

INITIAL CAPITAL
for the
NEW TECHNOLOGICAL ENTERPRISE

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ABSTRACT

The article presents an assessment of the capital market for technology-based firms, focusing upon the links between the stages of evolution of a firm and the investment preferences of various capital sources. These factors lead to an expectation that initial capital will be supplied most frequently by the entrepreneurs themselves from their own savings, secondarily by their families and friends and by private investors, all these being sources of capital outside of the formal channels. More substantial but still initial funding from "wealthy family funds", special "seed" funds and somewhat more conventional venture capital funds are expected to be the primary complements of the informal sources.

Data from studies of new technological firms support these expectations, providing evidence of the usual small initial capital base (almost half with less than \$10,000) and the dominance of personal savings as the principal source of initial capital (74 percent of the companies). "Outside" sources of capital are responsible for the larger initial investments when they occur. Larger amounts of initial capital are both contributed and raised by larger groups of co-founders, especially when the founders are involved in the companies from the outset on a full-time basis. Specific plans for the company are associated with greater initial capitalization, as well as with raising outside capital, as is also true for the effect of having an initial product. The needs for initial capital vary enormously by amount and intended use as a function of the type of business being started, with consulting firms and software companies requiring far less than hardware developers and producers.

INITIAL CAPITAL FOR THE NEW TECHNOLOGICAL ENTERPRISE

Entrepreneurial people provide the initiative, the energy and the vision for launching a new company. Advanced technology often provides the unique competitive advantage over existing companies or the basis for creating a new market. But money provides "the grease", the wherewithal to make it happen, even for the high technology firm.

In recent years numerous books and articles have been published on how to manage venture capital investing along with even more publications on how to raise capital for the new enterprise. The related research literature has been growing at a rapid clip, as indicated by the fact that approximately eleven percent of the papers presented at the annual Entrepreneurship Research Conference since 1981 have focused on venture capital and an additional six percent on other aspects of financing. (Hornaday & Churchill, 1987) A reasonable number of these papers have looked at technology-based firms and several contain data regarding initial financing of these companies. This article establishes a general background for understanding the financing of a technological firm by first discussing the several stages of a company's financial development and the variety of potential financial sources relevant to the firm, utilizing the research literature to help provide this background. This discussion leads to a set of expectations or hypotheses as to the initial sources of capital for the technological enterprise. Empirical studies of more than one hundred technological firms then provide the detailed data for verifying these expectations, indicating the sources and extent of initial capital base of the technical enterprise and the factors affecting this initial financing.

STAGES OF FINANCIAL DEVELOPMENT

The new technology-based firm evolves through a succession of several stages of corporate growth and parallel development of its financial needs. The period of time during which a company can be classified in a particular phase varies widely among firms and the dividing line between phases is at best fuzzy. Yet the relative stage of evolution does strongly influence the type and amount both of capital required and especially of capital available. Ruhnka & Young (1987) surveyed executives of 73 venture capital companies and found that in general they perceived five different stages of new company

development, from seed to exit, each stage characterized by distinctive features. Of most importance these potential investors estimated sharp decline in their risk of loss of investment, depending upon the stage at which they invested, from 66 percent at the seed stage down to 20 percent at the exit stage. (p. 181) To understand this relationship more clearly I shall first examine the general characteristics of the firm at each stage, which in turn imply the nature of its likely financial backers. Empirical research will later be used further to illuminate these financing relationships.

Traditionally the technical firm has been visualized as going through a usually pre-company R&D stage, followed by three phases of corporate development: (1) start-up, (2) initial growth, and (3) sustained growth. The research and development phase often takes place in the laboratory of some other "source" organization or the basement of a founder's home, often while the founders are still employed "full time" for another organization. It involves experimental verification of product principles and may include attempts to determine commercial applicability. Few resources other than the founders' time are generally employed at this "pre-venture stage". In recent years the financial community has become more involved in this pre-company stage, often with university laboratories or their direct spinoffs, in the long-term funding of ambitious R&D programs with hoped-for commercial outcomes. Sometimes the mechanism of an "R&D Limited Partnership" is employed during this stage, especially in recent years with biotechnology companies, but the R&D stage (especially R !) remains a largely pre-corporate or at least unfunded aspect of most new companies' formation and development. The R&D stage does sometimes overlap with the "zero stage" of start-up firms, as will be discussed below.

Phase 1 -- Start-up

The start-up phase begins with the founding of the company and ends, more-or-less, when the company has experienced significant sales (at least a few hundred thousand dollars per year) and has developed one or more products or services that exhibit growth potential. In recent years the start-up phase has been subdivided conceptually into the "seed stage" or "zero stage" and the "first stage". During the so-called "zero stage", the new company works out its basic technology, formulates its initial strategy, and rounds out the start-up team.

At the outset of its "seed phase" the company often lacks an operating prototype of its intended product and even has little in the way of a formal business plan. Many companies carry what we described above as a "pre-company R&D stage" into this "seed phase", continuing to solve key product development issues and moving toward an operating demonstration prototype of their initial product. Following the seeding activities is the more conventional "first stage", during which the company generally has produced a reasonably well-defined business plan, an emerging organizational structure built up around several key committed personnel, and a product for which at least some level of commercial applicability has been demonstrated.

During the entire start-up phase the new technological firm typically devotes considerable time to product development. It is dealing with only a few customers but is actively seeking new marketing/sales channels. The firm is housed in modest facilities, using barely adequate equipment. It has little or no available financial collateral. Typically few of the people in the company have substantial management experience; a large portion of the founders and their early employees are technical people by education and work experience. The company is able to react quickly when opportunities arise. However, the company is usually losing money.

The financial needs of the firm during the start-up phase are many. It needs capital to finance product development, primarily to support salaries for the technical personnel, despite the fact that many or all of them are being paid lower salaries than in their previous jobs, earning by their financial sacrifice the so-called "sweat equity" ownership in their company. Some capital is also needed for equipment. Working capital may be required if the company is already producing products for sale. Since the company is losing money, the entrepreneur must turn outside the firm for capital.

But what type of investor would be willing to supply initial capital to such a new company? Since the investment is so risky, the potential payoff must be high in order to outweigh the high probability of failure. The capital source must be patient, willing to wait for five to ten years for a return. He, she or it must trust unproven management to develop, produce, and sell a product or service that often does not yet exist. Such an investment is viewed by many as analogous to putting several hundred thousand dollars or

more on the Daily Double!

Phase 2 -- Initial Growth

The initial growth phase can be felt to begin when the company has completed the development of a product line and has sufficient sales to justify an expectation of rapid growth. The phase may be regarded to end when the company has lived up to such expectations and demonstrated a capability to operate profitably and grow quickly. During this phase the company matures somewhat. It begins to work on product quality and on lowering unit costs. Although gaining new customers it is also beginning to face some competition from other small firms and sometimes from large corporations as well, giving the young company strong incentives to develop new products. The company is operating profitably, but the resultant cash flows are typically insufficient to supply the needed growth capital.

The problems which the firm faces are also changing. Plant and equipment are needed. Working capital needs are expanding with the growth in sales. Key management personnel are needed as production, sales and marketing, and research and development become important functional areas. Management and operations control become important to keep the company operating efficiently.

The type of financial backers which the firm attracts tends to change with the company's characteristics. The risk and uncertainty associated with the company decrease. The young company still offers the opportunity for a large payoff, but the probability of failure, though still large, has decreased significantly. The investment need not be locked in for more than two to three years, if the founders are willing and the financial market permits the company to go public or to be sold to a larger firm during these next few years. The company no longer needs a gambler to supply capital, but phase two investors must still be speculators at least over the near term.

Phase 3 -- Sustained Growth

Having solved its initial start-up and early growth problems, the successful company emerges as a growth business. It has annual sales in the millions of dollars and employment numbers in the hundreds. The enterprise

begins to face many of the problems of the large corporation but on a smaller scale. The firm serves many customers with a variety of products and services and is faced with strong competition. Profits and cash flows are sufficient to meet the majority of its capital requirements, but new growth possibilities are continually being presented. Indeed, growth rate of the company may be the source of its most serious challenges, including financing the growth.

