PUBLICLY TRADED VENTURE CAPITAL FUNDS: IMPLICATIONS FOR INSTITUTIONAL "FUND OF FUNDS" INVESTORS

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EXECUTIVE SUMMARY

Institutional investors supply the bulk of the funds which are used by venture capital investment firms in financing emerging growth companies. These investors typically place their funds in a number of venture capital firms, thus achieving diversification across a range of investment philosophy, geography, management, industry, investment life cycle stage, and type of security. Essentially, each institutional investor manages a "fund of funds," attempting through the principles of portfolio theory to reduce the risk of participating in the venture capital business while retaining the up-side potential which was the original source of attraction to the business. Because most venture capital investment firms are privately held limited partnerships, it is very difficult to measure risk adjusted rates of return on these funds on a continuous basis.

In this paper, we use the set of twelve publicly traded venture capital firms as a proxy to develop insight regarding the risk reduction effect of investment in a portfolio of venture capital funds, i.e., a fund of funds. Measurements of weekly total returns for the shares of these funds are compared with similar returns on a set of comparably sized "maximum capital gain" mutual funds and the daily return of the S&P 500 Index. A comparison of returns on an individual fund basis, as well as a correlation of daily returns of these individual funds, were made. In order to adjust for any systematic bias resulting from the "thin market" characteristic of the securities of the firms being observed, the Scholes-Williams beta estimation technique was used to reduce the effects of nonsynchronous trading.

The results indicate that superior returns are realized on such portfolios when compared with portfolios of growth-oriented mutual funds and with the S&P 500 Index. This is the case whether the portfolios are equally weighted (i.e., "naive") or constructed to be mean-variant efficient, ex ante, according to the capital asset pricing model. When compared individually, more of the venture funds dominated the S&P Market Index than did the mutual funds, and by much larger margins. When combined in portfolios, the venture capital funds demonstrated very low beta coefficients and very low covariance of returns among portfolio components when compared with portfolios of mutual funds. To aid in interpreting these results, we analyzed the discounts and premia from net asset value on the funds involved and compared them to Thompson's findings regarding the contribution of such differences to abnormal returns. We found that observed excess returns greatly exceed the level which would be explained by these differences.

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The implications of these results for the practitioner are significant. They essentially tell us that, while investment in individual venture capital deals is considered to have high risk relative to potential return, combinations of deals (i.e., venture capital portfolios) were shown to produce superior risk adjusted returns in the market place. Further, these results show that further combining these portfolios into larger portfolios (i.e., "funds of funds") provides even greater excess returns over the market index, thus plausibly explaining the "fund of funds" approach to venture capital investment taken by many institutional investors.

While the funds studied are relatively small and are either small business investment companies or business development companies, they serve as a useful proxy for the organized venture capital industry, despite the fact that the bulk of the funds in the industry are institutionally funded, private, closely held limited partnerships which do not trade continuously in an open market. These results demonstrate to investors the magnitude of the differences in risk adjusted total return between publicly traded venture capital funds and growth oriented mutual funds on an individual fund basis. They also demonstrate to investors the power of the "fund of funds" approach to institutional involvement in the venture capital business. Because such an approach produces better risk adjusted investment results for the institutional investor, it seems to justify a greater flow of capital into the business from more risk averse institutional investment sources. This may mean greater access to institutional funds for those seeking to form new venture capital funds. For entrepreneurs seeking venture capital funds for their young companies, it may also mean a lower potential cost of capital for the financing of business venturing. From the viewpoint of public policy makers interested in facilitating the funding of business venturing, it may provide insight regarding regulatory issues surrounding taxation and the barriers and incentives which affect venture capital investment.

INTRODUCTION

Because institutional investors have become the dominant source of funds for the U.S. venture capital industry (Tyebjee and Bruno 1984; Robinson 1987), their venture capital investment policies and practices are of great interest to those involved in the financing aspects of business venturing. A fundamental investment policy issue is the motivation for risk-sensitive institutional investors—particularly with the fiduciary responsibilities many of them carry—to invest in the venture capital business with its inherently high level of risk. Why do these institutions invest in venture capital: Are they simply "rolling the dice," or are there characteristics of the venture capital market which permit such investors to pursue the attractive returns apparently available while holding risk to tolerable levels?

While certain regulatory, legal, and structural changes (Stevenson, et al. 1986) have been the "necessary" factors in enhancing the ability of institutional investors to even consider participation in the venture capital market, we argue in this paper that fundamental principles of portfolio management provide the factors which are "sufficient" to rationalize institutional participation in the market. Toward this end, we test the hypothesis that institutional investors, by following a "fund of funds" investment policy (i.e., investing in a diverse set of separate venture capital investment pools), are able to achieve exceptional returns on a risk adjusted basis.

We test this hypothesis using weekly total return data over a five year period for the set of 12 venture capital funds which have their shares traded publicly on the over the counter (OTC) market. For the remaining funds in the venture capital universe, all of which are closely held corporate or limited partnership entities, observations of periodic value are not publicly available (Bygrave and Timmons 1985). Despite differences, discussed below, the

set of venture capital funds studied is representative of the universe for purposes of this study.

PREVIOUS RESEARCH

An early study of the risk/return characteristics of venture capital investments was done by Dorsey (1977), who analyzed 368 investments held by 140 venture capital firms as of year end 1974. Dorsey's analysis was perhaps the first to demonstrate empirically the investment performance of venture capital funds and to show the extent to which that performance was influenced by highly successful investments on the one hand and totally unsuccessful (i.e., liquidated) investments on the other. While the study produced information helpful in identifying the risk/return characteristics of venture capital investments when pooled into portfolios, and in suggesting operating policy guidelines for managing such funds, it made no explicit attempt to relate the observed risk and return characteristics to the market in general, or to other types of investment.

