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Benchmarking the Returns to Venture

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November 23, 2003

In a brief 10 years, venture investing has grown from a tantalizing sideshow to a serious and institutionalized function of US capital markets. Flows into venture capital funds were about \$3 billion in 1990, but \$103 billion in 2000. Some of these interests are held directly as stock in the issuing company, and some as limited partnerships in venture capital funds. Holders are primarily pension plans, endowment funds, corporations, and individual investors. Total venture-type private equity now exceeds roughly \$500 billion in the US. Venture Capital is now a major force in launching companies in the public markets. Over the last five years, roughly two-thirds of the companies doing initial public offerings had backing from venture capital funds. Investment by outside investors in pre-public companies is no longer experimental or exploratory, but a permanent feature of the US financial landscape. Venture is here to stay.

Although large sums are now invested in venture, reliable information on the outcomes from these investments is hard to come by. For registered and publicly-traded securities, quantitative performance evaluation is straightforward and nearly universal. Standard indices, such as the S&P500 and the Wilshire 5000, provide measures of overall market measures of value, return, risk, and risk-adjusted return. For non-traded holdings, such as venture, investors have no similar benchmark.

This paper introduces a new index for venture, the Sand Hill Index®, providing venture a benchmark on the same footing as the S&P for traded equity. This Index can be used for venture capital the same way market-wide indices are used for traded securities. Because it enables calculation of the mean and variance of venture returns, as well as their covariance with returns on other assets, the Index can be used for asset allocation analysis. A second use is portfolio performance evaluation. By comparing portfolio returns to Index returns, investors can get a better measure of the performance of particular holdings in comparison to all venture capital. The third use is unique to venture: The Index can be used to update company and portfolio values to obtain more timely estimates of value, and even to predict the returns that GPs will be reporting six months forward.

With a reliable benchmark for venture capital and a set of techniques for using it, investors will gain a clearer understanding of their successes and failures. Decades ago, mutual fund performance analysis resembled the analysis now done for venture funds. Funds were ranked by return over a given interval, and little attention was paid to risk because there was no clear standard for measuring it. Things changed in the late 1960s when the capital asset pricing model was introduced, and the focus on performance shifted from pure return to risk and risk-adjusted return. The introduction of better quantitative tools for analyzing venture capital will bring a similar revolution in the assessment of venture performance.

In this paper, we use the term *venture capital* to mean equity in pre-public companies with outside investors. We exclude leveraged buyouts, management buyouts, or private placements in public companies (PIPES) in our notion of venture-type investments. And we exclude businesses that have no intention or likelihood of becoming public companies.

The Challenges of Building the Index

The Sand Hill Index is built from company-level pricing data, not fund-level return data. We believe that only the company approach allows creation of a timely, unbiased, monthly index of value that is analogous to traded-market indices such as the S&P500. Only company-level transactions can pinpoint value at a point in time. The companies from which the Sand Hill Index is built are those that are a) privately held, b) organized as C corporations, and c) have sold securities to outside investors. To get a sense of how our companies fit into the universe of businesses, consider the following data:



Approximately 22 million businesses in the U.S. file income tax returns. Five million have a payroll. Of these, 1.5 million are organized as C corporations. Approximately 12,000 C corporations are registered with the SEC and trade on stock exchanges. There are at present roughly 20,000 companies represented in the Sand Hill Index, over the period starting in 1987, and a total of roughly 65,000 valuation events (private rounds of funding, acquisitions, IPOs, and shutdowns). About 9,000 of these companies are still private and operating.

Building an index from company-level data faces two major challenges. First, events that reveal market values do not occur continuously for private companies as they do for traded stocks, but instead occur episodically, when a company raises new money, goes public, is acquired, or goes out of business. Second, reporting of valuation by companies that complete deals is voluntary. Often companies report that they completed a fund-raising but do not report the value at which stock was sold. The companies that do report valuations are not a random sample of all companies, they are a biased sample. Good news is reported more often than bad.

Sand Hill Econometrics has developed tools to solve both of these problems. Intermittent pricing is handled by an interpolation method similar to the one used in repeat-sales analysis. The repeat-sales technique has been enthusiastically adopted in other markets facing similar intermittent pricing challenges. For example, it has revolutionized estimation of nationwide and local housing values, replacing tedious and unreliable individual appraisals. Freddie Mac and Fannie Mae now pool their data and build an index for houses based on this technique. The Federal Housing Finance Board also compiles a repeat-sales index for the nation and numerous metropolitan areas, available on its website (www.fhfb.gov). The firm of Case, Shiller, and Weiss provides local price indices and individual house valuations based on this technique. In addition, the US Commerce Department uses a repeat sales model to construct its price indices for durable goods.