The major problems facing the entrepreneur change significantly during phase three; he is now required to think about overall corporate direction, development of multiple product lines, employee morale, communications, and long range planning. Potential merger or acquisition candidates present themselves; and the company itself is courted by larger corporations. Tax and legal considerations loom increasingly large. The entrepreneur may find himself no longer the central figure of the company and he may wish to sell his interest and retire or start over again. The company has ceased to be a new enterprise and has become a growth business, maybe the IBM of the future!

Despite, indeed perhaps because of, its speculative future prospects, the company has undoubtedly become attractive to the public. If it had not previously issued stock publicly, it can now turn to the public financial markets with some degree of confidence. Long term loans are now also available since the company has sufficient assets to serve as collateral. The technological enterprise, through its ingenuity, efforts, persistence and good luck, has stood the test of time and established itself as a going concern.

FINANCIAL SOURCES

A wide variety of financial sources are potentially available to fund the technology-based company's capital requirements through the successive stages of its growth and development. But embryonic technological enterprises are quite different from most other new firms in their lack of tangible resources. Many research- or technology-based companies start out with little more resources than an oscilloscope and a soldering gun or a magnifying glass. Many begin with only the entrepreneur's intelligence and drive as inventory. With little else for collateral, the entrepreneur's searches for funds from banks and other formal financial institutions are also

often fruitless. Alternatively, the term "venture capital" often comes to mind when thinking of the initial financing of new enterprises. And yet, it has long been true (and still is!) that the bulk of financiers known as "venture capitalists" do not support the earliest stage of capital acquisition for the vast majority of technology-based enterprises. Venture capitalists generally prefer later-stage investments in growing enterprises, not early-stage investments in technological start-ups. (See Rubenstein, 1958, for historical evidence.)

Despite all the attention paid to them, venture capital firms of all sorts (including "wealthy family funds", conventional venture capital firms, seed capital funds, SBICs, as well as financial and non-financial corporations operating their own funds), still account for only a small fraction of initial financing of new firms. At the extreme Dunkelberg & Cooper (1983, p. 370) found less than half of one percent of their sampled companies funded by venture capital firms. But this is due in part to the fact that their sample "included few of the growth-oriented, high-technology companies which are of particular interest to venture capital firms." Bygrave & Timmons (1985, p. 115) found that the 1978 decrease in capital gains tax was followed by a sharp increase "in the proportion of ... first round [venture capital] investments in highly innovative technological companies ($p < .0001$). The proportions of seed-stage companies [also] showed an increasing trend ... ($p < .002$)." But recent data on the entire venture capital industry (*Venture*, 1989, p. 55) show that only 2 percent of their 1987 investments went into so-called seed-stage firms and only 11 percent went into so-called start-ups, a significant decline from the 22 percent startup funding in 1981. Fully three-fourths of the venture capital industry's investments now go for second-stage and later-stage financings or leveraged buyouts of established companies.

But if not the venture capitalist, then to whom does the entrepreneur turn for funds to finance his dreams? Although initial requirements may be low, who is willing to gamble on the start-up's success? And once the future begins to look promising, where can the entrepreneur find several hundred thousand to a few million dollars of growth capital? The many classes of potential financiers for new technical enterprises are examined here in an effort to determine their resources, attitudes toward risk, selection criteria, preferred investment terms, and post-investment relationships with the

young technical firm. I will consider them in the order of their general likelihood of being an initial investor in the new firm.

Personal Savings

Undoubtedly the most available source of capital to the entrepreneur is his personal savings. Indeed, Dunkelberg & Cooper (1983) had found personal savings, either alone or in combination with other sources, to be the primary source of financing for 59 percent of the 890 owner-started firms they studied in a wide variety of mostly non-technical industries. Tyebjee & Bruno (1982) indicated similar dominance of personal savings in the funding of 185 California technology-oriented companies. However, those savings are typically quite limited and the average individual scientist or engineer in his early 30s would have difficulty in raising more than \$25,000 to \$50,000 on the strength of his savings account, his signature, and his available collateral. The entrepreneur must realize though that he may be required by other investors to gamble much of his own assets on his company as a sign of good faith. It is especially important that he and his co-founders own the bulk of the company initially, as later dilution of their ownership will necessarily follow from the required acceptance of increasing amounts of outside capital. The entrepreneur should recognize that his potential capital gain is phenomenal if the company proves successful and that he should be risking much of his own "wealth" if the future looks bright.

Personal savings then are the foundation of initial capital. Usually additional funds are not needed for close to a year or more, depending on the scale of initial efforts. The entrepreneur can make many non-monetary forms of investment in the company in the form of patents, developed products, and free labor, previously referred to as "sweat equity". However, the assets of the entrepreneur are all too soon exhausted and he must turn to outsiders for capital. If the entrepreneur is personally wealthy, from birth or from previous entrepreneurial success, the need for outsider investments may be delayed significantly.

Family and Friends

Next to personal savings the assets of an entrepreneur's relatives and friends are probably most available. The Dunkelberg & Cooper study (1983)

cited earlier found that friends and relatives were the most important source of capital for starting 13 percent of the businesses in their survey of members of the National Federation of Independent Businesses. Such investments often take the form of short term loans, although the loans may later be changed into "equity" investments at the insistence of subsequent investors. The main advantage of such funds is that they are relatively easy to get. The investors know the entrepreneur and have assessed his capabilities. Often the entrepreneur, unsure of whether his venture will succeed, properly feels reluctant to "take advantage" of such close personal relationships to raise money. The major disadvantage if friends and relatives do invest is that they may feel that the investment gives them the right to advise or actively interfere with management. Therefore, although such "naive" money is relatively easy to obtain, many problems may result from its acceptance.

Private Individual Investors, or "Angels"

The great majority of initial investing through outside investors has traditionally been undertaken by wealthy individuals. Gordon Baty long ago characterized the traditional private venture capitalist as having a tax bracket favoring capital gains. Furthermore, being "accountable only to himself for his actions, he can afford the inevitable loss and he often has motivations for investing which are not strictly economic". (Baty, 1964) Non-economic motivations include a sense of gambling, participation in an exciting growth company, especially the involvement with young bright people, and sometimes satisfying his sense of social responsibility, perhaps related to his wealth. Unfortunately the current lack of tax differences between regular income and capital gains may well affect this individual's motives and actions.

The private individual seldom seeks out investments. Instead he learns of opportunities from contacts within the financial community of which he is often a member. Investment bankers, commercial bankers and brokers all refer companies to him. Occasionally the prospective individual investor participates in local groups like the MIT Enterprise Forum, where early-stage entrepreneurs present their aspirations and problems.

William Wetzel (1983, 1986, 1987) and his followers (Neiswander,

1985; Tynes & Krasner, 1983) have carefully analyzed this informal risk capital investor, whom Wetzel calls a "business angel", and the market in which they operate. The angel's resources are considerable, with venture investment portfolios aggregating in the neighborhood of \$50 billion according to Wetzel (1987, p. 412) and a study funded by the Small Business Administration (SBA) (IC² Institute, 1989, p. 40). Acting alone or through a syndicate of friends and acquaintances he can raise as much as \$1,000,000 for a given deal, although he seldom does. The several studies cited above find that a large fraction of the deals are for \$50,000 to \$300,000, typically involving an angel and one or more of his friends, each putting up \$25,000 to \$100,000. These investors usually do not seek a controlling interest or management position in the company, but most prefer to be consulted on major management decisions.

Such investors rely heavily on the advice of their friends and other backers when making investment decisions. Few make a detailed analysis of the situation, evaluating the company primarily on the basis of its management. The investments are usually straight equity. The wealthy individual venture capitalist thus tends to qualify as the type investor needed in the company's initial phase. The entrepreneur need only find the right angel for his company; this is not easy, despite the computerized "matching network" created by Wetzel for informal investors in the New England area and now also replicated elsewhere in the United States. Patterns of informal investor behavior seem comparable in California and New England (Tynes & Krasner, 1983) as well as in the midwest (Neiswander, 1985).