In a subsequent study, Huntsman and Hoban (1980) analyzed the performance of 110 private equity investments made by three major venture capital funds between 1960 and 1975. Their analyses included tests of simulated portfolio combinations of the individual investments but were limited by the infrequency of market transactions in these securities. Their inability to compare rates of return with those of other securities over time intervals was also limiting. While they found an annualized rate of return of 18.9% on the total group of 110 investments over the 1960–1975 period, they were unable to discriminate between market risk and firm-specific risk. They concluded that it "would not be illogical to assume that the variances of returns on such investments, if they could be observed and measured, would be very high relative to securities used in the Dow Jones or Standard & Poor's indexes." Their intuitive judgement, which has been part of the motivation for our research, is confirmed by the return variance data generated by our study and presented below.

In a later study, Martin and Petty provided a partially satisfactory answer to this risk/reward question. They compared the performance of 11 publicly traded venture capital funds, 20 "maximum capital gain" mutual funds, and the Standard and Poors 500 Index (S&P 500), over the 1974–1979 time period (Martin and Petty 1983). Martin and Petty argued that since the mutual funds are "bundles" of marketable equity securities which are eligible investments for institutional investors, they offer a useful basis of comparison for the publicly traded venture capital funds. For each fund, they computed the compound annual return and standard deviation and normalized the fund's performance by computing Sharpe's Ratio: [mean return—mean risk free rate] ÷ standard deviation of returns. They then performed two comparisons. First, they ranked the funds by Sharpe's ratio and found that seven of the top ten performers, along with the two worst performers, were venture capital funds. Second, they found that even the most risk averse investors would prefer to invest in individual venture capital funds at least as often as they would invest in "maximum capital gain mutual funds" or a portfolio representative of the S&P 500. These findings regarding the comparative performance of individual venture capital funds would give a certain amount of comfort to an institutional investor. However, like Huntsman and Hoban, their risk measure (i.e., standard deviation of return) does not discriminate between market risk and firm-specific risk. As a result, they provide only limited operational guidance to those attempting to factor venture capital investment into a portfolio management strategy for such an investor.

The importance of this distinction between total risk and market related risk is reflected

by a recent survey in which *Institutional Investor* magazine examined the venture capital investment strategy employed by a number of large corporate and state pension funds (Jansson 1984). The study found that 89.1% of the organizations which invest in venture capital do so through purchasing shares in a number of dedicated venture capital investment pools. That is, they tend to invest in a cluster of funds as opposed to just one individual fund. In a sense, they manage a "fund of funds." Further, they tend to make few direct investments in individual high growth companies. Explanations for this strategy abound, ranging from a desire to pinpoint particular managers with an outstanding "track record" to a desire to cover specific industry sectors or subgroups (e.g., plant genetics, C.D. ROM), to an objective of broad investment diversification. While we do not dispute the validity of these explanations in specific cases, we suggest that the fundamental rationale for this approach in the general case is found in modern portfolio theory. Toward this end we test the hypothesis that the systematic risk and covariance characteristics of publicly traded venture capital funds, and the portfolios in which they could be held, make it possible for diversified investors (i.e., large institutional investors) to achieve returns superior to the market and to a set of comparable investment vehicles on a risk adjusted basis through a "fund of funds" investment strategy.

RESEARCH OBJECTIVES AND METHODOLOGY

In this study we analyze the performance characteristics of twelve publicly traded venture capital funds for the time period 1981–1985 and provide an explanation, based on modern portfolio theory, of the rationale for the "fund of funds" approach to venture capital investment by institutional investors. In this way, we build upon the work of Martin and Petty, and address their central issues in a context which may be more operationally useful to the institutional investor.

Nature of the Data

To be consistent with the MP study, we compared the 12 publicly traded venture capital funds in existence during the 1981–1985 period with a set of 12 randomly selected open end mutual funds which had stated objectives of attaining exceptionally high capital gains (see Appendix for a list of these firms). We also employed the S&P 500 Index as a representative measure of the equity market in general over that time period. We chose to analyze the time period from May 1981 through February 1985 so as to cover a recent time period, to maximize the number of publicly traded funds studied, and to capture both a rising and falling stock market.

Although the securities examined in this analysis were traded during each week of the study's time period, some of the public venture capital firms issues were thinly traded. We therefore chose to use weekly closing prices instead of daily prices in order to minimize the "thin market" effect[1] and weekly instead of monthly prices in order to increase the number of observations. The weekly returns of each security were calculated with the appropriate adjustments being made for stock splits and dividends.

As mentioned earlier, caution is urged in considering publicly traded venture capital

[1]Time series data of the twelve publicly traded venture capital firms and the maximum capital gain mutual funds analyzed were provided by the Compuserve Executive Data Service and the Standard and Poors Daily Price Index.

companies as a proxy for the venture capital industry. To do so, one must be willing to assume that existing differences between the 12 public firms and the 700 or so privately held firms are not critically important to the comparison. The publicly traded funds are either Small Business Investment Companies (SBIC) or Business Development Companies (BDC), while the privately held fund group include both SBIC, BDC, and limited partnerships. Regulatory differences between SBIC, BDC, and limited partnerships may affect the comparability of these types of entities. Whereas SBIC's are chartered and regulated by the Small Business Administration, limited partnership venture capital funds are subject only to partnership statutes at the state level and to the securities laws of the United States and of the several states in which they operate. Also, with respect to size (i.e., equity market valuation) and operating characteristics, there may be differences between the public firms and the majority of private firms, whether SBIC or limited partnership. For example, approximately 60% of the existing private limited partnership funds have over $100 million of committeed capital, considerably larger than the average size (approximately $50 million) of the 12 public venture capital funds analyzed in this study. While these differences are not trivial, we do not believe that they diminish the usefulness of the results.

Analytical Steps in the Study

Using the data described above, we first calculated the mean, standard deviation, and beta relative to the S&P 500 Index of weekly returns of the stock of each of the twelve publicly traded venture capital companies and for 12 randomly selected "maximum capital gain" open-end mutual funds over the May 1981 to February 1985 time period. We then did an ex post performance analysis on portfolios consisting of the 12 venture capital funds and portfolios consisting of the 12 mutual funds using both beta and standard deviation as the measures of risk. The venture capital performance results were measured against the market portfolio, using the S&P 500 stock index as a market proxy, and against the performance of the portfolios of mutual funds. In the remainder of this section we describe in detail the calculations involved in these analyses.

