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A MODEL OF VENTURE CAPITALIST INVESTMENT ACTIVITY*

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The paper describes the activities of venture capitalists as an orderly process involving five sequential steps. These are (1) Deal Origination: The processes by which deals enter into consideration as investment prospects, (2) Deal Screening: A delineation of key policy variables which delimit investment prospects to a manageable few for in-depth evaluation, (3) Deal Evaluation: The assessment of perceived risk and expected return on the basis of a weighting of several characteristics of the prospective venture and the decision whether or not to invest as determined by the relative levels of perceived risk and expected return, (4) Deal Structuring: The negotiation of the price of the deal, namely the equity relinquished to the investor, and the covenants which limit the risk of the investor, (5) Post-Investment Activities: The assistance to the venture in the areas of recruiting key executives, strategic planning, locating expansion financing, and orchestrating a merger, acquisition or public offering. 41 venture capitalists provided data on a total of 90 deals which had received serious consideration in their firms. The questionnaire measured the mechanism of initial contact between venture capitalist and entrepreneur, the venture's industry, the stage of financing and product development, ratings of the venture on 23 characteristics, an assessment of the potential return and perceived risk, and the decision vis-à-vis whether to invest. The modal venture represented in the database was a start-up in the electronics industry with a production capability in place and seeking $1 million (median) in outside financing. There is a high degree of cross-referrals between venture capitalists, particularly for the purposes of locating co-investors. Factor analysis reduced the 23 characteristics of the deal to five underlying dimensions namely (1) Market Attractiveness (size, growth, and access to customers), (2) Product Differentiation (uniqueness, patents, technical edge, profit margin), (3) Managerial Capabilities (skills in marketing, management, finance and the references of the entrepreneur), (4) Environmental Threat Resistance (technology life cycle, barriers to competitive entry, insensitivity to business cycles and down-side risk protection), (5) Cash-Out Potential (future opportunities to realize capital gains by merger, acquisition or public offering). The results of regression analyses showed expected return to be determined by Market Attractiveness and Product Differentiation ($R2 = 0.22$). Perceived risk is determined by Managerial Capabilities and Environmental Threat Resistance ($R2 = 0.33$). Finally, a discriminant analysis correctly predicted, in 89.4% of the cases, whether or not a venture capitalist was willing to commit funds to the deal on the basis of the expected return and perceived risk. The reactions of seven venture capitalists who reviewed the model's specification were used to test its validity.

(FINANCE—INVESTMENT CRITERIA; FINANCIAL INSTITUTIONS—INVESTMENT; RESEARCH AND DEVELOPMENT—PROJECT SELECTION; STATISTICS—REGRESSION—VENTURE CAPITAL)

Introduction

Venture capital has become an increasingly important source of financing for new companies, particularly when such companies are operating on the frontier of emerging technologies and markets. It plays an essential role in the entrepreneurial process. The purpose of this paper is to model the deal flow in a venture capital firm, namely the stages in the consideration, scrutiny and disposition of venture investment deals. The theory of equity markets is well developed in finance; it will not be reviewed here. These theories are typically oriented toward equity financing in publicly traded companies. Venture capital investments, however, differ in several important aspects (Poindexter 1976). First, venture capital is usually invested in new firms which have very little performance history. As a result, the investor cannot rely on historical performance data, as in the case of the stock market. Second, the investment is typically in small firms and the nature of the investor and investee relationship involves a higher degree of direct involvement as

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compared to the relatively inactive role of investors in publicly traded companies. Third, venture capital investments are illiquid in the short term because of the lack of efficient capital markets for equity shares of privately held companies. Long horizons of product and market development make valuation difficult. Moreover, the legal restrictions that apply to the resale of such investments lock the investor in for a certain period. Fourth, when a venture capitalist invests in a new startup, it is usually with the implicit realization that future rounds of capital infusion may have to be financed before the initial investment can bear fruit (Cooper and Carleton 1979).

The lack of capital markets for the financial instruments of small, new companies introduces considerable problems in studying venture capital investments within the paradigm of the capital asset pricing model. The absence of a clearing price determined by the market makes the valuation of an investment vulnerable to the subjective assessment procedures of the analyst. One study of 29 SBIC funds found that venture capital funds enjoy a rate of return 63% higher than Standard & Poor's market index returns. This premium, however, is offset by a higher risk; the variability of the firm's returns were higher than that of the market index return (Poindexter 1976). Poindexter concludes that venture capital markets are efficient since higher returns are offset by higher risk. Using a considerably different methodology, Charles River Associates (1976) reached the same conclusion.

The efficiency of venture capital markets is a central public policy concern because of the latter's goal of stimulating the flow of funds to new, small companies. However, the efficiency proposition provides little insight into the decision process of venture capitalists, other than the implication that they select investments with potential returns high enough to offset the higher risk. In the next section we develop a descriptive model of the activities or processes involved in managing a venture capital fund. Portions of the model are empirically tested on the basis of interviews with venture capitalists, and analyses of the characteristics and disposition of deals which they had recently considered. This methodology is not without its problems. In the experience of the authors, venture capitalists are reluctant to violate the confidentiality of their investees. Also they are not receptive to highly structured measurement instruments, which are perceived to be time consuming to complete. They view every deal and every venture capital fund to be peculiar to itself, and resist the generalizations which behavioral scientists wish to impose upon them. For this reason, research methodology which relies on the cooperation of venture capitalists in divulging data on their activities is likely to suffer from a high nonresponse bias and criticisms regarding the generalizability of small sample research. It is with this backdrop that we seek to model the activities of venture capitalists.

Model of the Venture Capitalist's Investment Activity

The investment activity of a venture capitalist is modeled as a sequential process involving five steps (see Figure 1). The first step is one of *deal origination* which describes how venture capitalists become cognizant of potential investment activities. The second step is a *screening* process by which venture capitalists seek to concentrate only on a manageable set of potential deals. The *evaluation* step involves an assessment of the potential return and risk of a particular deal. If the outcome of the evaluation process is a favorable one, the venture capitalist enters into a negotiating process with the potential investee so as to *structure the deal* in terms of the amount, form and price of the investment. Once a deal is consummated, the venture capitalist typically has close contact with the venture. These *post-investment activities* include setting up controls to protect the investment, providing consultation to the fledgling management of the venture, and, finally, helping orchestrate the merger, acquisition, or public offering which would create a public market for the investment.

On the basis of several previous studies (Dorsey 1977; Hoffman 1972; Poindexter 1976; Timmons and Gumpert 1982; Wells 1974) we can describe the salient features of each of these steps as follows:

Step 1—*Deal Origination.* The venture capitalist faces a very poorly defined environment within which to find prospective deals. The typical investment prospect is too small a company to be readily identifiable as a potential candidate. For this reason, we could expect that various intermediaries play an important role in matching venture capital investors with fledgling ventures with cash needs.