Wealthy Family Venture Capital Groups

More-or-less next in line, at least historically, in likelihood of investing at the outset of a technological enterprise is the formal private venture capital investment group established by a wealthy family. Shortly after World War II several wealthy families created such organizations to invest family resources in young businesses, especially those based on advanced technologies, in search of capital gains. The largest of these groups, led by such people as Laurance Rockefeller, Jock Whitney, and Payson and Trask, became well-known within the investing community and instrumental in funding numerous technological enterprises. Rather than invest informally and as individuals (as the "angels" above) those families

usually funded an autonomous investing organ (corporation or partnership), managed by a staff of full-time employees who analyze incoming investment proposals, make the investment decisions (usually without family participation in the decision), and work with the investee companies during the post-investment period. Venrock, founded by the Rockefeller family, is perhaps the best known of the current survivors of these organizations.

As these family groups developed they evolved a certain style of operations that became the basis for today's U.S. venture capital industry, with resulting advantages and disadvantages to the entrepreneur who deals with them. The advantages to an entrepreneur who gets funds from such family groups are many. Other investors look more favorably at the new company because these larger family groups have a reputation for choosing only the best companies. This of course makes it easier to obtain additional capital later. Their resources are essentially unlimited, making it possible for the entrepreneur to come back later for more capital. The staffs of such family groups have had top quality reputations, with both business and technical expertise. The final advantage is that they are patient investors, willing to wait five or ten years for their returns, and they do not have to answer to stockholders or outside investors for their performance.

The disadvantages associated with investments by the organized family groups are also numerous. They have been very discriminating in choosing their investments, investing typically in less than 1% of the proposals they receive; the entrepreneur must submit a detailed proposal (called a "business plan") to be considered. The investors will demand one or more positions on the board of directors of the company and detailed ongoing reports of operations. They may insist on placing a staff member in an operating position in the company if growth does not materialize, or even worse from the entrepreneur's perspective, they may step in and replace the founding entrepreneurial head of the company. They are also rather slow in reaching a decision, so the entrepreneur must approach them several months before he needs the money. At their beginnings the family venture capitalists often avoided initial financing, but now tend to be willing to put in small sums as early-stage investments, especially in companies headed by entrepreneurs with whom they have had prior experience.

Venture Capital Companies

The family venture capital groups were the models for the formation of specialized closed-end investment companies that focused on venture capital. The first of these was American Research and Development Corporation (ARD), organized in Boston in 1946 in large part through the efforts of the then Chairman of the Massachusetts Institute of Technology (MIT), Karl T. Compton, and a number of prominent alumni and friends of MIT, to move research and technological ideas forward into the market. This approach led to formation of and ARD investments in such MIT spinoff companies as High Voltage Engineering and Ionics. Gradually ARD's approach changed under the guidance of Georges Doriot, a professor at the Harvard Business School who served as president of ARD, and who moved ARD toward imitation of the larger family groups in almost every respect. A full-time staff of professionals annually screened hundreds of incoming proposals, giving careful consideration to perhaps ten percent of them, and eventually investing in two to three percent of the companies. In its early days ARD usually took dominant stock ownership position in a company through an investment of \$100,000 to \$500,000 in the form of convertible debentures, with \$200,000 buying 80 percent of High Voltage in 1946 and \$100,000 gaining 75 percent of Ionics in 1948. Its principal success by far was the \$70,000 start-up investment in 1957 that purchased 78 percent of Digital Equipment Corporation, that success dwarfing all other actions ever taken by ARD, accounting for 86 percent of ARD's total value distributed to its stockholders. (Stevenson, Muzyka & Timmons, 1986, p. 383)

Following the lead of pioneers like ARD other professionally-managed venture capital funds were formed, usually raising their money privately from wealthy individuals, banks, pension funds and corporations. Whereas ARD had strong bias toward companies located in the greater Boston area, funds were formed in other parts of the United States with tendencies toward regional biases. Florida & Kenney (1988) trace the evolution of these regional venture capital complexes and their current behaviors as investors, especially in regard to high technology firms. Gradually these professional funds proliferated and came to dominate the venture capital sector, becoming far larger in magnitude of total funds managed and invested than the earlier-formed wealthy family funds. Venture capital companies such as TA Associates, Hambrecht and Quist, Kleiner Perkins and many others became well-known for technology-oriented investments in particular. Recent

analysis demonstrates "a core group of highly skilled and experienced venture capital firms accounting for a disproportionate share of HITV [highly innovative technological venture] investing. The 21 venture capital firms that were most active in HITV investing represent less than 5 percent of the 464 firms in our database, yet they were involved in nearly 25 percent of all the investments in HITVs." (Timmons & Bygrave, 1986, p. 168) And despite the general aversion of most venture capital companies to early-stage investments, Fast (1982) has shown that venture capital investments are a leading indicator of the growth of new technological industries, perhaps driven by the investment behavior of this "core group".

In general the professionally managed venture capital funds follow patterns of investment analysis, decision-making and management similar to those practiced first by the family funds and then by ARD. Careful screening and selectivity characterize their investments, only 2% of the proposals received getting a favorable response (Maier & Walker, 1987, p. 208). The venture capital firms aspire toward high rates of potential return to compensate their investors for the presumably high risks being taken, and devote considerable post-investment effort to monitoring and actively assisting their portfolio companies. Indeed, founders of many high-technology companies "reported that they actively seek out those venture capitalists with noteworthy reputations for their nonmonetary, high value-added contributions to fledgling firms." (Timmons & Bygrave, 1986, p. 169)

Among the hundreds of venture capital funds is a small group of so-called "seed funds", like the Zero Stage Capital Equity Funds which I co-founded, that focus on investments primarily in the initial and early stages of technology-based firms. These "seed" or "zero stage" funds follow in the tradition of the earliest activities of the wealthy families and of ARD in helping to put together the startup enterprises, working very closely with the company founders to round out their team, more sharply define their business objectives, help develop a completed business plan, providing possibly more value in advice and "sleeves rolled up" assistance than in the capital itself. Such funds typically invest from \$200,000 to \$500,000 at the initial stage of a new company, with perhaps matching funds available for participation in a later second round of financing. The seed funds seldom have "deep pockets", and seek kindred spirits for sharing the initial investment so

as to ease the difficulties that might be experienced later in securing the hopefully much larger requirements of growth financing. One unique seed fund that has helped many Massachusetts startups is the Massachusetts Technology Development Corporation (MTDC), state chartered and funded during a period of low public availability of venture capital. It works very closely and effectively with other Boston-area seed funds to help initiate and enhance early growth of local technical firms.

Small Business Investment Companies (SBICs)

A special form of venture capital company that was especially important in the U.S. during the early 1960s was the SBIC, enacted by Congress in the 1958 Small Business Investment Act. Private capital was given tax incentives and low interest leveraged loans from the U.S. government to invest in small business. Several hundred SBICs were chartered with combined assets of nearly \$1 billion, but only 50 of them had assets greater than \$1 million. The resulting generally small financial organizations invested heavily in real estate and the trade sector, with some of the larger ones investing in new technical companies. In this early period 15 to 20 percent of the SBIC investments were made in early-stage companies that were less than one year old. But probably less than ten percent of the SBIC capital was invested in technologically-oriented companies. Overall, however, the SBICs did have significant impact by the principal fact of their funds availability during a period of time that was otherwise relatively dry of small business investing resources.

A recent analysis of SBIC activity shows that "the number of SBIC financings to firms 1 year or younger exceeded the combined financings of 3 year old and 2 year old firms" (Feigen & Arrington, 1986), indicating that they still provide a critical role to young companies. However, the 91 independent SBICs control less than half of one percent of the capital in the venture capital industry, restricting the magnitude of their overall impact. (*Venture Capital Journal*, 1989, p. 11) Data are not available on how many of them focus on technologically-oriented investments although personal experience supports that some large SBICs, such as Bank of Boston Ventures, are active and important participants in investments in early stage technology-based firms.