The total weekly return on each of the funds over time is estimated as follows:

$$R_{i,t} = \frac{P_{i,t} - P_{i,t-1} + D_{i,t} + T_{i,t}}{P_{i,t-1}} \tag{1.1}$$

Because two of the funds, Allied Capital Corporation and Narragansett Capital Corporation, paid taxes on behalf of shareholders during the time period studied due to regulatory requirements,[2] we assumed a cash payment (i.e., Ti,t) was made to shareholders on December 31 of the appropriate year in an amount equal to the tax credit in order to account for this in the return calculation.

[2]If the fund is to qualify as a regulated investment company and retain its tax free status, the fund must distribute 90% of all realized capital gains to shareholders. This may not always be in the best interest of the shareholders. If the fund has other investment opportunities and wishes to retain the capital gains within the fund and not lose their tax free status, the fund must create a transaction whereby the gains are distributed to shareholders and then immediately reinvested back into the fund. In doing so, a tax liability is created for shareholders. To solve this problem, the fund pays taxes directly to the federal government (at the maximum capital gains rate) on behalf of shareholders so as to eliminate any liquidity problems that may result from the transaction. The taxpayers thus receive a tax credit with which to offset the tax liability.

Variance estimates were obtained using the following relationship:

$$VAR(R_i) = [1/(N-1)]SUM_{t=1,N}(R_{i,t} - \bar{R}_i)^2 \quad (1.2)$$

Next, the weekly returns of each security were correlated against those of the other securities of its type (i.e., either venture capital fund or mutual fund) using the ordinary least squares (OLS) method:

$$CORR(R_i,R_j) = [1/(N-1)]SUM(R_{i,t} - \bar{R}_i)(R_{j,t} - \bar{R}_j) \quad (1.3)$$

In addition, the calculated weekly returns and variance of each security over the time period studied were converted to an annualized basis using the following relationships.

$$\bar{R}_i = \frac{52}{N} SUM_{t=1,N} R_{i,t} \quad (1.4)$$

$$VAR(R_i) = VAR(R_i) \times 52 \quad (1.5)$$

Beta estimates were obtained by correlating the returns of each security against the returns of the S&P 500 stock index using the Scholes/Williams beta estimation method (Scholes and Williams 1977). This method was employed in order to further reduce the effect of nonsynchronous trading, and to avoid the possibility of underestimating the required rate of return.

The 12 venture capital securities were then combined into two portfolios which were held unchanged for the period studied. The first portfolio was constructed to be mean-variant efficient, ex ante, through the use of the capital asset pricing model. In order to apply the CAPM to this situation, a number of necessary assumptions were made. They are:

1. perfect capital markets,
2. homogeneous expectations,
3. two parameter probability distribution of returns (i.e., returns are multivariant normal),
4. the market portfolio is adequately represented by the S&P 500,
5. Beta, variance and covariance are constant over time and can be accurately estimated ex ante,
6. no taxes,
7. no transactions cost,
9. a riskless asset can be represented by three month treasury securities.

The betas, correlations, standard deviation and market risk premium observed over the time period studied were employed in combining the securities into the portfolios referred to above. The expected return for each security was determined by assuming that no special information was known about any of the funds ex ante. Thus, in order to determine the optimal asset allocation for each security, the following relationships were used:

$$E(R_i) = R_f + B_i[E(R_m) - R_f] \quad (1.6)$$

$$E(P) = SUM_{i=1,12} E(R_i) \times X_i \quad (1.7)$$

$$VAR(P) = MIN\ SUM_{i=1,12}\ SUM_{j=1,12}\ X_iX_j \times COV(R_i,R_j) \quad (1.8)$$

$$1 = SUM_{i=1,12}X_i \quad (1.9)$$

TABLE 1 Performance Results: Public Venture Capital Funds

		Efficient Portfolio		Naive Portfolio	
	S&P 500	Required	Actual	Required	Actual
Return	14.31%	13.77%	23.76%	13.23%	18.54%
Beta (S/W)	1.00		0.87		0.73
Std. Dev.	15.80%		15.23%		14.31%

We used the test period to estimate the statistical parameters because time series data does not exist for all of the firms preceding the time period studied. The risk free rate of return was estimated by averaging the monthly averages of three month Treasury Bill returns over the period studied.[3]

The efficient frontier of portfolio returns was plotted in standard deviation space. The optimal portfolio was determined by drawing the steepest borrowing/lending line which is tangent to the efficient frontier of risky assets with a y-intercept equal to the risk free rate. The average annual rate of return on each security was calculated ex post. The net return of the portfolio was then calculated and compared to the returns obtained from a portfolio made up of the S&P 500 stocks.

By using the test period data for parameter estimation, we are implicitly assuming perfect foresight. To control for this, naive strategies (all securities equally weighted) were examined as well. This was done to determine the performance of both the venture capital funds and the mutual funds assuming absolute ignorance ex ante. The performance of these strategies was compared to the mean-variant efficient portfolios and the S&P 500 index on an ex post basis as well.

This entire procedure was done identically for both the venture capital funds and the mutual funds. The reader should be aware that open end mutual funds, during the test period, could not be sold short. Therefore, we used the full covariance model, but added the restriction of no short sales. So as not to allow this technical restriction to affect our comparison, we also constructed a mean-variant efficient portfolio allowing short sales. The portfolio results obtained were compared to both the S&P 500 portfolio and the portfolio of venture capital funds.