Step 2—*Screening.* Venture capital firms typically have small staffs. As a result, these firms must screen the relatively large number of potential deals available and consequently invest in only a fraction of the deals which come to their attention. Their screening criteria reflect a tendency to limit investments to areas with which the

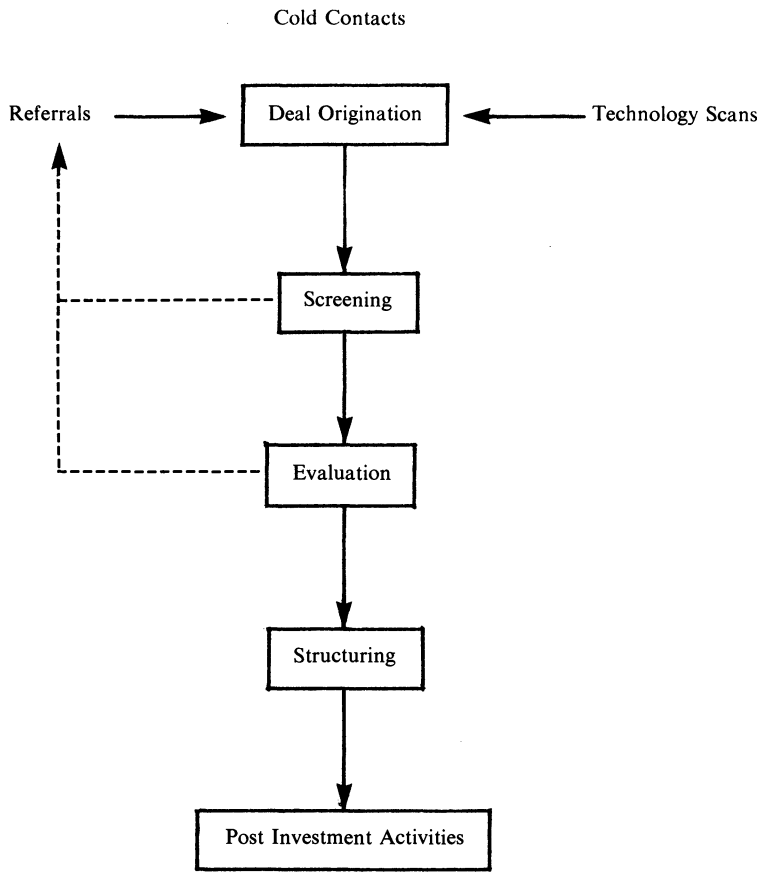

FIGURE 1. Decision Process Model of Venture Capitalist Investment Activity.

venture capitalist is familiar, particularly in terms of the technology, product and market scope of the venture.

Step 3—Evaluation. As noted before, most ventures in search of capital have very little, if any, operating history. The venture capitalist has to rely on a subjective assessment procedure based upon the business plan presented by the venture's management. Venture capitalists do weigh risk and return in their decision whether or not to invest in a particular deal, but few formalize this assessment into a computation of an expected rate of return or determine its sensitivity to future uncertainties. Instead, the evaluation procedure seeks to subjectively assess the venture on a multidimensional set of characteristics. Table 1 shows the characteristics found to be important in previous studies. Not surprisingly, these criteria are similar to those found in several new product evaluation models (Montgomery and Urban 1969; O'Meara 1961; Pessemier 1982). It is interesting to note, however, that none of these criteria reflects how a prospective deal may correlate with one already in the venture capitalist's investment portfolio.

Step 4—Deal Structuring. Once the venture capitalist has decided that a deal is acceptable, the deal will be consummated only if the venture capitalist and the entrepreneur are able to structure a mutually acceptable venture capital investment agreement. From the perspective of the venture capitalist, the agreement serves several purposes. First, it establishes the price of the deal, that is the equity share the entrepreneur will give up in exchange for the venture capital (Golden 1981). Second, it establishes protective covenants which limit capital expenditures and management

TABLE 1

Venture Evaluation Criteria

WELLS (1974) Sample: Eight Venture Capital Firms (Personally interviewed)		POINDEXTER(1976) Sample: 97 Venture Capital Firms (Mailed questionnaires)	TYEBJEE & BRUNO (Study I) Sample: 46 Venture Capitalists (Telephone survey, open-ended questions)	
Factor	Average Weight	Investment Criteria by Rank Order Of Importance	Factor	% of Respondents Mentioning
Management Commitment	10.0	1. Quality of Management	1. Management Skills & History	89
Product	8.8	2. Expected Rate of Return	2. Market Size/Growth	50
Market	8.3	3. Expected Risk	3. Rate of Return	46
Marketing Skill	8.2	4. Percentage Equity Share of Venture	4. Market Niche/Position	20
Engineering Skill	7.4	5. Management Stake in Firm	5. Financial History	11
Marketing Plan	7.2	6. Financial Provisions for Investor Rights	6. Venture Location	11
Financial Skill	6.4	7. Venture Development Stage	7. Growth Potential	11
Manufacturing Skill	6.2	8. Restrictive Covenants	8. Barriers to Entry	11
References	5.9	9. Interest or Dividend Rate	9. Size of Investment	9
Other Participants in Deal	5.0	10. Present Capitalization	10. Market/Industry Expertise	7
Industry/Technology	4.2	11. Investor Control	11. Venture Stage	4
Cash-Out Method	2.3	12. Tax Shelter Consideration	12. Stake of Entrepreneur	4

salaries. Covenants also establish the basis under which the venture capitalist can take control of the board, force a change in management or liquidate the investment by forcing a buy-back, a merger, acquisition or public offering even though the venture capitalist holds a minority position. The covenants may also restrict the power of the venture management to dilute the equity of the original investors by raising additional capital elsewhere (Cooper and Carleton 1979; Glassmeyer 1981). Third, through a mechanism known as the earn-out arrangement, where the entrepreneur's equity share is determined by meeting agreed upon performance objectives, the venture capitalist is able to assess the entrepreneur's expectations for the venture (Leland and Pyle 1977; Ross 1977).

Step 5—Post-Investment Activities. Once the deal has been consummated, the role of the venture capitalist expands from investor to collaborator. This new role may be via a formal representation on the board of directors or via informal influence in market, supplier and creditor networks. The intensity of involvement in the venture's operations differs from one venture capitalist to another. However, most of those interviewed agree that it is undesirable for a venture capital company to exert control over the day-to-day operations of the venture. If a financial or managerial crisis occurs, the venture capitalist may intervene and even install a new management team.