Non-Financial Corporations

Beginning in the early 1960s and increasing significantly only in the 1980s, major manufacturing firms have become interested in supplying venture capital to young technological companies. Many of them are seeking to supplement their in-house research and development efforts by backing entrepreneurs in hopes of gaining access both to technology and engineering talent. Initially companies such as DuPont, Ford, Texas Instruments and Union Carbide experimented with this approach of direct venture capital investment in new or early stage companies. Later Exxon, Inco, Lubrizol and Monsanto demonstrated active and effective programs of investment that encouraged widespread participation by many Fortune 500 corporations. Today 84 U.S. industrial corporations are managing approximately two billion dollars in dedicated venture capital pools, in addition to many more corporations that invest in pooled funds managed by professional venture capitalists, in addition to still more corporations that occasionally make a strategic investment in a new company but do not have ongoing venture investment activities. (*Venture Capital Journal*, 1989, p. 11)

Non-financial corporations differ significantly from the previously discussed venture capitalists in regard to their motivations, selection criteria and attitudes toward the technological enterprise. Their prime consideration is usually technology. Most investing firms choose only a few technical fields in which to invest, sometimes related or complementary to their current lines of business, at other times wholly unrelated, depending upon the corporation's present strategy of concentration or diversification. The quality of the entrepreneurial team is usually the second most important decision criterion. They have tended to avoid providing initial capital, often because they do not see the opportunities soon enough or because they cannot act fast enough, instead preferring somewhat later growth financing. In recent years this tendency has changed somewhat, especially in areas of medical technology and advanced materials, where a number of non-financial corporations have developed close ties to venture capitalists that allow the corporations to see and participate in early stage financings.

The non-financial firms often are willing to provide technical, marketing and managerial assistance to the companies in which they invest, potentially more valuable than the funds themselves if these services can be

accessed and utilized effectively by the investee. This assistance, which in earlier writings I have labelled "venture nurturing" (Roberts, 1980), plus very "deep pockets", may be the primary advantages provided by the corporate venture capitalist, but combine with some potential disadvantages. The corporation may have a tendency to interfere more in the day-to-day operations of the young firm than the entrepreneurs find desirable. Furthermore, the corporate investor may oppose the firm "going public", preferring to merge it eventually into its own operations. Entrepreneurs often think that going public is the ultimate measure of and route to personal glory and financial success, but the facts are that far more technical companies eventually sell out to larger companies than go public. Thus the entrepreneur frequently is leery of corporate funding at early stages of the firm but becomes less naive and resistant to their funds and help as his company moves forward.

Commercial Banks

In some areas of the U.S. commercial banks have taken an active role in supplying capital to new technical enterprises, even though the bank itself is restricted by regulations in how it can invest its resources. During the early years of a company the more venturesome banks supply short term loans secured by projected accounts receivables based on contracts or orders received by the firm. These sometimes can get converted effectively into intermediate or even long term loans through constant renewals and renegotiation. Bruno (1986, p. 113) cites Ashton-Tate, the large software company, as having refused venture capital funds offered to it, securing instead a \$6 million line of credit from Bankers Trust. Banks can also help through long-term lease financing of laboratory or manufacturing equipment. Bank-owned SBICs, discussed above, can of course become direct investors and the SBICs and/or bank commercial lending officers can assist in establishing relationships with conventional venture capital funds. Bank-affiliated venture capital funds account for almost \$2 billion, approximately 6 percent of the venture capital industry's total resources. (*Venture Capital Journal*, 1989, p.11)

The bank's motives for its lending, investing and referral activities are primarily future profits to be generated through regular banking business with a growing corporation. By helping to finance the firm when it is young

the bank hopes to retain the company's conventional banking business when the company becomes large and successful. Thus the bank's attitudes and patience may well differ from other potential investors. Banks are strongly influenced by the Small Business Administration's loan guaranty program, which substantially lessens a bank's risks of lending to a small company. In the last decade SBA guaranty approvals have declined from about 24,000 per year to nearly 15,000, (*Venture*, 1989, p.55) but we have no information available on the extent to which these affect the initial funding of technological firms.

Public Stock Issues

During several short periods of time since the early 1960s the start-up entrepreneur could turn even initially to the public market in the United States for very early-stage capital, especially for a high-tech or otherwise "glamorous" company. Although few people active today in venture financing will remember, 1969 was the peak year to date (!!) for initial public offerings by early-stage companies. More recent peaks occurred in 1983 and then again in 1986. But those speculative times are usually short-lived. In contrast when a more conservative mood prevails, especially in "bear market" conditions, it becomes very difficult, certainly very costly, for even the successful growing new enterprise to raise public funds.

A young technical company may have many reasons to go public. The entrepreneur and the venture capital backers may wish to realize capital gains; the entrepreneur may want a public market to insure that his holdings will be liquid if he should die; the new enterprise may want the prestige of being listed on the financial pages of the newspaper. Or, specifically relevant to our current discussion of the financial base of the company, the company may find that the public market will supply the least expensive or otherwise most attractive funds for its further growth and development.

Regardless of the motivations the entrepreneur needs expert advice from the financial community before attempting a public stock issue. The U.S. Securities and Exchange Commission (SEC) has extensive and complex requirements that affect the process of "going public", as do many state regulatory bodies. There are several different ways for a U.S. firm to raise public money, including both underwritten and non-underwritten methods, and

in recent years including the possibility of going public in Britain. Underwriters vary greatly in criteria and effectiveness, and need to be carefully evaluated by the entrepreneur. Large investment banking houses, for example, seldom underwrite issues of less than \$10,000,000 and then usually only when the firm meets other performance criteria. Thus early-stage entrepreneurs need to deal with the smaller underwriters, with whom greater caution is recommended. Consequently the public markets typically serve the technical firm's growth capital financial needs, and not earlier requirements.

Synopsis

Figure 1 portrays the relationship of the stage of evolution of the technology-based firm to the likely availability of capital from the various investment sources discussed above. As such it constitutes a loose set of testable hypotheses with respect to the sources of initial capital for the technological firm. The diagram is inexact and is meant to convey the primary tendencies of each class of investor during the three stages of a company's development. As should be expected the investment behavior of each group contains considerable variance, to be evidenced by the presentation of empirical findings that follows.

 INSERT FIGURE 1 ABOUT HERE

This synopsis of initial capital sources for new technology-based firms has not included any mention of pension funds or insurance companies, both major participants in the overall U.S. capital markets. In fact, until recently neither type of institution directly participated in initial or even early round financing of high-tech firms. But both sources are major investors in the pooled funds managed by venture capital firms, and a growing number of pension funds and insurance companies have initiated programs of direct venture investing. Corporate pension funds have been major players since 1981 and public employee retirement funds have become active since then. In recent years over 20 states have also become involved in venture capital fund investments, often with the combined motives of economic stimulus of their own regions as well as increased returns on their investment portfolios. (Maier & Walker, 1987, p. 210) Of course, both pension funds and insurance companies often invest in the later growth financing of technical companies.

SAMPLE SELECTION AND DATA COLLECTION

The data analyzed here in order to test the rough hypotheses presented above are part of a twenty years research program on all aspects of the formation and growth of high-technology new enterprises. Elements of the data collected in nine related studies (shown in Table 1) are used in part in this article, covering information from one hundred fifty-six firms founded by former employees of major laboratories and engineering departments of the Massachusetts Institute of Technology (MIT). Contrasting information is used throughout from our unpublished studies of new firms founded by the former employees of two large technological corporations, selected from firms within the Greater Boston area that were most comparable in size and nature of work to the MIT "source" labs. All data referred to in this article relate to the financing of these companies at age zero of their lives. Work is now underway to examine patterns of evolution of the later funding and performance of these firms.

INSERT TABLE 1 ABOUT HERE

Beginning with strong cooperation of senior managers in each of the nine MIT source organizations studied, initial lists were developed of people who were thought to have spun-off new enterprises from that organization. Follow-up interviews were used to generate further suggestions in a "snowball" sample creation process as well as to screen the initial lists for errors. Rigorous criteria were applied to include only those who had been former full-time employees of the source organizations, who later participated as founders of wholly-new for-profit companies. (As very few female entrepreneurs were found in these samples of technical entrepreneurs, the male pronoun will be used in the remainder of this article in referring to the entrepreneurs.)