OBSERVATIONS AND RESULTS

The methodology described above permitted the comparison of returns achieved by the venture capital funds portfolios, the mutual funds portfolios, and the S&P 500. Based upon the "naive" portfolio structures, the average return of the portfolio of venture funds was 18.54% as compared with 13.89% for the portfolio of mutual funds and 14.31% for the S&P 500. The results of the "efficient" portfolio are even more striking when compared with required rates of return. Both of the venture capital fund portfolios (efficient and naive) greatly exceeded their required rates of return, while both of the mutual fund portfolios produced returns lower than their required rates of return. Tables 1 and 2 provide a summary of the results obtained for the efficient and naive portfolios.

[3]This data was obtained from the Thorndike Encyclopedia of Banking & Financial Data and the Annual Statistics Digest published by the Federal Reserve.

TABLE 2 Performance Results: Maximum Capital Gains Mutual Funds

	Efficient Portfolio					
	w/ Short Sales		w/o Short Sales		Naive Portfolio	
	Required	Actual	Required	Actual	Required	Actual
Return	15.35%	6.54%	14.90%	10.34%	14.59%	13.89%
Beta (S/W)		1.26		1.11		1.07
Std. Dev.		16.32%		15.36%		17.69%

Both of the venture capital fund portfolios provided a return greater than the S&P 500 while having market betas less than 1.0. Further, the standard deviation of each portfolio is less than the standard deviation of the S&P 500 portfolio. Since these results are also superior to those generated by the mutual fund portfolios, one might infer that the shares of publicly traded venture capital funds may be combined in portfolios in such a way as to obtain expected risk/return characteristics which are attractive relative to alternative investments and the corporate equity market in general. This suggests that venture capital investing by institutional investors may be judged to be prudent, especially if these investors allocate funds to a number of different venture capital portfolios, that is, follow the "fund of funds" approach, rather than placing all of their capital under one management group—whether that group is "outside" or "in house." This is consistent with the observations reported by Institutional Investor cited above.

In Tables 3–6 we present a summary of the numerical analysis performed on the individual venture capital funds and "maximum capital gain" mutual funds studied. A comparison of these individual fund results may explain why the portfolios of venture funds and of mutual funds performed as they did. Tables 3 and 4 show that seven of the 12 venture funds provided returns which exceeded the required rate of return. At the same time, five of the 12 mutual funds beat the market on a risk adjusted basis. However, this does not tell the complete story. With the exception of Midland Capital, the venture funds which beat the market did so by wide margins. Four of the funds produced returns which were twice the required rate of return. On the other hand, the mutual funds which exceeded the required rate of return, did so by only a very small margin.[4]

INTERPRETATION OF THE RESULTS

Some of this excess return by the public venture firms may be explained by the underpricing phenomenon commonly associated with closed end investment funds. Thompson (1978) analyzed the effects of premiums and discounts using ex post returns on closed end mutual funds, and found that closed end funds which sell at a premium to net asset value tend to

[4]A naive strategy is implemented by committing equal amounts of money to each fund, i.e., $1/12^{th}$ of the assets under management is placed into each fund. The reader will note that the beta, ex ante and ex post returns of the naive strategy are equal to the average beta, ex ante and ex post returns of the funds studied. This is because the method for calculating each of these items is equivalent. Further, one should note that the average variance and the variance of the naive portfolio strategy are not the same because of the covariance terms in the portfolio variance calculation, which do not enter the average variance calculation.

TABLE 3 Characteristics of Venture Capital Funds Studied

	Market Beta (O.L.S.)	Market Beta (S/W)	Required Return (S/W)	Actual Return	Standard Deviation of Returns	Funds Which Beat The Market (Ind. 1)	Investment Weight (w/Short Sales)
ALLC	0.26	0.70	13.11%	43.60%	24.57%	1	20.22%
BITC	1.47	1.96	18.15%	−2.60%	78.12%	0	5.10%
CSWC	0.18	0.28	11.43%	8.88%	24.58%	0	−3.91%
FCO	0.16	0.28	11.43%	10.86%	25.63%	0	10.32%
FKLN	0.12	0.26	11.35%	19.46%	23.88%	1	5.23%
FMWC	0.27	0.39	11.87%	28.00%	38.01%	1	7.49%
GWII	0.71	1.17	14.99%	28.35%	51.67%	1	6.36%
HZR	1.19	1.49	16.27%	13.46%	42.07%	0	11.18%
MCAP	0.22	0.38	11.83%	16.45%	26.01%	1	5.13%
NARR	0.40	0.43	12.03%	34.55%	27.04%	1	4.36%
RAND	0.08	0.22	11.19%	−3.68%	28.15%	0	5.66%
SPR	0.63	1.19	15.07%	25.11%	31.67%	1	22.86%
AVG	0.47	0.73	13.23%	18.54%	35.12%	7	100.00%

Risk Free Rate 10.31%; Market Return 14.31%; Market Std. Dev. 15.80%

	Firm Type S.B.I.C. B.D.C.	Paid Div	Paid Tax	Number of Shares (Thousands)	Share Price 5/81 $/Sh	Market Value 5/81 (Millions)
ALLC	SBIC	x	x	1,738,556	5.033	8.80
BITC	BDC			3,717,633	9.063	33.70
CSWC	SBIC	x		2,008,208	14.500	29.10
FCO	SBIC	x		1,014,000	8.000	8.10
FKLN	SBIC	x		1,003,986	10.500	10.50
FMWC	SBIC	x		885,809	3.556	3.10
GWII	SBIC	x		3,253,102	4.000	13.00
HZR	BDC	x		15,982,000	17.625	281.70
MCAP	BDC	x		1,604,236	12.875	20.70
NARR	SBIC	x	x	2,175,000	25.000	54.40
RAND	SBIC			329,758	11.375	3.80
SPR	CEIC	x		5,000,000	4.500	22.50