The second problem, bias in the reporting of valuations, is addressed with techniques developed by economists over the last two decades for dealing with selection bias. These techniques exploit all available information about companies that have done even one round of fund raising, whether or not they report value when a round of funding is done.

These two techniques are applied together to produce an unbiased index of value for venture companies. This Index serves as the private company analog of a market-wide index such as the S&P500. The Index measures return more accurately than do other measures of venture returns that fail to account for intermittent pricing and fail to correct for selection bias. Because the Index is calculated monthly, it offers the capacity to measure variance through time and covariance with other assets' returns. While it remains an Index of estimated value – as opposed to an index composed of almost continuously reported bona fide trades such as the S&P500 – it is more



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powerful than any other current tool for quantitative analysis of venture holdings.

The effort necessary to build the database for the Index was substantial. First, when data are obtained from multiple sources, they must be integrated. In addition, duplicates must be eliminated, small and large inconsistencies in dates of deals, amounts of money raised, and post-money values must be resolved, typos identified and dealt with, and stray irrelevant records – foreign companies, buyout deals, PIPEs, venture funds that are not operating companies – must be eliminated.

As we began the work of assembling the data and building the Index, we discovered another source of selection bias: we lacked information about many companies that last raised funds some time ago, but are not reported to have been acquired, gone public, or shut down. We undertook research to learn what had become of companies with a last private round prior to 2001, but no exit. This research confirmed that these companies were more likely to have shut down worthless than other companies. Thus, it was necessary to embark on a systematic program of tracking them down. This research is an important contribution to the integrity of the Index and has been in progress for nearly two years.

Uses of the Index – Marking to Market

An important use of the Sand Hill Index is making more timely estimates of venture portfolio values. Investors can estimate the value of an entire portfolio or particular fund by updating the most recent deal values with the Index. This can be done using the broad Index for a broadly diversified portfolio, or by applying sector indices for specific parts of a portfolio.

As soon as we had built the Index, we compared it to the quarterly averages of returns reported by general partners of venture funds. It is clear that these average GP quarterly returns lag quarterly returns on the Sand Hill Index by about six months. Quarterly returns on the Sand Hill Index *predict* the average quarterly returns reported by GPs six months forward. GPs use their knowledge about individual companies in their portfolios to estimate value, but they do not use market-wide information. Indeed, without an index like the Sand Hill Index, how could they do so in a systematic way? The Sand Hill Index provides information about valuations on a market-wide basis that is both relevant and more current than what is in the hands of limited partners of venture funds. The Index could not predict the average GP quarterly returns if this were not so.

Uses of the Index – Portfolio Allocation Analysis

A second use of the Index is for portfolio asset allocation analysis. Given the means, variances, and covariances of returns among different asset classes, what is the optimal allocation to venture capital? Given an investor's particular portfolio of stocks and bonds (which may be less than fully diversified, and likely to remain so for tax reasons) what is the optimal allocation to venture



capital? How many companies or funds does an investor need, and how should investments be distributed across industries and stages, in order for an investor to be reasonably diversified in venture capital? For traded securities, the standard tools for addressing these issues are the means, variances, and covariances of returns. Prior to the creation of an index for venture capital, no similar analysis of venture allocations was possible. The Sand Hill Index and its sector indices provide the same tools for portfolio analysis of venture capital that have become the industry standard for traded securities.

Uses of the Index – Performance Evaluation

We believe that the Sand Hill Index is the right starting point for the most informative approach to the evaluation of performance for a venture portfolio. The Index enables investors to measure risk-adjusted performance on their venture investments in essentially the same way as they measure it for their traded securities. In other words, investors can now do the same risk-adjusted analysis for their venture holdings that they do for their traded stocks and bonds.

The most basic evaluation compares the changes in the value of the Index to changes in the value of the investor's own portfolio. For a portfolio that contains a typical mix of venture investments with respect to industry and stage, this comparison will indicate whether the investor's own portfolio is performing above or below the average, adjusted for risk.

For a portfolio that is not a representative set of venture investments, Sand Hill can provide a targeted index. The indices we have developed are:

- The Sand Hill Index, incorporating all venture-type companies, including those funded only by angels and/or corporations.