Structured interviews with a detailed questionnaire, lasting typically one to two and one-half hours, were used to gather data from each entrepreneur personally, with telephone interviews used in less than ten percent of the cases and mailed interviews used only as a last resort in less than one percent of the cases. (A copy of the questionnaire is available upon request from the author.) Some interviews stretched to seven or eight hours over two or three sessions. Despite extensive efforts to include all spin-offs

from each source organization studied, no doubt some minor bias has crept into the sample of companies studied in that it is likely that any companies not located were less successful than those traced. The bias did not prevent many companies from being found and studied that were clearly failures or not very successful.

The limitation of the primary source organizations of the spinoffs to the major laboratories and major academic departments at one technological university is a key restriction on any claims of generality from these data. However, the comparisons with firms formed by ex-employees of two major corporations may help, although they too are limited to a single geographic area, Greater Boston, and are dominated by electronics technology.

Answers to the detailed questionnaires led easily to the quantification of information. Most all of the answers were coded and arranged in computer data files. Incomplete information on some of the companies does not particularly affect the data analysis as relevant codes were given to isolate missing information.

THE INITIAL CAPITAL BASE

Amount and Source

Many entrepreneurs begin their companies with a minimal amount of initial capital and often find their operations hampered by a shortage of capital. Other entrepreneurs, perhaps wiser or just monetarily more fortunate, raise substantial funds before beginning their ventures and have their operations proceed relatively free of financial constraints.

Figure 2 presents the distribution of initial capital of 113 new technology-based companies spun-off from MIT departments and laboratories.

 INSERT FIGURE 2 ABOUT HERE

Twenty-three percent of these companies (26) were begun with funds of less than one thousand dollars. Almost half began with less than \$10,000. Only twenty-two percent (25) began with funds equal to or in excess of fifty thousand dollars, of which the vast majority (20 out of 25) began operations

on a full-time basis.

Comparisons with these data arise from our several separate samples of new companies, including 38 spin-off firms from a large electronic systems company which had initial funding similar to the MIT spinoffs: 18 percent with less than one thousand dollars; 42 percent with less than \$10,000; only 18 percent with more than fifty thousand dollars. And twenty three spin-offs from a large technologically diversified corporation had somewhat higher but still small average startup equity of \$67,000. Rather remarkably, clusters of companies incorporated ten years apart experienced the same distribution of initial capital, with a median of \$15,000. A very different type of company, the consumer-oriented manufacturing firms we studied in a separate sample, also had modest beginnings, over half of them starting with less than \$10,000.

The precise amounts of initial capital for 154 technology-based companies in our samples ranged from zero dollars for several firms to one company's \$900,000. Close to half of these firms started on a part-time basis. Of 52 firms begun on a part-time basis that provided financing data, 58 percent started with less than \$10,000 while only 38 percent of the full-time operations began with so little.

As reported in Table 2 personal funds of the founders were the primary sources used to finance the start of over seventy percent of these companies, and family and friends were key contributors to the start of an additional five percent. These percentages were consistent across all subgroups of MIT

 INSERT TABLE 2 ABOUT HERE

spin-off companies, as well as those from a large electronic systems company and from a sample of high-technology entrepreneurial firms whose early years were carefully assessed. Similar personal or "close" sources funded 20 out of 23 companies spun-off from a large diversified corporation, as well as 80 percent of the consumer-oriented manufacturers. The other companies were begun through funds obtained primarily from private investors or "angels", venture capital firms or non-financial corporations at which the founders worked, with a few funded by the public stock market. We found these same two sources, the founders themselves and private investors,

to be the dominant initial financiers of a sample of 21 companies which were carefully evaluated for later funding by one venture capital firm we studied.

Those starting on a part-time basis were even more likely to use their own personal funds to finance the early years of the company. (Query, not answerable from the data: Does this reflect less need for funds by part-time founders, not yet fully committed to their firms? Their "burn rate" might certainly be smaller than the full-time companies. Or does it reflect "savvy entrepreneurs", moving ahead appropriately slowly on their own funds, holding on to equity ownership until further progress is achieved? Or is the direction of causality here really the other way? Did lack of outside capital support force the entrepreneur to utilize his own limited personal resources and thus restrict him to starting on a part-time basis only?)

As anticipated in the discussion above no equity capital was supplied by commercial banks, but bank credit came early and frequently into these companies. Many of the companies had early sales by contract to government or large industrial organizations, and the banks often granted loans to these firms, attaching the contract payments as security.

In Table 3 the amounts of initial capital and their sources are shown in detail for 110 new enterprises. The specific amounts of money provided by the various categories of investors are obviously incidental to the specific time periods at which these companies were incorporated and to some extent to the specific industries in which they were involved. New biotechnology companies, not included in this sample, would for example typically generate far more initial capital than new software firms, of which several were in this sample. But what is more important and persistent over time and industry in my experience are the relative distributions of which sources are actively involved at the outset of new technical firms, and which ones provide more rather than less amounts of capital.

 INSERT TABLE 3 ABOUT HERE

The figures in Table 3 demonstrate empirically what might have been assumed beforehand: In the relatively few cases where money was obtained through "outside" forms of financing (those sources other than the founders or their families or friends), those sources provided far greater average

amounts ($p < .001$). Of twenty-six firms begun with funds from outside sources, twenty had initial capital equal to or in excess of \$50,000. Of eighty-five companies funded by personal or "close" money, only five were begun with comparable amounts. Similar patterns were found in each of our research clusters. For example, among the enterprises being assessed by a venture capitalist for "step-up" funding, those which initially had been self-financed had started with considerably less capital (an average of \$90,000) than the companies funded by private investors (an average initially of \$215,000) ($p = 0.02$).

The primary reason for this difference is understandable. The amount of money that the founders and their associates have is limited by the fact that these are personal funds. Indeed some of the founders did have a healthy personal stake from the sale of previous ventures, e.g., 5 of 21 self-funded spin-offs from the MIT Instrumentation Lab, to cite an extreme case. But most entrepreneurs had access only to accumulated savings from past earnings, not capital from sales of prior companies. The "outside" financial sources by their nature have a much greater supply of money available for investment in a technological entrepreneurial startup.

The more basic question of why some entrepreneurs sought out and received funds from outside sources and why other entrepreneurs either did not seek or did not receive initial outside capital cannot be answered simply. Some more insight will be provided in analyses of venture capitalist decision-making that will be carried out in later research using our database. But three possible answers to this question are apparent and all somewhat applicable: (1) The need did not exist. (2) The desire for outside funds did not exist. (3) The entrepreneurs were unable to obtain outside funds.

Analyses below will demonstrate that the need for initial funds varies significantly among new enterprises as a function of their industry and type of business, and indeed size of founding group, among other influences. Clearly, many firms did not need outside financing. At the opposite end of the spectrum, the general interviews and our several specific studies of venture financing did reveal many failed attempts at raising capital by entrepreneurs who ended up using only personal or family and friends funding. Some entrepreneurs did not know how to go about seeking outside funding and used their own monies as a default.

However, other entrepreneurs knew of the more formal sources, might well in our judgment have been successful in gaining outside commitments, but chose not to. Some entrepreneurs want little or no equity financing at the outset because they wish to retain a maximum amount of ownership and control. They often seek primarily debt from outside sources, resulting usually in relatively small loans because of the founders' limited net worth. Then, in order to cope with the constraints of their limited funds, the entrepreneurs gear their operations to reduce their need for funds, e.g., they render a service instead of producing hardware or they tend to engage in custom-oriented development and production that can be contracted with larger firms or government agencies. The contracts provide advances and/or progress payments that minimize additional financial requirements. One small study provided statistical support for this explanation, demonstrating that the entrepreneurs who initially preferred debt to equity tended to finance the companies themselves (0.015) and had lower initial capitalization (0.11).