TABLE 4 Venture Capital Funds Correlation Matrix

	ALLC	BITC	CSWC	FCO	FKLN	FMWC	GWII	HZR	MCAP	NARR	RAND	SPR
ALLC	1.000	−0.007	0.236	0.043	0.114	0.021	0.071	0.170	0.068	0.124	−0.104	0.200
BITC	−0.007	1.000	0.100	−0.022	0.039	0.069	0.170	0.273	0.042	0.098	−0.018	0.155
CSWC	0.236	0.100	1.000	−0.003	0.091	0.076	0.121	0.133	0.144	0.004	0.017	0.121
FCO	0.043	−0.022	−0.003	1.000	0.029	0.018	−0.125	0.091	0.047	0.088	0.032	−0.028
FKLN	0.114	0.039	0.091	0.029	1.000	−0.107	−0.173	−0.020	0.003	0.109	0.137	0.026
FMWC	0.021	−0.069	0.076	0.018	−0.107	1.000	0.086	0.091	−0.008	0.173	−0.043	−0.075
GWII	0.071	0.170	0.121	−0.125	0.173	0.086	1.000	0.130	0.009	0.054	−0.019	0.115
HZR	0.170	0.273	0.133	0.091	−0.020	0.091	0.130	1.000	0.274	0.164	−0.133	0.213
MCAP	0.068	0.042	0.144	0.047	0.003	−0.008	0.009	0.274	1.000	0.196	0.070	0.007
NARR	0.124	0.098	0.004	0.088	0.109	0.173	0.154	0.164	0.196	1.000	0.066	0.150
RAND	−0.104	−0.018	0.017	0.032	0.137	−0.043	−0.019	−0.133	0.070	0.066	1.000	0.026
SPR	0.200	0.155	0.121	−0.028	0.026	−0.075	0.115	0.213	0.007	0.150	0.026	1.000

High 0.274; Low −0.133; Avg 0.147; Std 0.272.

TABLE 5 Characteristics of Mutual Funds Studied

	Market Beta (O.L.S.)	Market Beta (S/W)	Required Return (S/W)	Actual Return	Standard Deviation of Returns	Funds Which Beat The Market (Ind. 1)	Investment Weight (No Short Sales)	Investment Weight (w/Short Sales)
ACRNX	0.66	0.85	13.71%	12.17%	12.72%	0	12.99%	−7.63%
AFUTX	0.75	0.81	13.55%	2.28%	18.46%	0	0.00%	−15.30%
ALPHX	0.90	1.06	14.55%	7.06%	21.08%	0	0.00%	−1.57%
CLMBX	1.12	1.23	15.23%	16.98%	19.22%	1	0.00%	−35.70%
VEXPX	0.83	1.19	15.07%	11.94%	17.11%	0	27.90%	33.37%
FCNTX	0.95	1.12	14.79%	7.91%	16.70%	0	21.87%	32.02%
JANSX	0.80	0.95	14.11%	8.82%	18.28%	0	0.00%	9.43%
LEXGX	0.91	1.19	15.07%	1.99%	17.65%	0	16.58%	48.15%
NYVTX	0.83	1.11	14.75%	16.30%	17.89%	1	20.66%	25.29%
PENNX	0.81	0.67	12.99%	22.93%	41.07%	1	0.00%	−9.16%
PVISX	1.47	1.41	15.95%	41.62%	87.10%	1	0.00%	0.60%
SRSPX	1.01	1.26	15.35%	16.64%	18.79%	1	0.00%	20.50%
AVG	0.92	1.07	14.59%	13.89%	25.51%	5	100.00%	100.00%

Risk Free Rate 10.31%; Market Return 14.31%; Market Std. Dev. 15.80%.

TABLE 6 Mutual Funds Correlation Matrix

	ACRNX	AFUTX	ALPHX	CLMBX	VEXPX	FCNTX	JANSX	LEXGX	NYVTX	PENNX	PVISX	SRSPX
ACRNX	1.000	0.862	0.656	0.864	0.864	0.800	0.702	0.850	0.688	0.292	0.275	0.859
AFUTX	0.682	1.000	0.540	0.695	0.656	0.628	0.566	0.660	0.540	0.310	0.229	0.682
ALPHX	0.656	0.540	1.000	0.675	0.655	0.623	0.545	0.639	0.561	0.285	0.246	0.705
CLMBX	0.854	0.695	0.675	1.000	0.831	0.867	0.729	0.833	0.739	0.348	0.274	0.914
VEXPX	0.864	0.656	0.655	0.831	1.000	0.759	0.663	0.836	0.684	0.330	0.235	0.862
FCNTX	0.800	0.628	0.623	0.687	0.759	1.000	0.632	0.789	0.702	0.273	0.249	0.812
JANSX	0.702	0.566	0.545	0.729	0.663	0.632	1.000	0.675	0.629	0.291	0.238	0.702
LEXGX	0.850	0.660	0.639	0.833	0.836	0.789	0.675	1.000	0.628	0.287	0.239	0.819
NYVTX	0.688	0.540	0.561	0.739	0.684	0.702	0.629	0.628	1.000	0.248	0.230	0.726
PENNX	0.292	0.310	0.285	0.348	0.330	0.273	0.291	0.287	0.248	1.000	0.092	0.336
PVISX	0.257	0.229	0.246	0.274	0.235	0.249	0.238	0.239	0.230	0.092	1.000	0.267
SRSPX	0.859	0.682	0.705	0.914	0.862	0.812	0.702	0.819	0.726	0.336	0.267	1.000

High 0.914; Low 0.092; Avg 0.607; Std 0.247.