Industry indices for:

- Information technology
- Health
- Retail
- Other sectors

We are in the process of developing:

- The Sand Hill Venture-backed Index, a narrower index including only companies with backing from a venture fund

Company Stage indices for:

- Early stage companies
- Late stage companies

Vintage Year indices for:

- All vintage years 1993 and later

With the sub-indices, investors can evaluate performance of the parts of the portfolio invested in different industries and stages by comparing them to the relevant index. This analysis will indicate whether the portfolio is performing



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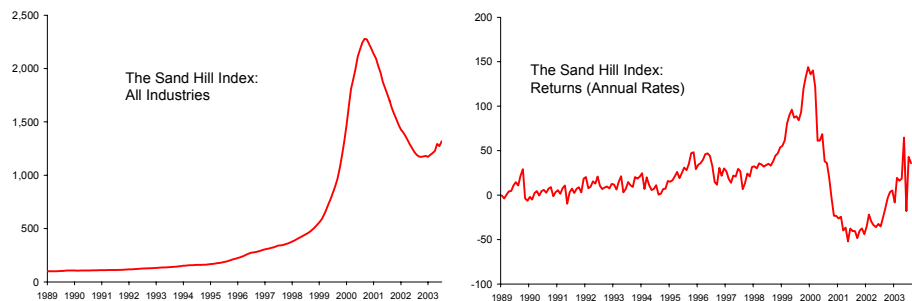
better or worse than a portfolio invested in companies of a similar industry and stage. Custom industry indices can be produced upon request.

Investors will likely be interested in the past performance of prospective managers. How has the track record of this group measured up against other managers? Against all venture? Against funds emphasizing the same industry group? Again, comparison to the overall Index is the first guide, and then comparison to a sub-index based on sector or stage will indicate whether the source of over- or under-performance is sector-specific or deal-specific. Venture capital managers often represent themselves as not just good at choosing companies to invest in, but also as adding value to these companies themselves through their involvement in strategic decisions. The Index will provide the tools necessary to substantiate this claim.

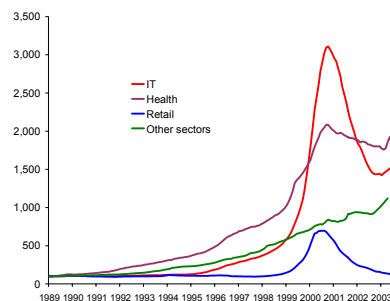
The venture community – entrepreneurs, investors, and venture capitalists – can gain from the discipline of formal performance evaluation. Some investors are reluctant to invest at all in a sector where no benchmarks or analytics for optimal allocation are available. The Sand Hill Index provides guidance on return and risk, as well as correlation with other asset classes. These will give comfort to investors that their investment decisions are consistent with portfolio diversification strategies.

The Index

The graphs below show the Sand Hill Index as of November 2003 in level and return form. The returns are stated at annual rates – they are 12 times the actual measured monthly percent returns.



Here are the four sector indexes:



We applied financial analysis to the Sand Hill Index with the following findings: Venture-type investments – before consideration of charges of

venture funds – earn about 8 percent per year more than a portfolio corresponding to the Nasdaq index, after adjustment for risk. In terms of systematic risk (beta) venture-type investments are slightly less risky than Nasdaq. But the annual standard deviation of return on the Sand Hill Index is nearly 50%, substantially above the standard deviation of .16 for traded stocks over the same period.

The Present Focus in Venture Capital

The two most common methods of performance evaluation for venture are the *IRR* or internal rate of return and the *investment multiple*. The IRR is the rate of return that equates the present discounted value of the cash received to the present value of the amount invested. The IRR is sensitive to the timing of investments and returns. The investment multiple is the ratio of the amount received back to the amount paid in. It neglects the timing of the flows.

Investors typically compare the IRR and investment multiple for a fund to data provided by consultants for similar metrics for funds that were started in the same year, usually called the *vintage year* of the fund. Thus a fund started in 1997 will be compared to average results for funds started in 1997. Some investors also make use of market-wide information by comparing their portfolio IRRs to ones calculated from publicly traded stocks.

In our experience, the procedures followed by pension funds and other large fiduciary venture holders are similar. Table 1 shows the first few lines of the most recent disclosure by the largest public entity holding venture investments, the California Public Employees Retirement System (CalPERS).