Finally, venture capitalists typically want to cash-out their gains five to ten years after initial investments. To this end, they play an active role in directing the company towards merger, acquisition or a public offering. Bruno and Cooper (1982) followed up on 250 startups of the sixties. They found that over half of these had either gone public, or had been merged or acquired.

The post-investment activities of venture capitalists vis-à-vis their portfolio companies have been ignored by the bulk of research on venture capital. In particular, the venture capitalist's decision-making process for second and subsequent rounds of financing for ventures already in his portfolio remains a fertile area of research.

Method

The results of two databases, referred to as Study I and Study II, are presented in the next section. These databases are described briefly below.

Study I

A telephone survey of 46 venture capitalists in California, Massachusetts and Texas. Of these, half were SBIC's. The telephone survey used a structured questionnaire which asked about how ventures are evaluated. The responses were open-ended and their analysis is based upon a post-hoc categorization of responses.

Study II

Venture capital firms listed in Pratt's directory (1981) of venture capital were contacted by mail to solicit their participation in a study of investment decision criteria. The mailing was restricted to the 156 venture capital firms in the states of California, Massachusetts, and Texas as these states account for a major portion of the venture capital industry, particularly as it applies to high technology startups. Forty-one venture capital firms agreed to participate in the study. For nonparticipants, the dominant reason for refusing to participate was the sensitivity of the information we requested. A second reason was the busy schedule of the venture capitalists. Finally, several firms disqualified themselves as participants in the survey as they were either inactive in new investments or only invested in deals put together by others. The 41 cooperating venture capital firms were mailed a structured questionnaire on which to evaluate deals under consideration. We asked that they indicate their decision vis-à-vis investing in that deal. Ninety completed evaluations were returned by the 41 participants, an average of 2.2 deals per participating venture capitalist. The industries represented in the 90 deals in our sample were computers, semiconductors and telecommunications (59.6%), energy (13.5%), consumer goods (10.1%) and miscellaneous industries including transportation, construction and biomedical (16.8%).

A major problem with the methodology used in this study for describing the evaluation step is that it may be biased in favor of the results obtained. In particular, the statistical relationships between subjectively assessed characteristics of deals and the venture capitalist's decision regarding them may reflect a post-hoc rationalization of the decision. To mitigate this problem, the methodology includes a validation component in which the key results described in the next section were presented to 7 venture capitalists and their reactions recorded. The validation component was administered by mail and its outcome is discussed following the next section.

Results

In this section, the results from Studies I and II are discussed within the context of the five-step model developed earlier. While the data and results are largely focused on the deal evaluation step of the model, results for the first two steps are also presented. The last two steps, namely deal structuring and post-investment activities, are not considered in this section, but will be discussed in the validation section which follows.

Step 1—*Deal Origination*

Potential deals are brought to the attention of venture capitalists from three sources. In Study II, 25.6% of the 90 deals in the sample originated as unsolicited cold calls from entrepreneurs. The typical response of the venture capitalist is to request the inquirer to send in a business plan. The second source is through a referral process. Sixty-five percent of the deals were referred to the venture capitalist. A third of the referrals came from within the venture capital community, 40% were referred by prior investees and personal acquaintances, 10% were referred by banks and the remainder involved an investment broker.

Of those deals referred by other venture capitalists, a substantial number represent the case of the referring venture capitalist acting as a lead investor and seeking the

participation of other venture capital funds. This practice, known as a syndication, is becoming more prevalent as venture capital firms seek to diversify their portfolios over a larger number of deals. Syndication offers the capability of adding investments to the portfolio without adding to the administrative burden, the bulk of which is borne by the lead investor.

The third mechanism of deal origination is the active search for deals by the venture capitalist. The venture capitalist sometimes played an active role in pursuing companies at the startup stage or those at the critical point of needing expansion financing. The venture capitalist monitors the environment for such potential candidates through an informal network and attendance at conventions, trade shows and special conferences by groups such as the American Electronics Association. An extreme variant of this active role occurs when the venture capitalist first decides which technology markets he would like to add to his portfolio and uses executive search agencies to locate the management team for the venture. In such cases, the roles of venture capitalist and entrepreneur overlap considerably.

Step 2—Screening

The venture capital firm receives a large number of proposals; far more than they can possibly fund with the size of the staff and portfolio of the typical venture fund. Wells (1974) reports that in seven venture capital funds, the annual number of proposals received ranged between 120 and 1,000, with an average of about 450 per year. Broad screening criteria are used to reduce this set to a more manageable number for more indepth evaluation. The initial screening is based upon four criteria:

(1) *The size of the investment and the investment policy of the venture fund.* The lower limit of this policy is determined by the fact that a venture capital company is run with a lean staff and it cannot afford to spread its portfolio over too many small deals because the subsequent control and consultation demands placed on the venture capitalists are essentially the same regardless of the size of the investment. Brophy (1981) reports that of 73 venture capitalists surveyed in 1979 the average number of deals invested in was 5.6 and the average portfolio size was ten ventures. The upper boundary of the investment policy is determined by the capitalization of the portfolio and the desire to maintain an investment base which is diversified across several ventures. However, the upper limit to the investment policy is relatively flexible because a venture capitalist may consider larger deals with the intent of soliciting the participation of other venture capital funds. In fact, in our research we found that the venture capital community is highly inbred with a substantial amount of participation across funds, leading many entrepreneurs to conclude that the venture capital market involves substantially less competition between suppliers than is indicated by the mere count of number of funds in existence. Brophy (1981) estimates that approximately 80% of the venture capital deals struck in 1980 involved the participation of more than one venture capital fund and about a third of the deals involved five or more participants. Fifty-six percent of the deals analyzed in Study II involved the participation of more than one venture capital fund. In the case of two-thirds of the deals which were given a positive evaluation, the venture capitalist was himself willing to commit less than 75% of the amount requested, with the balance to be raised by inviting the participation of other venture capital funds.

The investment policy, in terms of the maximum and minimum amounts which will be considered, is quite heterogeneous across venture capital firms (Timmons and Gumpert 1982). The dollar amount requested in the 90 deals examined in Study II reflects this diversity. The amounts range from $30,000 to $7,500,000, with the median amount being $1,000,000. About a third of the deals were for less than $500,000 and another third were for amounts in excess of $1,500,000.

(2) *The technology and market sector of the venture.* Of 46 venture capitalists interviewed in Study I, 29 used this screening criterion. The venture capitalist is investing in more than a company. Implicitly, he/she is investing in the future of a particular technology or market. For this reason, the venture capitalist must have some familiarity with the technology or the market of the proposed venture. This leads to an implicit specialization in a few technology markets because of the inability of the venture capital fund's manager to be well-versed across a large number of technologies or markets. Also, venture capitalists tend to favor nascent technology industries over mature technologies, the industrial market over the consumer market, and products over services.