TABLE 7 Discounts (−) and Premiums (+) to Net Asset Value on Publicly Traded Venture Capital Funds

	1981	1982	1983	1984	1985	AVG
ALLC	−23.3%	−25.9%	− 1.8%	3.1%	12.2%	− 6.4%
BITC	16.8%	−58.0%	73.2%	−52.0%	−13.2%	−16.5%
CSWC	−27.6%	−35.5%	−32.1%	−24.2%	−23.1%	−28.5%
FCO	NA	−9.9%	26.1%	8.6%	11.3%	9.03%
FKLN	−36.9%	−34.6%	−24.8%	−15.5%	−23.3%	−27.0%
FMWC	−36.1%	−45.9%	−24.0%	−19.1%	−18.4%	−35.9%
GWII	−41.0%	−22.4%	−16.1%	−23.3%	−42.3%	−29.0%
HZR	− 8.6%	−41.6%	−36.9%	−15.7%	0.0%	−20.6%
MCAP*	NA	NA	− 2.8%	28.2%	NA	12.7%
NARR	−13.0%	24.3%	40.8%	55.2%	25.0%	26.5%
RAND	−40.2%	−20.2%	−31.0%	−34.5%	−34.6%	−32.1%
SPR	−33.7%	−32.2%	−26.4%	−22.9%	−17.5%	−26.5%
AVG	−24.3%	−27.4%	− 4.3%	− 9.3%	−11.2%	−14.9%

*MCAP is no longer in business. As a result, net asset value data was not available for all years for the fund. The data shown here for MCAP was obtained from Dow Jones News Retrieval. Net asset value for all other firms was obtained from published annual reports.

underperform the market on a risk adjusted basis, while funds which are priced at a discount tend to outperform the market on a risk adjusted basis.[5]

Based on his findings, he states that if a portfolio of closed ended mutual funds could be comprised of funds with 20% discounts to net asset value, one could expect a positive abnormal return of about 2%. To relate this to our data, we calculated the discounts and premiums to net asset value shown in Table 7 for each fiscal year the venture capital funds were studied.

The public venture firms examined had discounts to net asset value of 14.9% on average. However, this does not entirely explain the excess performance observed, which is 5 to 30%, depending on the venture fund. According to Thompson's results, these discounts account for only about 1.5% of the abnormal performance. Five of the funds which had large excess returns (ALLC, FKLN, FMWC, NARR, SPR), also had substantial reductions in discounts to net asset value over the time period. Narragansett, for example, had an increase from a 12% discount to a 25% premium. While this realignment does not account for all the excess performance it does explain some of it.

While Thompson's conclusions may explain discounts and premiums in closed end mutual funds in general, there may be additional factors to consider with venture capital funds. Pettit and Singer (1985) provide an agenda of key issues regarding small business

[5]Thompson concludes that "discounts and premiums on closed-ended funds which do not suffer from accounting problems in the estimation of net asset value must stem from one of four sources: (1) The existence of personal income taxes and related price adjustments to account for tax liabilities; (2) the existence of investor transactions costs and price adjustments to reflect distribution policy and portfolio diversification; (3) capital market information inefficiencies resulting from biased expectations of management productivity (the future performance of the funds portfolio, net of expenses) or, perhaps, the arbitrary exclusion of closed-end funds from the investment portfolios of institutional investors: and (4) the existence of a capitalized value (or cost) of management' s genuine ability, ex ante, to either outperform the market, thus inducing a premium, or generate expenses in the process of attempting unsuccessfully, to outperform the market, thus inducing a discount."

finance, turning principally on agency costs and problems of asymmetric information. They state that the ability of outsiders to analyze the risk of small, closely held, private firms is severely curtailed due to the problem of asymmetric information. Since the securities held by a venture capital fund are not usually publicly traded, the management personnel of the fund evaluates investments periodically, sometimes using general partners and independent outsiders as valuation committee members. Because investors are not privy to the information that management has, they may not be able to make as accurate an evaluation as management. Arguably, investors may be price-protecting themselves due to this information asymmetry. This may explain some of the discount observed. There is some evidence indicating that, as the funds' valuation policies and managers' valuation abilities are judged by the market place, investors price stocks at discounts and premiums to fund net asset valuation. Narragansett Capital and Allied Capital are examples of long established, well known, and respected publicly traded venture funds which trade at a premium. This "respectability" may be a contributing reason for their trading at premiums to net asset value. Also, even if one could precisely calculate the value of a fund's investments in nontraded securities, there is no practical way to arbitrage these funds. Unlike the mutual funds, the securities owned by the venture fund are not publicly traded. Consequently, there is no opportunity to buy shares in the fund and simultaneously sell short the individual securities held by the fund.

In another paper relevant to these issues, Keim (1983) showed that small firms tend to have higher market betas than do larger firms. He also found that ordinary least squares (OLS), as a method of beta estimation under conditions of infrequent trading, causes this estimator to be downwardly biased. While analysis of the 12 public venture capital firms does not permit large firm vs. small firm comparisons, it should be kept in mind that the public venture capital firms studied are indeed "small" firms. Six of the 12 funds had equity values less than $20 million at the beginning of the study and only two of the funds had equity values greater than $50 million.

As may be seen from Table 3, the average beta of the venture funds was 0.47 using the OLS method while the average beta estimated for the mutual funds using OLS was 0.92. The relationship between size and beta is not consistent across the venture capital funds studied. For example, Biotech Capital, which had an equity market capitalization of $34 million at the beginning of the time period, had an OLS beta of 1.47. Narragansett Capital, with a market capitalization of $54 million had an OLS beta of 0.40. Franklin Capital, with an equity capitalization of $11 million, had an OLS beta of only 0.12. The variance makes generalization hazardous.

Along with Keim, Pettit and Singer also state that small firms' common stock tends to be less actively traded than that of firms with large market values, thus producing a beta estimation which is downward biased when using the OLS method. Our results are consistent with these findings. And, as mentioned earlier, we used the Scholes/Williams correction technique to estimate betas. As shown in Tables 3 and 5, the Scholes/Williams estimation technique produced an average beta of 0.73 for the public venture capital firms. This is 55% higher than the average beta observed using the OLS method. The Scholes/Williams average beta estimate for the mutual funds was 1.07. This amounts to an average beta 16.5% higher than the OLS betas observed. Lastly, Pettit and Singer state that even after correcting for this effect, smaller firms have higher than expected ex post returns. Using the Scholes/Williams betas to determine the required rate of return, we find that seven of the 12 venture firms substantially outperformed the required rate of return, ex post. This concurs with the findings cited by Pettit and Singer.

