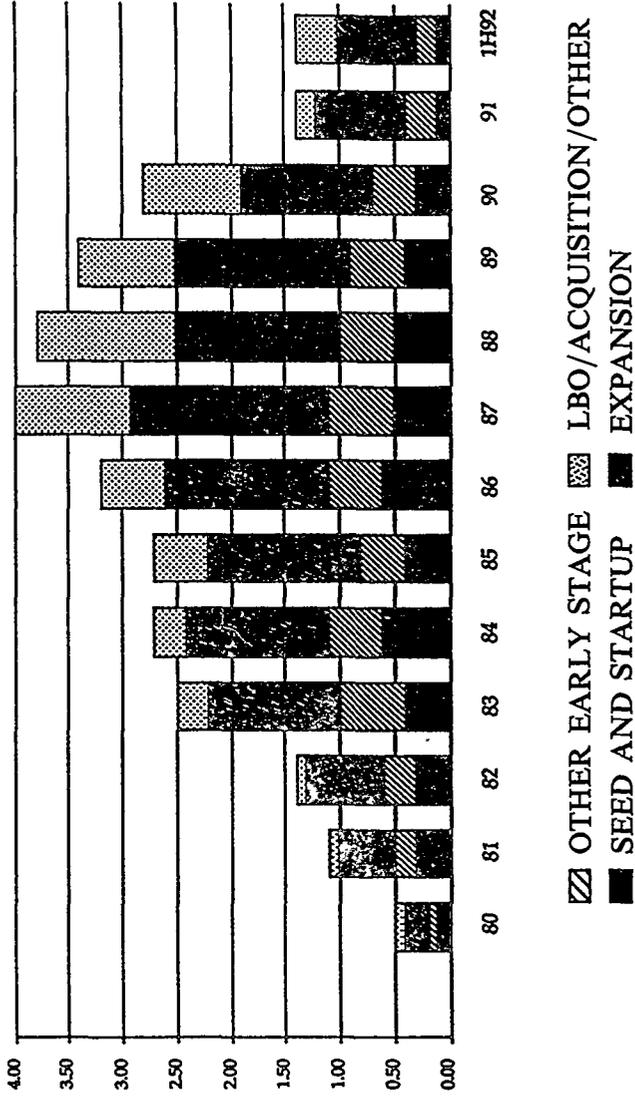


SOURCE: Venture Economics

Chart #6

**Venture Capital Disbursements
By Financing Stage**

Dollars Invested
(Billions)



SOURCE: Venture Economics

Chart #7

Venture Capital Disbursements
By Industry

	1H92		1991		1990		1989	
	\$(Mil)	No. of Cos.						
				Total	Total	Total	Total	Total
		New		New		New		New
Biotechnology	149	55	112	60	151	77	251	97
Medical/Healthcare	223	108	152	115	317	177	469	198
Computer H/W	74	55	168	79	216	101	342	158
Computer S/W & Service	293	131	337	178	302	177	358	204
Telecom & Datacom	190	75	169	96	224	109	336	123
Commercial Comm.	9	15	20	14	67	17	154	40
Other Electronics	94	50	129	69	123	78	267	114
Industrial Products	54	32	47	44	64	64	197	95
Industrial Automation	0	5	3	10	13	11	33	21
Energy	23	6	3	4	18	13	17	12
Consumer	79	53	135	68	189	104	370	144
Other	186	48	83	55	238	90	468	149
Total	1,374	633	1,359	792	1,922	1,018	3,261	1,355
				173		259		492
				17		35		84

Chart #8

CONCLUSIONS**I. UNIVERSITIES**

- Centers for Research & Innovation
- Need Help with Commercialization
- Need Government Financing

II. YOUNG GROWTH COMPANIES

- Best at Commercialization
- Created Virtually Every Exciting Industry in U.S.A. in Last 50 Years
 - Semiconductor
 - Minicomputer
 - PC
 - Software
 - Biotechnology
- Need Venture Capital

III. BIG BUSINESS

- Best at Development
- Need Patient Capital