The 90 deals in Study II, which presumably had passed initial screening, demonstrated these preferences. More than three out of four were in technology-intensive industries, only a tenth were in the consumer goods sector, and over 90% were manufacturing companies. Sixty-four percent of the deals were described by the venture capitalist as involving either a new technology or a new application of an existing technology, 18% were described as improvements on current products, and the remaining 18% were described as me-too products.

(3) *Geographic location of the venture.* Of 46 venture capitalists interviewed in Study I, 9 used this screening criterion. When a venture capitalist invests in a company, he expects to meet regularly with the management of the new venture. To maintain travel time and expense at manageable levels, some venture capitalists limit their investment activity to major metropolitan areas with easy access. Sometimes, this screening criterion will be ignored if the venture capitalist can involve the participation of another venture capital fund which is close to the venture's location and which can oversee the venture with greater ease. Though most venture capital companies do not actively pursue a policy of restricting their investment activity to a specific geographic boundary, their portfolios often exhibit this specialization because of a tendency of entrepreneurs to search for capital close to their venture's home where their banking, legal and accountancy contacts are strongest.

(4) *Stage of financing.* Of 46 venture capitalists interviewed in Study I, 22 used this screening criterion. Venture capital infusions into a company occur at several points in the life cycle of the venture. Seed capital refers to funds invested before the venture exists as a formal entity. Venture capitalists rarely invest seed capital and entrepreneurs typically turn to informal sources for this money (Wetzel 1981). Startup capital refers to financing for establishing the operation; subsequent rounds of financing are used for expanding operations. Brophy (1981) reports that of 196 venture investments in 1978, 34.2% were for startups, 40.3% were for first round expansion and 19.4% were for second round expansion (6.1% were unclassified).

In Study II, the 90 deals showed a very similar profile to Brophy's data: 45.6% were startups, 22.2% were first round expansion deals and 21.1% were second round expansion deals. Described in another manner, in the case of 23% of the deals the product was still at the design stage, in the case of another 23% a working prototype had been developed and in the case of the remaining 54% the product was already in production.

These aggregate statistics, however, hide the fact that the risk preferences of venture capital funds differ. As a result, some funds will commit capital to later stage rounds only. Others will not commit to later stage rounds unless they have already invested in the venture in the prior rounds.

Step 3—Evaluation

We asked cooperating venture capitalists to rate several deals which had passed their initial screen and were under serious consideration. The deals were rated on 23 criteria

TABLE 2

Factor Structure of Evaluation Criteria

Evaluation Criteria	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Management Skills (6.6%)*	0.15	− 0.07	0.85	0.16	0.10
Marketing Skills (8.9%)	0.31	− 0.06	0.80	− 0.07	− 0.03
Financial Skills (6.6%)	− 0.23	− 0.01	0.74	0.16	0.12
References of Entrepreneur (16.7%)	0.24	0.09	0.48	0.16	0.33
Technical Skills (7.8%)	0.11	0.72	0.01	− 0.12	0.27
Profit Margins (13.4%)	0.19	0.62	0.25	− 0.02	− 0.04
Uniqueness of Product (11.1%)	0.14	0.87	− 0.02	0.03	0.06
Patentability of Product (30.0%)	− 0.02	0.67	− 0.31	0.27	0.01
Raw Material Availability (31.1%)	0.12	0.18	− 0.07	0.05	− 0.07
Production Capabilities (30.0%)	0.11	0.11	0.06	0.04	− 0.03
Access to Market (12.3%)	0.66	0.07	0.14	0.13	0.24
Market Need for Product (12.2%)	0.79	0.07	0.00	0.12	0.04
Size of Market (10.0%)	0.84	0.03	0.00	0.10	0.07
Growth Potential of Market (13.3%)	0.66	0.35	0.06	− 0.20	0.20
Freedom from Regulation (16.7%)	0.09	− 0.09	− 0.20	0.07	0.41
Protection from Competitive Entry (12.3%)	− 0.01	0.36	− 0.12	0.77	0.24
Resistance to Economic Cycles (12.2%)	0.28	0.32	0.27	0.59	− 0.38
Protection from Obsolescence (17.8%)	0.10	− 0.19	0.12	0.75	0.17
Protection against Down-side Risk (13.4%)	0.02	− 0.13	0.09	0.70	0.18
Opportunities for Exit (15.6%)	0.28	0.15	0.12	0.24	0.76
Merger/Acquisition Potential (17.8%)	0.12	0.20	0.25	0.12	0.80
Hedge Against Current Investments (53.3%)	—	—	—	—	—
Tax Benefits (34.4%)	—	—	—	—	—
% Variance Explained	22.5	12.9	9.6	8.2	7.2

*Percentage of deals for which evaluation was not reported.

(see Table 2) using a four-point rating scale (Poor = 1, Adequate = 2, Good = 3, Excellent = 4). In addition to rating the venture on the 23 criteria, the participant also rated the venture on overall expected return and risk, respectively. A straightforward measure of expected return proved intractable because in 42% of the cases the venture capitalist was unable to assign a numerical estimate of the expected rate of return. For this reason, expected return was measured on a four-point scale (Low = 1, Moderate = 2, High = 3, Very High = 4). The perceived riskiness of the deal was measured by asking the venture capitalist to assign a subjective probability to the venture being a commercial failure. Finally, the venture capitalists indicated their decision regarding the deal. Of the 90 deals in the sample, 25 were rejected, 43 were found to be acceptable and thus fundable, 18 were pending further investigation, and in the case of 4 deals, the decision was not specified.

Table 2 lists the 23 items which served as the basis for evaluating deals under consideration. The number in parentheses next to each item reports the frequency with which deals received no evaluation at all on each of these criteria. A deal would not be evaluated on a particular criterion if it did not enter the decision-making process. The frequency of missing responses was particularly high in the case of five of the evaluation criteria. The patentability of the product was not evaluated in 30% of the cases. Manufacturing aspects such as raw material availability and production capabilities were not evaluated in almost one-third of the cases. The tax benefits of the investment were not evaluated in 34.4% of the deals. Finally, the extent to which the investment offset or hedged the risk of the existing portfolio was not evaluated in 53.3% of the cases.