IMPLICATIONS OF THE RESULTS

The statistical results of our observations are interesting in the contex of modern financial theory and are useful to those interested in the expected return on funds used in business venturing. First, because the market betas of the public venture capital funds are lower, on average, than the corporate equity market and the betas of maximum capital gains mutual funds (0.73 vs. 1.07)—in fact, nine of the 12 public venture capital firms have market betas less than 0.7—there is *less market risk* in a typical individual venture capital fund than in the market overall and in most individual maximum capital gains mutual funds. This implies that the investments made by such firms have much more unique risk (and less systematic risk) than the market and the investments made by the mutual funds. It is widely felt that young firms in general have this low beta characteristic, and that their total returns are driven by firm-specific events rather than general market movement. As a result, one would expect that the systematic risk would be a relatively small component of overall risk. This observation is significant because it indicates that the required rate of return (the cost of equity capital) for the publicly traded venture capital funds, as defined by the capital asset pricing model, is low relative to the mutual fund portfolios and the market in general. Further, since most of the risk of these securities is unique, it may be reduced through diversification.

On this latter point, it is important to note that the matrix presented in Table 4 indicates that there is little correlation among these securities. The average correlation coefficient among the venture capital funds is 0.147 with a high of only 0.274 and a low of −0.133. As a result, the unique risk of these securities can be diversified away using relatively few securities. Table 6 shows that the correlation coefficients of the mutual funds are far higher. The average correlation is 0.607 with a high of 0.914 and a low of 0.092.

Applying financial theory to combine these securities into a portfolio such that for any given level of return we minimize the standard deviation of the portfolio, an efficient frontier was developed. Figure 1 presents this frontier graphically. Point P on the graph represents the optimal portfolio of these securities. Should the investor want to take on less risk, it is better to unlever the portfolio, using a combination of T-Bills and portfolio P, than it is to move further down the efficient frontier.[6] Similarly, should the investor be willing to take on more risk, it is better to borrow and lever up portfolio P than it is to move further to the right on the efficient frontier.

If a portfolio of venture capital firms were considered as a portion but not all of a diversified investor's portfolio, beta would be the appropriate measure of risk. On a risk adjusted basis, using beta, both portfolios of venture capital funds outperformed the S&P 500 index in our analysis. With less than half the market risk, the venture capital funds produced a return slightly less than the market. Put another way, if the portfolio were levered up to produce a beta of 1.00 by borrowing at the risk free rate, the return would have been 25.78% per year for the ex ante mean/variant efficient portfolio versus 14.31% per year for the S&P 500. Further, the return on the naive strategy, levered to produce a beta of 1.0, beat the market as well, with an ex post return of 21.59% per year. At the same time a

[6]The leverage factor represents the proportion of total value invested in the portfolio. For example, a leverage factor of 1.15 means: put 115% of the value of the fund in the portfolio and borrow 15% of the value of the fund at the risk free rate. It should be pointed out that borrowing at the risk free rate is not possible. An investor must borrow at the broker loan rate which is 2–3% higher than the treasury bill rate. However, this additional borrowing cost is insignificant and does not change the results of this test. Further, leveraging up to a venture capital portfolio is not suggested to be the most appropriate strategy to employ. The method of leveraging the portfolio or, as in the case of the mutual funds, combining a portfolio with treasury bills, is used to make comparisons at the same risk level.

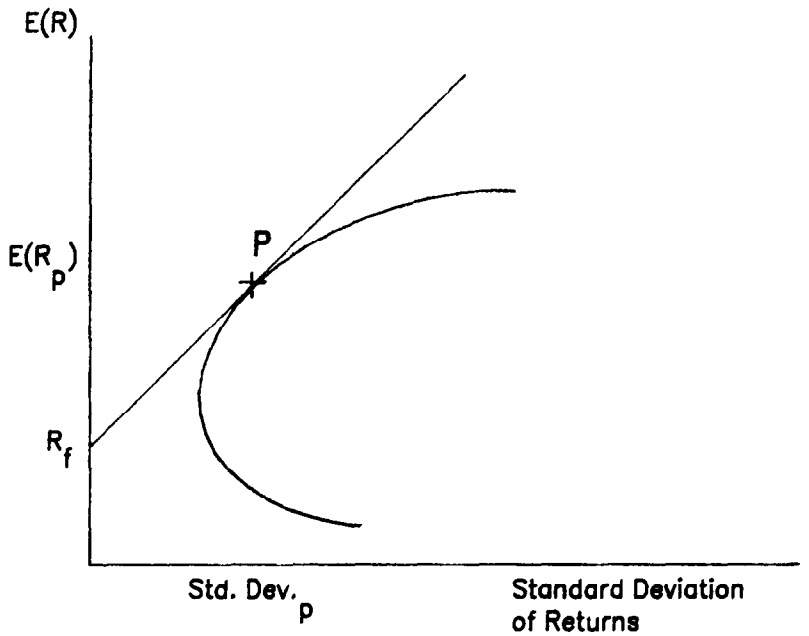

FIGURE 1 Frontier of Efficient Portfolios

portfolio of open ended maximum capital gains mutual funds not only underperformed the portfolios of publicly traded venture capital funds on a risk adjusted basis, but underperformed the S&P 500 on a risk adjusted basis as well. The ex ante efficient portfolio of mutual funds, combined with the risk free asset to produce a beta of 1.0, provided an ex post return of 10.34% per year. The naive strategy produced better results with an ex post return of 13.64% per year. Both strategies underperformed the market on a risk adjusted basis and significantly underperformed the portfolios of venture capital funds. These results are summarized in Table 8.