But several of the self-financing entrepreneurs seemed rather less rational and more emotional in their emphatic opposition to sharing the profits of their labors and their ideas with others "who did nothing more than provide money"! Not understanding that initial capital for a high-technology company is a very risky investment, such entrepreneurs repeatedly cite venture capitalists as "vultures" who want something for nothing. Underlying this rather naive and often angry opposition, and also involved with many other aspects of financing, are a complexity of motivations that I cannot even attempt to explain. In a small study of 20 entrepreneurs who were seeking capital, we compared those who had initially supplied more than 50 percent of their equity from personal funds with those who had obtained that much from outside investors. The self-funded entrepreneurs were found to have significantly higher evaluations of the importance of independence of action ($p=.025$). In addition five of the seven entrepreneurs in this cluster who indicated that independence of action was the most important reason for starting a company initially engaged primarily in self-financing.

The data analyses reveal that those individuals with the greatest amount of commercial work experience started their companies with more initial phase capital financing (.08). These individuals, by virtue of their

more extensive familiarity with the industrial and financial community, were probably more aware of venture capital sources and how to approach them successfully. Their greater experience no doubt also provided some modicum of comfort to the investors. Not necessarily in conflict with this finding is that a significant fraction of entrepreneurs coming out of MIT labs and departments felt their previous association with MIT had aided their capital seeking efforts.

Initial Capital and the Number of Founders

The number of founders can influence the amount of initial capital both directly and indirectly. As the number of founders increases more personal funds are available from which to draw money. This has a direct effect in that over seventy percent of the companies we studied were financed initially by personal funds. Indirectly, the more founders there are, the greater possibility that one of them knows a receptive "outside" source. Furthermore, multiple founders are likely to reflect a more substantial intended undertaking, e.g. product development and manufacture rather than just research or consulting. This implied need for greater funds both generates and justifies its supply. And the larger team is itself likely to be more impressive to outside sources, partly explaining our research finding that outside sources are more willing to invest in multi-founder companies.

Table 4 presents the initial capital amounts associated with the number of founders of 109 companies. The largest proportion of companies which began with less than \$10,000 (62.5%) was in the group of one-founder companies. In general the larger the number of founders, the less the occurrence of financing under \$10,000 and the greater the occurrence of funding in excess of \$50,000.

 INSERT TABLE 4 ABOUT HERE

We carried out separate analyses of the companies begun primarily with the entrepreneurs' own funds and those started with others' funds. Nearly half of the firms founded by a single individual using his own money began with less than \$1000. In the founder-funded firms greater amounts of initial capital were provided as the number of founders increased. ($\tau=0.19$, $p=.03$) Looking across the entire sample of companies, at each size of founding group

the average amount of funds supplied by others was greater than the average supplied by the founders themselves. All but six of twenty-six companies which obtained funds primarily from others were started by multi-founder teams. And for outsider-funded firms, the same finding holds that the number of founders and the amount of initial capital received are positively related. (Tau=0.23, p=.08)

These results are wholly supported by other studies of venture capital decision processes. Tyebjee & Bruno found (1984, p. 1060) that "lack of managerial capabilities significantly increases the perceived risk ($p < 0.05$) [of investing]", those capabilities reflecting multi-functional skills only achievable with a multi-founder team. Their earlier work (Bruno & Tyebjee, 1983, p. 290) had also shown that deficiencies in the venture's management team explained funding rejections in a third of the cases. Goslin & Barge (1986, p. 366) agreed that "the significant factor leading to [venture capitalist] funding is the management team". And MacMillan, Siegel & Subba Narasimha (1985, p. 125) concluded that "just under one-half [42%] of venture capitalists will not even consider a venture that does not have a balanced team."

Initial Capital and Specific Plans

Not all the entrepreneurs had specific plans for their companies when they decided to start them. Twenty-four of fifty-three entrepreneurs (45%) who responded to questioning indicated that they had neither specific short term nor long term plans at the beginning of their companies. With no specific plan considerable investment is not necessary. The Alice in Wonderland adage applies here: If you don't care where you are going, any path will get you there. Nor is an investment likely to be attracted from an outside professionally managed financial source when the nature of the future work is so uncertain.

In Table 5 the amounts of initial capital for twenty-nine firms started with specific plans are compared with the amounts for twenty-three firms started without specific plans. Seventy-four percent of those without

 INSERT TABLE 5 ABOUT HERE

specific plans started with less than \$10,000 whereas only 24 percent of the companies with specific plans were formed with so little funding.

Furthermore, 38 percent of the companies begun by founders with specific plans received funding in excess of \$50,000 while only 9 percent of the companies lacking specific plans had so much initial capital. Clearly entrepreneurs with specific plans raised more initial capital than those without plans. (.001)

As might be expected from the discussion thusfar the more institutional sources of financing are much more inclined to support ventures which have a specifically planned future. Table 6 shows that ten of twelve companies which received other than personal or "close" funding had specific operational

 INSERT TABLE 6 ABOUT HERE

plans at the start. Clearly most investors see firms with plans as better bets. In addition the entrepreneurs who prepared detailed plans no doubt foresaw needs for greater capital and went out to get it. But of course not all prospective entrepreneurs who plan get funded. MacMillan & Subba Narasimha (1986, p. 409) found that "excessively optimistic forecasts of performance can create a fatal credibility problem", which might explain in part why only 17 of the 27 planners in our sample of firms received outside funding.

The two companies in this cluster that received outside funds despite lack of specific plans are special exceptions. One was founded by several MIT employees who had been left without work when MIT abandoned its atomic energy research. These founders along with nearly ninety other MIT employees engaged in the same work formed a company without specific goals, but backed strongly by private investors, an investment that is easily understood. The other situation involved a new company formed from the division of a larger corporation, spun-off in its entirety due to rising costs. The venture was backed by a public stock issue generated by the parent company. Excluding these two unique cases only companies with specific plans obtained money from the more sophisticated sources of financing.

Specific backgrounds of the entrepreneurs, age, education, work experience did not relate statistically to the amount or source of initial capital. Other researchers (MacMillan, Siegel & Subba Narasimha, 1985, p.

122) have found that entrepreneur personality characteristics are strong influences upon venture capitalist investment decisions, but we did not have adequate data in our sample to validate these findings. Of those firms formed from the large electronic systems corporation, founders with prior patents raised larger amounts of initial capital (.02), but this relationship was not supported in any of our other samples.

Initial Capital and Product Initially

Information gathered from 110 firms indicated that forty-seven (43 %) of them were based on specific products that had already been developed or which the entrepreneurs planned to develop immediately. A firm dependent upon a product needs capital, whether for product development or production facilities or market launch. Such a firm would have difficulties getting operations underway without substantial capital. Since the sixty-three other firms in this grouping did not have a product or immediate product objectives, they needed considerably less initial capital to get going.

Table 7 displays the amount of initial capital for forty-three companies that had a product or specific product plans initially and for fifty-nine companies that did not. The group with initial products were initially

 INSERT TABLE 7 ABOUT HERE

financed to a greater extent. (.02) This situation is driven statistically by the fact that twenty-one of these firms without product began with less than \$1000, while only three companies with products had similarly small initial funding.

A product-oriented company's capital requirements do vary according to the nature of the product, its stage of development, development requirements, its production process, as well as the demand for the product. Among 21 firms in one of our samples those with a "proprietary" product (the combination perhaps of "specific plans" and a product orientation) had significantly higher initial capitalization (\$200,000 on average) than those without a proprietary product (\$129,000) (.07). But it is doubtful that capital required would ever be much less than \$1000. Indeed each of the three product-oriented firms listed in Table 7 that had begun with less than \$1000

was in the process of developing its first product, making its meager funding slightly more understandable.

The distribution of initial capital within the group of spin-offs that began without a product is readily explainable. Many of these companies were initially engaged in activities such as technical consulting or computer programming. Little or no financing was needed to start them. Others were involved with work such as systems design and development, which required capital primarily to support technical personnel and equipment. Here capital needs varied, depending on the size of work to be done. There is a bit of the chicken-versus-egg issue here. In some of these cases companies that had problems in raising initial outside capital had already abandoned their earlier intentions and started to do things that were not capital-intensive. Thus lack of available initial capital often influenced the apparent lack of "initial" product orientation!