Why do these five items sustain such a high nonresponse rate? Though the data themselves do not answer these questions, it is possible to speculate why this occurs. There is a disillusionment with the patent process and many entrepreneurs and venture capitalists feel that the public disclosure of the product design in the patent application leads to more competitive entry rather than less. Venture capitalists generally do not worry about raw material and production capabilities as these are technical problems easily solved if the product and its marketing are viable. Tax benefits are not relevant in evaluating many deals because venture capitalists see their mission as reaping capital gains rather than providing tax shelters for the investors in their fund. Finally, the fact that a deal's relationship to the existing portfolio is not evaluated in more than half the cases is consistent with the results of Study I. Of the 46 venture capitalists interviewed, 28 claimed that they evaluated each deal on its own individual merit. Only one of the interviewees claimed that impact on portfolio risk was formally analyzed.

All the scales, with the exception of the two which had the highest rate of missing data, namely the tax benefits and hedge against current portfolio, were factor analyzed.

The varimax factor loadings are given in Table 2. A five-factor solution explains 60.4% of the variation in the 21 rating items. Adding a sixth factor would have added an incremental 6.3% of the variance explained; however the interpretability of this sixth factor was poor (each factor was interpreted on the basis of the items which load most heavily on it).

Based upon the factor structure in Table 2, we conclude that venture capitalists evaluate potential deals in terms of five basic characteristics. The first characteristic which we labeled *Market Attractiveness* depends upon the size, growth and accessibility of the market and on the existence of a market need. The second characteristic reflects *Product Differentiation* which is determined by the ability of the entrepreneur to apply his technical skills in creating a product which is unique can deter competition through patents and enjoy a high profit margin. The third characteristic reflects the *Managerial Capabilities* of the venture's founders. This capability results from skills in managing several business functional areas and is associated with favorable references given to the entrepreneurs. The fourth factor represents the extent to which the venture is resistant to uncontrollable pressures from the environment. These pressures may result from obsolescence due to changing technology, from sensitivity to economic conditions or from low barriers to entry by competition. This factor was labeled *Environmental Threat Resistance*. The final factor represents the extent to which the venture capitalist feels that the investment can be liquidated or "cashed out" at the appropriate time. This is labeled as *Cash-Out Potential*.

The next step was to profile each deal in terms of the five dimensions. A score was computed for each deal on each factor as an average of the ratings of the items which loaded heavily on the factor.[1] For each factor, a Cronbach alpha was computed as an indication of the reliability of that factor. The Cronbach alpha values are reported on the diagonal of the matrix in Table 3. These range from 0.71 to 0.79. Table 3 also reports the intercorrelation of the factors.

A linear regression model was used to relate each deal's scores on the five dimensions to subjective estimates of its level of expected return and perceived risk, respectively. The expected return was estimated on a four-point scale. Risk was

[1] The items used in computing each factor score are those blocked in Table 1, with the exception of "Reference of Entrepreneur" and "Patentability of Product" which were excluded as they lowered the Cronbach alpha reliability.

TABLE 3

Cronbach Reliability and Intercorrelation of Evaluation Factors[1]

	Market Attractiveness	Product Differentiation	Managerial Capabilities	Environmental Threat Resistance	Cash-Out Potential
Market Attractiveness	0.79*	0.35*	0.20*	0.48*	0.39*
Product Differentiation		0.76	0.12	0.33*	0.25*
Managerial Capabilities			0.77	0.18	0.18
Environmental Threat Resistance				0.71	0.26
Cash-Out Potential					0.77[2]

[1] Cronbach alpha reliability is reported on the diagonal. The off-diagonal elements are Pearson correlation coefficients between the factors.

[2] The Cronbach alpha when only two items are used in constructing a scale is equivalent to the Pearson correlation between the two items.

* $p < 0.05$.

estimated in terms of the probability of commercial failure: the higher the probability of failure, the greater the riskiness of the venture.[2] Table 4 reports the results of the two regressions.

The evaluation scores are able to explain 33% of the variance in perceived risk and 22% of the variance in estimated rate of return. The R^2 values associated with the two regressions are significant at the 0.01 level.

Two aspects of the deal's evaluation have a significant impact on the risk associated with the deal. A lack of managerial capabilities significantly increases the perceived risk ($p < 0.05$).The relative magnitudes of the beta coefficients show that managerial capabilities have the strongest effect on reducing the riskiness of the deal and resistance to environmental threats has the next highest effect. Other characteristics of the deal do not influence the perceived risk at a significant level.

Two different aspects of the deal's evaluation influence the expected rate of return. Attractive market conditions have the strongest effect ($p < 0.01$) and a highly differentiated product has the next highest effect ($p < 0.05$). Other characteristics of the deal do not significantly influence the expected return.

Interestingly, the cash-out potential of a venture does not seem to influence either perceived risk or return. This is particularly surprising because without a merger, acquisition or public offering, the investor is severely constrained in realizing any gains.

TABLE 4

Determinants of Risk and Return Assessment

Dependent Variable	Market Attractiveness	Product Differentiation	Managerial Capabilities	Environmental Threat Resistance	Cashout Potential	Adjusted R^2
Risk	− 0.05	− 0.12	− 0.46[a]	− 0.23[b]	0.01	0.33[a]
Return	0.40[a]	0.26[b]	0.03	0.02	− 0.13	0.22[a]

[a] Significant at the 0.01 level.

[b] Significant at the 0.05 level.

[2] The correlation between expected risk and return was −0.13. This relationship is not statistically significant.

In our sample of 90 deals, 43 were endorsed as acceptable investments, 25 were denied funds and the balance were either pending a decision or no decision was specified. Discriminant analysis was used to examine the ability of the perceived risk and return to distinguish between rejected and accepted deals. For this purpose, we analyzed only the 68 deals for which a definite decision was made.

The standardized discrimination function coefficients of the two predictor variables, expected return and perceived risk, are 0.52 and -0.87, respectively. The signs are as expected; namely, a high expected return increases the likelihood that the deal is accepted and a high perceived risk increases its likelihood of being rejected. The fact that the signs of the discriminant coefficients are different, i.e., one is positive whereas the other negative, indicates a trade-off relationship between risk and return, a lower expected return is acceptable if offset by a lower risk.

The predictive ability of the discriminant function can be evaluated in terms of the accuracy with which it can classify deals as accepted or rejected. 68.4% of the deals actually rejected were classified as such and 95.2% of the deals actually accepted were classified as such. Together, this represents 86.9% of the deals being correctly classified. The predictive ability of a discriminant function can be evaluated by comparing the percentage of cases correctly classified against two criteria (Morrison 1969).

Proportional Chance Criterion: $C_{pro} = \alpha^2 + (1 - \alpha)^2$,

Maximum Chance Criterion: $C_{max} = \max(\alpha, 1 - \alpha)$,

where α and $1 - \alpha$ are the proportions in each group.