If a portfolio of venture capital firms represents all the risky assets in an investor's total portfolio, standard deviation would be the appropriate measure of risk. On a risk adjusted

TABLE 8 Comparative Performance Analysis—Beta As Risk Measure

		Venture Funds		Mutual Funds		
	Bench Mark S&P 500	Efficient With Short Sales	Naive	Efficient With Short Sales	Efficient Without Short Sales	Naive
Return	14.31%	25.78%	21.59%	7.33%	10.34%	13.64%
Beta	1.00	1.00	1.00	1.00	1.00	1.00
Standard Deviation	15.80%	17.51%	19.60%	12.82%	13.82%	16.45%
Leverage Factor		1.15	1.37	0.79	0.90	0.93

TABLE 9 Comparative Performance Analysis—Standard Deviation As Risk Measure

		Venture Funds		Mutual Funds		
	Bench Mark S&P 500	Efficient With Short Sales	Naive	Efficient With Short Sales	Efficient Without Short Sales	Naive
Return	14.31%	24.30%	19.36%	6.65%	10.34%	13.50%
Beta	1.00	0.90	0.80	1.22	1.14	.95
Standard Deviation	15.80%	15.80%	15.80%	15.83%	15.82%	15.74%
Leverage Factor		1.04	1.10	.97	1.03	0.89

basis, our portfolios of venture capital funds outperformed the S&P 500 index using this measure of risk as well. Further, the portfolio of venture capital funds outperformed the portfolios of mutual funds. Table 9 summarizes these results.

Martin and Petty found that even moderately risk averse investors, when considering investments in individual funds, would prefer to invest in public venture capital funds versus maximum capital gain mutual funds. Our analysis agrees with this result but goes further by considering such investment in a portfolio context. From Table 3 and 6 we can compare the average standard deviation of returns for the individual venture capital funds versus the individual mutual funds and the S&P 500. As expected, the average standard deviation of returns for the venture funds, 35.12%, was higher than the 25.51% measured for the mutual funds and the 15.80% measured for the S&P 500. Martin and Petty's data indicate the average standard deviation of returns was 40.3% for the venture capital funds, 23.8% for the mutual funds and 21% for the S&P 500. Their data also indicate that the average return on the venture capital funds was 26.8% (compared with 18.54% in our results) and 13.6% for the mutual funds (compared with 13.89% in our observations).

Our study extends the Martin and Petty analysis by considering these securities within a portfolio context. By estimating the correlation between securities, we find we can create a portfolio with a standard deviation as low as the S&P 500 by combining individual publicly traded venture capital funds into a portfolio or "fund of funds." Even with a naive strategy, such a portfolio outperforms the S&P 500 by a wide margin. Since the correlation between the individual funds is so low, the diversification effects achieved by creating a "fund of funds" are so strong that almost all the unique risk can be diversified away. Having secured downside protection in this fashion, the investor may pursue upside opportunities by choosing to allocate funds among various fund management groups or bases of investment specialization such as industry, geographic areas, or life cycle stage of portfolio company. These findings provide a provocative explanation of why and how highly risk averse entities, such as pension funds, participate in venture investing.

SUMMARY AND CONCLUSIONS

This study has confirmed and extended previous work on the relative risk and return characteristics of individual publicly traded venture capital funds. It has shown how these investment characteristics, when used as the basis for a portfolio or "fund of funds" approach, enable risk averse investors (e.g., pension funds) to invest heavily in venture capital with

tolerable risk exposure. Regarding individual venture capital funds, we found that seven of the 12 venture funds outperformed the return on the market by wide margins on a risk adjusted basis. We observed that many of the funds traded at discounts to net asset value and concluded that some but not all of the excess return could be attributed to discounts from net asset value and reductions in discounts from net asset value over the time period. In contrast, five of the 12 maximum capital gains mutual funds outperformed the market and did so by slim margins.

Using the same data, we have shown that if an investor diversifies over a set of venture capital pools, a relatively low risk, high return portfolio can be obtained. This we found to be a joint result of the relatively low market betas, which suggest low market risk, and low correlation among the total returns on venture capital funds. This allows the investor to significantly reduce risk by diversification.

We conclude that risk averse investors are attracted to investment in venture capital funds for two major reasons: first, investing in individual venture capital funds offers better risk/return characteristics than does investing in individual, randomly selected growth oriented mutual funds as a vehicle for investing in emerging growth companies; second, the "fund of funds" portfolio strategy for investing in the venture capital process offers risk-return characteristics which are very attractive to risk sensitive investors relative to the corporate equity market in general. The venture capital industry has grown significantly in the past 15 years, with the bulk of its new funding coming from institutional investors, such as pension funds, which are generally considered to be risk averse investors. These institutions have tended to place their funds in several venture capital funds, participating as limited partners in a variety of investment pools. We believe that this behavior is at least partially explained by the empirical findings presented in this paper. We also believe that these results might encourage the commitment of even larger amounts of funds by even greater numbers of institutional and other risk averse investors to the venture capital business.

APPENDIX

Public Venture Capital Funds Studied

NAME	TICKER
1. Allied Capital Corp.	ALLC
2. Biotech Capital Corp.	BITC
3. Capital Southwest Corporation	CSWC
4. First Connecticut SBIC	FCO
5. Franklin Capital Corp.	FKLN
6. First Midwest Capital Corp.	FMWC
7. Greater Washington Investors Inc.	GWII
8. Heizer	HZR
9. Midland Capital Corp.	MCAP
10. Narragansett Capital Corp.	NARR
11. Rand Capital Corp.	RAND
12. Sterling Capital Corp.	SPR

Maximum Capital Gain Mutual Funds

NAME	TICKER
1. Acorn Fund Inc.	ACRNX
2. Afuture Fund Inc.	AFUTX
3. Alpha Fund Inc.	ALPHX
4. Columbia Growth Fund Inc.	CLMBX
5. Explorer Fund Inc.	VEXPX
6. Fidelity Contra Fund	FCNTX
7. Janus Fund Inc.	JANSX
8. Lexington Growth Fund	LEXGX
9. New York Venture Fund	NYVTX
10. Pennsylvania Mutual Fund	PENNX
11. Putnam Vista Fund Inc.	PVISX
12. Steinroe Special Fund Inc.	SRSPX

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