No significant differences were observable in the sources of capital for both groups. Thirty companies (70 percent) formed around a product were financed by founders or close associates, while thirteen generated other funds. Fifty-one companies (82 percent, slightly more than the above group) without an initial product focus were funded by founders or family or friends, while eleven received funds elsewhere. Tyebjee & Bruno (1984, p. 1057) demonstrate a strong bias by venture capitalists (over 90 percent of their deals) in favor of product manufacturing companies, but the venture capitalists' reluctance to get involved at ground zero no doubt prevented their product preference from being reflected in our data.

Amount by Needs and Type of Business

Table 8 presents responses from 107 entrepreneurs who ranked their needs for capital. They contain wide variances that reflect the types of business entered. In hardware production capital is first needed for product development, then for production facilities and working capital. Software companies need working capital for their technical personnel payroll and to finance their accounts receivable (A/R), but they also need funds for computer equipment and for product development work. Firms performing contract research and development (R&D) exhibit needs for lab equipment, product development, working capital and production facilities. Even

individual consultants need funds for lab equipment and to fund development work.

INSERT TABLE 8 ABOUT HERE

None of the groups found that either marketing expenses or production and clerical workers placed a stress on their capital needs. The technological enterprise unfortunately displays typically little emphasis on marketing. Also the Boston area labor market, relevant to most of the firms studied, has been especially efficient until recently in terms of a new company's ability to find both skilled and semiskilled hourly workers.

Given the differences in specific needs how do the capital requirements vary in amount by type of business? The consultants and the software houses required the least capital; nearly 80 percent of them were capitalized initially at less than \$10,000. Indeed, one software entrepreneur started his company on \$700 he received from selling his automobile. At the opposite extreme were the hardware production firms, but even here 84 percent were capitalized at under \$50,000. This relatively modest figure is explained in part by the fact that sixty percent of those companies were started on a part-time basis. Most of the companies found that their initial funds were insufficient to support their growth during their early years. Sixty percent of the companies sought capital a second time and nearly half sought funds a third time, but this will be discussed in more detail in later writings.

SUMMARY AND IMPLICATIONS

This article has presented an assessment of the capital market for technology-based firms, focusing upon the links between the stages of evolution of a firm and the investment preferences of various capital sources. The review of these factors led to an expectation that initial capital will be supplied most frequently by the entrepreneurs themselves from their own savings, secondarily by their families and friends and by private investors, all these being sources of capital outside of the formal channels. More substantial but still initial funding from "wealthy family funds", special "seed" funds and somewhat more conventional venture capital funds were expected to be the primary complements of the informal sources.

The data from our studies of technological firms support these expectations, while also providing evidence of the usual small initial capital base (almost half with less than \$10,000) and the dominance of personal savings as the principal source of initial capital (74 percent of the companies). Prospective entrepreneurs need to realize that most of their predecessors got started on a shoestring. Prior studies do, however, indicate that larger initial funding correlates with greater entrepreneurial success.

"Outside" sources of capital are responsible for the larger initial investments when they occur. As listed in the Table 9 summary larger

 INSERT TABLE 9 ABOUT HERE

amounts of initial capital are both contributed and raised by the larger groups of co-founders, especially when the founders are involved in the companies from the outset on a full-time basis. But the outside sources vary greatly, and informal investors or "angels" are far more likely to provide initial funds than are venture capital companies. Prospective entrepreneurs should seek out these informal investors, perhaps taking advantage of contact mechanisms such as Wetzel's New England Venture Capital Network (Wetzel, 1987) or Tulsa's Venture Capital Exchange (IC² Institute, 1989, p. 42)

Specific plans for the company are associated with greater initial capitalization, as well as with raising outside capital, as is also true for the effect of having an initial product. The needs for initial capital vary enormously by amount and intended use as a function of the type of business being started, with consulting firms and software companies requiring far less than hardware developers and producers. Prospective entrepreneurs need to be forthcoming, in writing, on their aspirations, their rationale for potential attractiveness of the contemplated companies, and their strategies for achieving corporate growth and success.

The empirical data analyzed in this article come largely from companies founded by former employees of MIT laboratories and academic departments. Therefore, they may well be unrepresentative of other technology-based new firms. However, at least within the Greater Boston area, the several other samples of spinoffs in our data set, new firms incubated by large industrial corporations or government laboratories, seem to confirm the findings from

the MIT-derived companies. Studies carried out by others in other parts of the United States, overlapping some aspects of our analyses, add some degree of confidence to the generalizability of the findings. But further research is clearly needed on the patterns and causes of initial capitalization of new technology-based enterprises founded in other regions and other countries.

Despite increasing numbers of studies of the decision processes of venture capitalists (Bruno & Tyebjee, 1985; Goslin & Barge, 1986; MacMillan, Siegel & Subba Narasimha, 1985; MacMillan & Subba Narasimha, 1986; Ruhnka & Young, 1987; Tyebjee & Bruno, 1984), additional comparable research is needed on the decision criteria of informal investors who are so critical in initial funding especially. And more understanding is needed of the linkages between entrepreneurial motivations and concerns and the process of decision-making that results in self-funding of a new enterprise. Our research studies only begin to touch upon this primary source of initial enterprise capital. Finally, all these factors relating to initial capital -- amount, source, influences such as number of founders, specific business plans, and type of business -- must be related to the later performance of the company. Several studies already illuminate some aspects of these relationships, but further research would be helpful to academics as well as prospective entrepreneurs.

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Figure 1. Primary Investment Preferences of Capital Sources