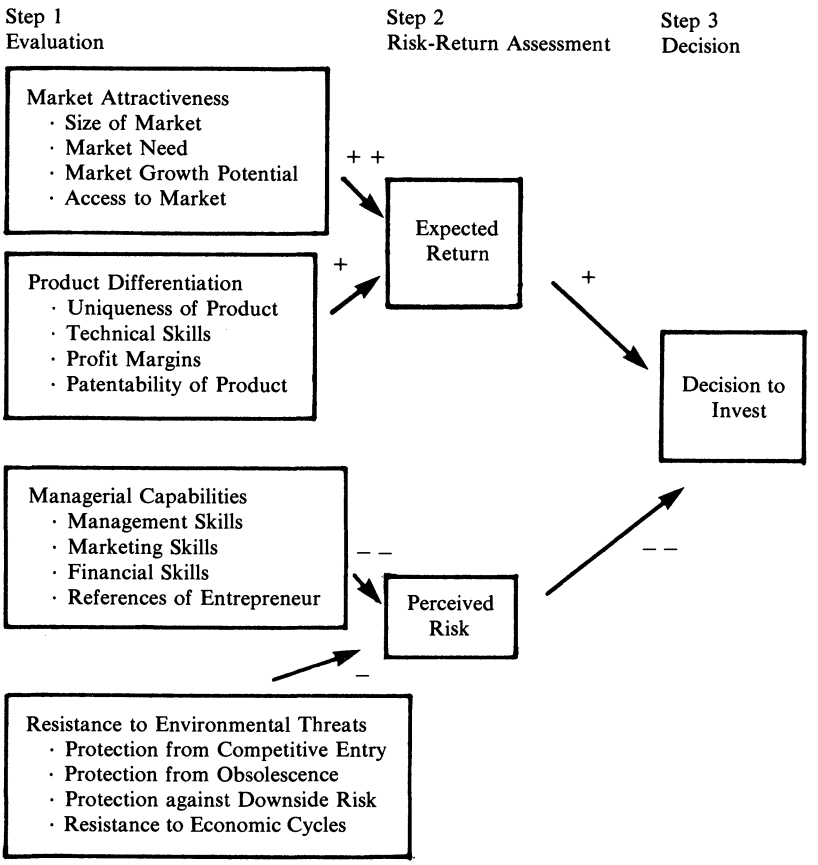

FIGURE 2. Venture Capital Investment Decision Process.*

*The + +, +, –, – – symbols indicate the direction and magnitude of the parameters describing the relationships of variables.

TABLE 5

Validation of the Model

	Venture Capitalist No. 1	Venture Capitalist No. 2	Venture Capitalist No. 3
DEAL ORIGINATION			
Most deals are referred to the venture capitalist rather than being cold contacts.	Agrees, but do get many cold contact deals. They tend to be considerably lower quality on average than "referred" deals.	Agrees.	Agrees.
A little less than half of the deals referred to the venture capitalist are referred by a former investee or a personal acquaintance; about a third are referred by other venture capitalists.	Agrees.	Agrees. In this case,"personal acquaintance" includes lawyers, auditors, and investment bankers that are well known to the venture capitalist.	Substantially true. A large number of deals come from personal or professional acquaintances. Number from other venture capitalists seems to be of less overall importance particularly for early stage deals.
Referrals by other venture capitalists are often in the form of an invitation to participate in a deal.	Agrees.	Agrees.	Not true in our experience. Often other venture capitalists invite us to examine a deal in conjunction with themselves. Their hope is to leverage our expertise and perspective in analyzing the deal. Quite often this may lead to a negative investment decision.
Sometimes a venture capitalist may select an industry of interest and set up a venture by searching out a management team. Such cases are rare. The more typical approach is when the venture capitalist lets the deal come to him.	Agrees.	Agrees.	Substantially true. Just as often as selecting an industry, however, we have more typically selected a management team and built a company around them.
DEAL SCREENING			
The most commonly used screening criteria are the size of investment, the technology and/or market, the stage of financing, and the geographic proximity	Interesting management team may be most important screening criterion.	Size of investment is not critical in the investment decision. Experience level of management group is the most important criterion.	The size of investment is often used as an excuse for turning a deal down but rarely would stand in the way of our participation if everything else seemed good. Technology and/or market are of interest but more particularly relate to barriers of entry achievable or ultimate size of the company achievable. Stage of financing has been a criteria for us in the past, i.e., we focus on first or second round deals. Geographic location has not been a concern. However, it is often used as an excuse to turn a deal down.
DEAL EVALUATION			
The decision to invest is based upon the expected return relative to the risk level.		The capabilities of the management team is a better indication of expected return than risk level.	Overall, I believe your conclusions are correct. Factored into this, however, are issues such as portfolio diversification, other investors and the size of capitalization required.
The best indicators of return prospect are			
(a) Market Attractiveness (size & growth potential, market used and ability of the venture to access the market).	Agrees.		Ability to develop a particular technology and bring it to market at a particular time represents a substantial risk in many deals.
(b) Product Differentiation (uniqueness of product, technical skills, profit margins/value added, patents).	Agrees.		Overall, it is very difficult to be comprehensive and succinct at the same time in stating all of the factors entering into a deal evaluation.
The best indicators of the risk level are:			
(a) Managerial Capabilities (management, marketing, financial skills, entrepreneur's background).	Agrees.		
(b) Protection from Uncontrollables (competition, obsolescence, economic cycles).	Agrees.		
DEAL STRUCTURING			
Convertible preferred stock is the typical form of financing.		Agrees.	With rare exceptions, all of our financing involve convertible preferred stock. Debt is used only in very rare instances for our partnership. A distinction should be made here between SBIC style financings versus more traditional mainstream venture capital financing; SBIC's are more prone to finance with debt instruments.
Equity share required is determined by pay-out expectations relative to rate of return objectives.			Price is determined largely by the quality of the opportunity as well as comparable opportunities which have recently been financed.
The entrepreneur's equity is determined by earn-out conditions.	In our experience, earn-out agreements are quite rare and counter productive for both the management team and venture capitalists.		In general we receive liquidity either through merger or public stock offering.
The negotiations regarding the earn-out agreement give insight into the entrepreneur's expectations for the venture.			
POST INVESTMENT ACTIVITIES			
The venture capitalist provides the venture with management guidance and business contacts.	"Management guidance" can cover a lot of sins. Critical input most often comes in the areas of:	Agrees.	Management guidance and business contacts vary widely depending on the particular investment and our level of involvement. This level of involvement is tied directly to our participation on the board. However, we sit on the board in less than one-third of our portfolio companies, and typically only those deals in which we are lead investors.
A representative of the venture capital firm generally sits on the board.	(1) Recruiting key executives or managers to fill out the team.		
The venture capitalist plays a significant role in orchestrating a merger, acquisition on public offering.	(2) Acting as a sounding board to CEO on self-evaluation and evaluation of other top management		I would view our role in orchestrating a merger acquisition or public offering as relatively minor compared to our role as a management sounding board.
	(3) Strategy development.		

TABLE 5 (*continued*)

Venture Capitalist No. 4	Venture Capitalist No. 5	Venture Capitalist No. 6	Venture Capitalist No. 7
Agrees. Agrees. Agrees. Agrees.	Founders have become very sophisticated. They develop relationship with lawyer and apprise bank contact of their intentions to start company. They also use their network, especially banks, lawyers and former associates who have started companies. This helps the targeting of vc potentials as well as providing introductions.	Agrees. More than 1/2, 1/2 by other v.c.'s. Also past & present investees, corporate contacts & personal accounts	Agrees. Agrees. Agrees. Agrees.
For us, I would rank in priority: (1) Management team (2) Technology/market (3) Stage of financing (4) Size (5) Location (only re being lead investor).	Missing is the most important... the people! I check the founders out before I will have first meeting.	We use potential return on capital as an early screening criterion.	Agrees.
Agrees. Agrees.	We don't actually use separate determinants of risk & return. Rather we use 3 evaluation criteria, weighted as follows: 40% - management quality/experience 40% - market (big wave can carry many surf boards) 20% - product niche, i.e., segmentation (performance/competition and many other implications)	Quality of management reflects return potential rather than the risk.	Managerial capabilities are an indicator of return prospects relative to the risk level.
Convertible preferred stock is typical for us; note that we discourage dividends.	One way to handle the question of performance is through a buy-back provision where the stock position of the entrepreneur is vested over a period of time. This allows for the replacement of poor/marginal performers and the ability to use repurchased (non-vested) stock to attract replacement in the management team. Past experiences in the realized valuation of comparable ventures which we have backed help determine the equity split between entrepreneur & us in future deals. For example, if we expect a company to have an upside potential of $10 million, we might put in $4 million and expect 40% equity in the venture.	Equity share is determined by the total equity valuation process; earn-out conditions are not used by our firm.	Converts were used more in the mid-seventies. They're still used by SBIC's but typically not by conventional VC partnerships. There hasn't been a convert in our last 40-50 investments. Equity share is determined by pay-out required expectations and by an assessment of the value currently represented by the business. Most VC's I know won't get involved in an earn-out. I haven't done one in 14 years in the business. You strike a deal with the management at the outset. Hopefully more equity is provided over time to successful management, but there's no way to take it away from them unless they leave or are fired. If you replace "earn-out" with "equity split," the statement would more accurately describe our reality.
For us, board seats for at least some venture investors. At least some of the venture capital investors, & especially the lead investor, should have representation on the board.	We agree. We especially contribute as follows: Help in recruiting key people Serve as sounding board to first time CEO Security check on strategy (OEM or direct sales, etc.)	We always serve on the board of our portfolio companies. We provide our portfolio companies with assistance in such areas as identifying legal counsel, performing compensation audits, focusing the product or service, recruiting management, locating additional capital and guiding acquisition/merger decisions.	Agree, but only one VC may be on the board even if there are 2-3 VC's in the deal, i.e., all of the investors don't go on the Board.

In our study, 43 of 68 deals were accepted ($\alpha = 0.63$) and 25 of 68 deals were rejected ($1 - \alpha = 0.37$). Thus $C_{pro} = 0.53$ and $C_{max} = 0.63$. Since the discriminant function classified 86.9% of the cases correctly, it performs considerably better than both the proportional chance criterion and the maximum chance criterion.

Figure 2 is a schematic representation of how evaluation criteria have an impact on the venture capitalist's decision to invest, as inferred by Study II. In summary, the attractiveness of the market and the product's differentiation are related to the expected return. A capable management team and resistance to environmental threats indicate a lower risk of commercial failure. Finally, the decision to invest is determined by the risk vs. return expectations vis-à-vis a venture. As expected, venture capitalists are risk-averse and profit-oriented in their decision and, moreover, they are willing to invest in risky deals if offset by the profit potential.

Neither Study I nor II collected any data relevant to the deal structuring (Step 4) or post-investment activities (Step 5) aspects of the model in Figure 1. These were addressed in a more general fashion in the validation component described in the next section.

Validation of the Model

Seven cooperating venture capitalists agreed to participate in a follow-up study to validate the model. The participants were selected to provide representation from the viewpoint of the various types of venture capital investors. Included in the set of cooperating venture capitalists were: a large venture capital firm which also participates in underwriting new equity issues; a small venture capital partnership composed of successful entrepreneurs who have sold their companies; a venture capital partnership with several generations of funds ranked in the top five in terms of number of deals made and dollars invested for 1982; a well-known venture capital firm which specializes in a narrow high technology industry segment; an SBIC; an individual venture capitalist investor; and a venture capital partnership substantially owned by a major banking institution. Each of the participating venture capitalists was asked to review the specification of the components of our model. These are summarized in the left-hand column of Table 5. Also the venture capitalists were asked to elaborate upon their reaction to the validity of the model. These responses are also shown in Table 5.

In general, there is agreement with the model's specification. Some of the comments elaborate upon the model specifications; others take exception with selected components of the model. The major departures from the model's specification are as follows:

(1) The model may have under-represented the extent to which venture capitalist's stress the quality of the management team as an early screening criterion. Also, the size of investment is not a screening criterion for several respondents.

(2) There was considerable disagreement with our statistical result that the quality of the management team influences risk but not expected return. Three of the seven respondents feel that management capabilities are an indicator of potential return rather than risk. A more fundamental issue is raised by VC5. This respondent does not formally distinguish between risk and return, as was implicitly assumed in our formulation.

(3) Earn-out arrangements are not extensively used in structuring deals. VC5 offers insight into a different type of deal structure which tries to achieve the same objective as an earn-out. In an earn-out arrangement, the share of the entrepreneur is determined by the venture's performance, thereby giving the investor control if the performance is poor. Instead, VC5 achieves much the same effect by the use of a "vesting" arrangement. Since the share of the entrepreneur vests over time, this gives the investor control in the early development of the venture even though his ultimate share may be a minority position.

Though the responses in Table 5 are in general agreement with our model's specification, there is a disturbing lack of common structure to the way the 7 venture capitalists reacted to the model. The diversity of the responses, both in content and style, demonstrates the heterogeneity in the practices of different venture capital firms. This heterogeneity cautions against too rigid a specification in any model describing venture capital management.

Conclusions

The purpose of this paper is two-fold. The first is to stimulate an interest in modeling the management of venture capital funds. The second is to provide entrepreneurs with insights which can help in their dealings with venture capitalists.