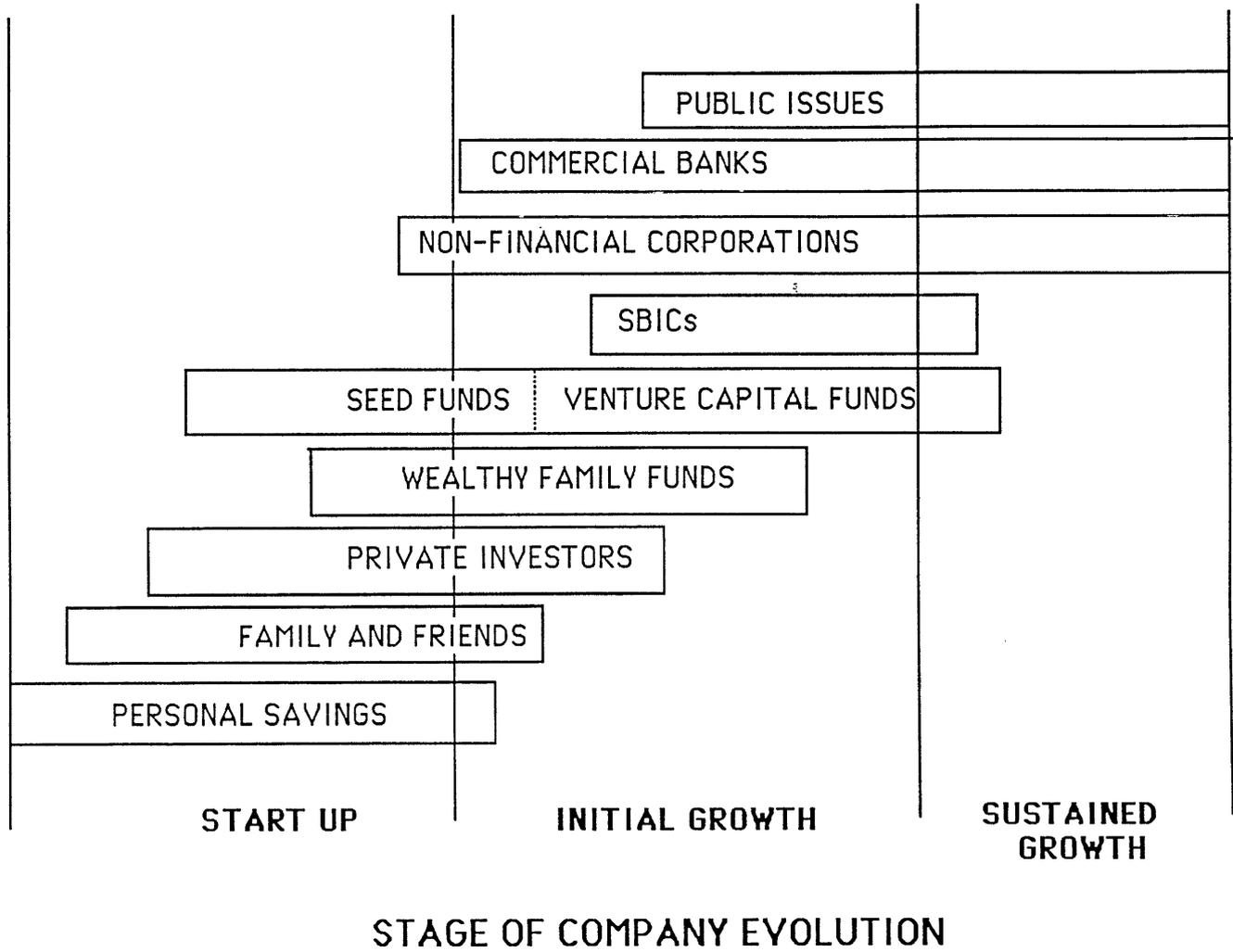


Figure 2. Amount of Initial Capital (113 MIT Spin-off Companies, Separated into Full-Time and Part-Time Founders)

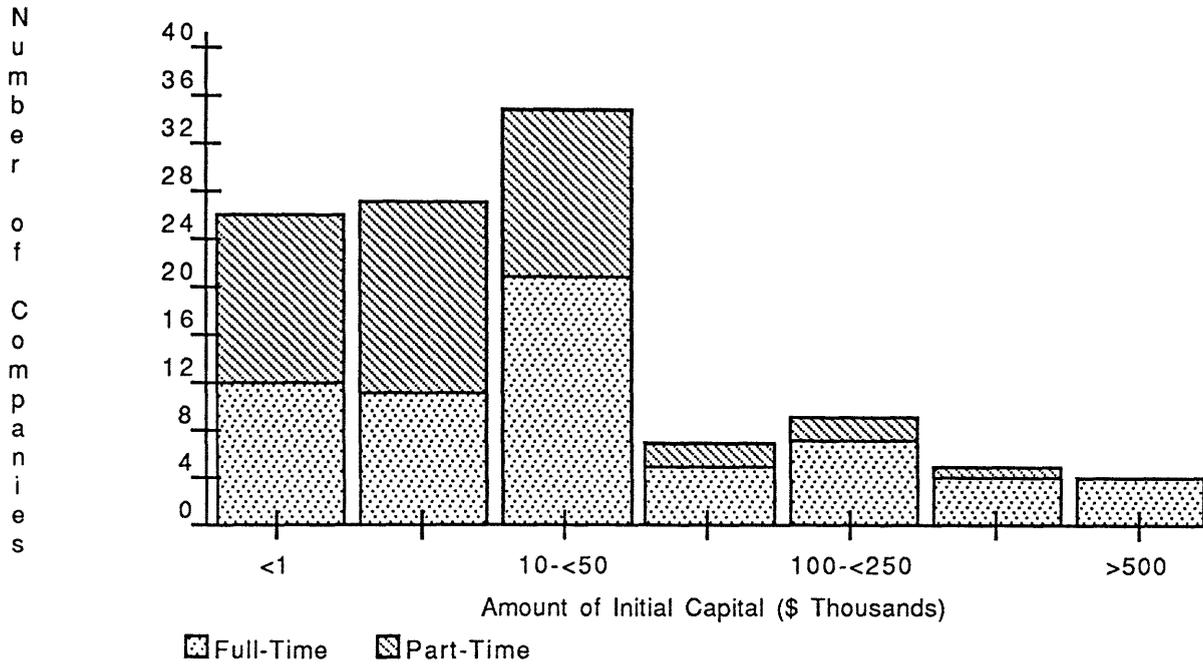


Table 1. Data Sources for Financing Study of New Technological Enterprises*

<u>Sources of New Enterprises</u>	<u>New Companies Identified</u>	<u>Participants in Research Study</u>
MIT major laboratories (4 studies)	107	96
MIT academic departments (5 studies)	<u>74</u>	<u>60</u>
Totals	181	156

* Among my former research assistants who contributed importantly to this phase of research were E.K. Bender, H.A. Cohen, D.A. Forseth, D.R. Hall, J.C. Ruth and P.V. Teplitz, as well as my former research associate Herbert A. Wainer.

Table 2. Primary Source of Initial Capital (154 companies)

<u>Source</u>	<u>Number of Companies</u>	<u>%</u>
Personal Savings	114	74
Family and Friends	8	5
Private Individual Investors	11	7
Venture Capital Companies	8	5
Non-Financial Corporations	9	6
Commercial Banks	0	0
Public Stock Issues	4	3
	<hr/>	<hr/>
Totals	154	100

Table 4. Amount of Initial Capital by Number of Founders (109 companies)

Number of Founders *	Amount of Initial Capital (\$ thousands) *						
	<u><1</u>	<u>1-<10</u>	<u>10-<50</u>	<u>50-<100</u>	<u>100-<250</u>	<u>250-<500</u>	<u>≥500</u>
1	17	8	11	1	3	-	-
2	2	10	9	2	1	2	-
3	3	5	10	-	1	1	2
4	1	4	1	1	1	-	-
5	1	-	2	1	1	1	-
6	2	-	-	1	-	1	-
7	-	-	-	-	1	-	1
8	-	-	-	-	-	-	-
9	-	-	-	-	-	-	1

* Kendall Tau= 0.25, p= 0.01

Table 5. Specific Plans for the Company and Amount of Initial Capital
(52 companies)

<u>Initial Capital</u> (\$ thousands)	<u>Specific Plans</u>	
	<u>Yes</u> *	<u>No</u> *
< 1	4	7
1 -< 10	3	10
10 -< 50	11	4
50 -< 100	2	0
100 -< 250	3	2
250 -< 500	3	0
≥ 500	<u>3</u>	<u>0</u>
Totals	29	23

* Mann-Whitney U, p=0.001

Table 6. Specific Plans for the Company and Source of Initial Capital
(49 companies)

<u>Source</u>	<u>Specific Plans</u>	
	<u>Yes</u>	<u>No</u>
Personal Savings	15	19
Family and Friends	2	1
Private Investors	3	1
Venture Capital Funds	3	0
Non-Financial Corporations	3	0
Commercial Banks	0	0
Public Stock Issues	<u>1</u>	<u>1</u>
Totals	27	22

Table 7. Product Initially and Amount of Initial Capital (102 companies)

<u>Initial Capital</u> (\$ thousands)	<u>Product Initially</u>	
	<u>Yes</u> *	<u>No</u> *
< 1	3	21
1 -< 10	12	13
10 -< 50	15	15
50 -< 100	2	5
100 -< 250	5	3
250 -< 500	4	0
≥ 500	<u>2</u>	<u>2</u>
Totals	43	59

* Mann-Whitney U, $p=0.02$

Table 8. Ranked Needs for Initial Capital (107 companies)

Type of Business #	Aggregate 107	Hardware 33	Software 10	Contract R&D 22	Consulting 20
<u>Rank</u>					
1	Product dev.	Product dev.	Other	Lab equip.	Tech. personnel
2	Lab equip.	Prod. facilities	Tech. personnel	Product dev.	Lab equip.
3	Tech. personnel	Inventory	Lab equip.	A/R	A/R
4	A/R	Other	A/R	Prod. facilities	Development
5	Prod. facilities	A/R	Development	Tech. personnel	Inventory

Table 9. Initial Capital for the Technological EnterprisePrimary Sources of Capital:

Personal savings

Family and friends

Private individual investors

Larger Initial Capital Associated with:

Full-time, rather than part-time, commitment

Larger co-founding team

"Outside" initial investors

Specific plans for business development

Initial product available or targeted

Hardware focus, rather than software or consulting

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Table 8. Ranked Needs for Initial Capital (107 companies)

Table 9. Initial Capital for the Technological Enterprise