With respect to the first objective, the value of the study may perhaps be as much in what it did not achieve as in what it did achieve. A five-step model of the activities of venture capitalists has been developed. The model, however, is highly descriptive and lacks a theoretical basis. Moreover, the model is admittedly simplistic. A more rigorously specified model, however, could not capture the heterogeneity of practices across the many venture capital firms. Wells (1974) achieved a higher level of specificity in his modeling of venture capital fund management, but only at the expense of a unique model for each of the firms in his relatively small sample. Finally, the empirical portion of this paper has focused on the first three steps, and especially the third step, of the model. Most of the previous research on this topic share the same focus. In contrast, the fourth and fifth steps, namely deal structuring and post-investment activities, have not received much attention. In particular, the pricing of venture capital investments, in terms of the equity relinquished has not been modeled. Also, since most ventures involve several rounds of financing, the implications of future capital needs on investment decisions in earlier rounds of financing need to be explored. These limitations of the model presented in this paper are, hopefully, the stimuli for a continued interest in modeling venture capital investments.

The second objective of this paper is to provide potential entrepreneurs with insight into the way venture capitalists manage their funds. These insights are also valuable to managers in large companies who wish to improve their allocation of resources to internal ventures competing for new business development funds. First, professional relationships with CPAs, lawyers, bankers and successful entrepreneurs who have a high degree of credibility with the venture capital community is a help in locating capital. Second, the venture capital community is often smaller than it seems due to the high incidence of syndication whereby several venture capitalists co-invest in a venture. Third, venture capitalists differ in the screening criteria used to guide their investments. Most deals would have to match the investor's industry and geographic preferences, risk preferences for different financing stages, and investment policy in terms of the amount they will invest in a single deal. Finally, four aspects of the business plan are used to evaluate the riskiness and potential profit associated with a particular deal. These are (1) the marketing factors and the venture's ability to manage them effectively, (2) product's competitive advantages and uniqueness, (3) quality of the management team, particularly in its balance of skills, (4) exposure to risk factors beyond the venture's control, e.g., technological obsolescence, competitive entry, cyclical sales fluctuations. In presenting a deal to a venture capitalist, these four aspects should be used to favorably position the venture.[3]

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References

BROPHY, D. J., "Flow of Venture Capital 1977-1980," in *Frontiers of Entrepreneurship Research*, K. H. Vesper (Ed.), Babson College, Wellesley, Mass., 1981, 246–280.

BRUNO, A. V. AND A. C. COOPER, "Patterns of Development and Acquisitions for Silicon Valley Startups," *Technovation*, Elsevier Scientific Publishing Company, Amsterdam, Netherlands, 1982, 275–290.

CHARLES RIVER ASSOCIATES, "An Analysis of Venture Capital Market Imperfections," NTIS Report PB-254996, National Bureau of Standards, Washington D.C., 1976.

COOPER, I. A. AND W. T. CARLETON, "Dynamics of Borrower-Lender Interaction: Partitioning Final Payoff in Venture Capital Finance," *J. Finance*, 34 (1979), 517–529.

DORSEY, T. K., "The Measurement and Assessment of Capital Requirements, Investment Liquidity and Risk for the Management of Venture Capital Funds," unpublished doctoral dissertation, University of Texas, Austin, 1977.

GLASSMEYER, E. F., "Venture Financing Techniques," in S. E. Pratt (Ed.), *Guide to Venture Capital Sources*, Capital Publishing Corp., Wellesley, Mass., 1981, 64–66.

GOLDEN, S. C., "Structuring and Pricing the Financing," in S. E. Pratt (Ed.), *Guide to Venture Capital Sources*, Capital Publishing Corp., Wellesley, Mass., 1981, 67–76.

HOFFMAN, C. A., "The Venture Capital Investment Process: A Particular Aspect of Regional Economic Development," unpublished doctoral dissertation, University of Texas, Austin, 1972.

LELAND, H. E. AND D. H. PYLE, "Informational Asymmetries, Financial Structure, and Financial Intermediation," *J. Finance*, 32 (1977).

MONTGOMERY, D. B. AND G. L. URBAN, *Management Science in Marketing*, Prentice-Hall, Englewood Cliffs, N.J., 1969, 303–312.

MORRISON, D. G., "On the Interpretation of Discriminant Analysis," *J. Marketing Res.*, 6 (May 1969), 156–163.

O'MEARA, J. O., "Selecting Profitable Products," *Harvard Business Rev.*, 39 (1961), 84–85.

PESSEMIER, E. A., *Product Management: Strategy and Organization*, John Wiley, New York, 1982, 347–351.

POINDEXTER, J. B., "The Efficiency of Financial Markets: The Venture Capital Case," unpublished doctoral dissertation, New York University, New York, 1976.

PRATT, S. E. (Ed.), *Guide to Venture Capital Sources*, Capital Publishing Corp., Wellesley, Mass., 1981.

ROSS, S. A., "The Determination of Financial Structure: The Incentive Signalling Approach," *Bell J. Econom.*, 8 (1977), 23–40.

TIMMONS, J. AND D. GUMPERT, "Discard Many Old Rules About Getting Venture Capital," *Harvard Business Rev.*, 60 (1) (1982).

TYEBJEE, T. T. AND A. V. BRUNO, "Venture Capital Decision Making" in *Frontiers of Entrepreneurship Research*, K. H. Vesper (Ed.), Babson College, Wellesley, Mass., 1981, 281–320.

WELLS, W. A., "Venture Capital Decision Making," unpublished doctoral dissertation, Carnegie-Mellon University, 1974.

WETZEL, W. E., JR, "Informal Risk Capital in New England," in *Frontiers of Entrepreneurship Research*, K. H. Vesper (Ed.), Babson College, Wellesley, Mass., 1981, 217–245.

References

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Ian A. Cooper; Willard T. Carleton

The Journal of Finance, Vol. 34, No. 2, Papers and Proceedings, Thirty-Seventh Annual Meeting, American Finance Association, Chicago, Illinois, August 29-31, 1978. (May, 1979), pp. 517-529.

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Informational Asymmetries, Financial Structure, and Financial Intermediation

Hayne E. Leland; David H. Pyle

The Journal of Finance, Vol. 32, No. 2, Papers and Proceedings of the Thirty-Fifth Annual Meeting of the American Finance Association, Atlantic City, New Jersey, September 16-18, 1976. (May, 1977), pp. 371-387.

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http://links.jstor.org/sici?sici=0022-1082%28197705%2932%3A2%3C371%3AIAFSAF%3E2.0.CO%3B2-E

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Journal of Marketing Research, Vol. 6, No. 2. (May, 1969), pp. 156-163.

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