Fund Description	Vintage Year	Capital Committed	Cash In	Cash Out	Cash Out & Remaining Value	Net IRR	Investment Multiple
1818 Fund II, L.P.	1993	\$75,000,000	\$75,127,168	\$90,273,988	\$119,983,944	11.67%	1.60x
ABS Capital Partners II, L.P.	1996	50,000,000	45,721,976	52,005,512	57,967,781	9.61	1.27x
ABS Capital Partners III, L.P.	1999	75,000,000	61,270,475	6,903,963	35,411,882	(16.96)	1.27x
ABS Capital Partners IV, L.P.	2000	75,000,000	30,955,547	6,389,208	28,355,365	(8.21)	0.92x
Advent Global Private Equity IV-A	2002	25,000,000	7,750,000	0	7,387,618	(6.74)	0.92x

Table 1. Extract from CalPERS's Venture Performance Disclosure (<http://www.calpers.ca.gov/invest/aim/aim.asp>)

Table 1 reveals a central feature of the evaluation process. The difference between the column labeled *Cash Out & Remaining Value* and the one labeled *Cash Out* is the remaining value – the general partner's estimate of the current value of its investment in portfolio companies that have not yet had a terminal event. Even in the case of the 10-year-old 1818 Fund II, there is almost \$30 million of estimated value out of a total of \$120 million. For the funds started in 1999 and later, the estimated value dominates the total value that is reported to the limited partners. The two performance measures both

use the estimated value as if it were the equivalent of cash received. Thus the accuracy of the measurement of venture performance rests on the accuracy of the estimates of remaining value. If these estimates can be improved upon, so can the estimates of the internal rate of return.

Role of Estimated Remaining Value

As Table 1 demonstrates, calculations of IRRs and other performance metrics rely on funds' estimates of remaining value. Even relatively mature funds (10 years or more) often have a substantial fraction of their value in companies that have not had a terminal event and are still operating as private stand-alone companies.

Each quarter, the general partners for most venture partnerships report estimated values for the remaining companies in their portfolio. Valuation techniques vary: most extend the price from the last valuation event; some write down companies based on insider bad news, a few adjust value upwards for companies meeting business milestones. Some funds systematically assign conservative remaining values, in which case their performance is understated until all of the companies have terminal events. We have observed none who uses any sort of market-wide information to adjust values.

These are precisely the values we were referring to earlier when we noted that GPs do not use market-wide information to update their estimates of remaining values. Comparing reported *averages* of GP quarterly returns across many funds to returns on the Sand Hill Index, we find that on average, the GP valuations are smoothed, too high, and about six months old. *For individual funds*, as opposed to averages built from biased samples, we find reported returns are about right when we compare them to the returns for their portfolio companies, but they are smoothed and, as with the averages, about six months old. They are too low in a rising market, but too high in a falling market. This evidence confirms our belief that GPs use company-specific knowledge to update company values, but not information about venture returns in general. By incorporating market-wide information, investors can obtain more accurate estimates of portfolio value.

Performance Evaluation for Publicly Traded Securities

Benchmarks for traded securities have reached a highly refined stage of development. Benchmarks are derived from state of the art finance theory. A leader in this field is Barra, a company founded by finance economist Barr A. Rosenberg. Because traded equities have known prices at frequent intervals, evaluation focuses on the *excess returns* earned by a portfolio on a daily, weekly, or monthly basis. The excess return is the capital gain plus dividend received during the period divided by the price at the beginning of the period, less the current safe interest rate. For brevity, we will call this measure the return, as the subtraction of the risk-free interest rate has little material effect. A given portfolio may have hundreds or even thousands of returns. Evaluation involves comparing these returns to a benchmark derived from the returns of

traded equities in general. In venture, the similar evaluation problem is addressed by computing a measure for a fund, such as the IRR or investment multiple and comparing that measure to an average of similar measures for funds in general.

For traded equities, a more powerful approach now dominates. According to finance theory, the returns to portfolio i in period t , $r_{i,t}$, are related to the returns of the market in general, $r_{M,t}$, by the following equation:

$$r_{i,t} = \alpha_i + \beta_i r_{M,t}$$

This equation encapsulates the Capital Asset Pricing Model or CAPM. The coefficient β_i measures the covariation of the portfolio return with the market return. It shows the percent return expected in a period when the market delivers a one-percent return. β_i measures the *financial risk* of the portfolio. In finance theory, risk relates to covariation. A risky stock is one that moves more than point for point with the market; investors require a higher return. The most desirable stock would insure the holder against movements of the market and would have a negative β_i . The CAPM's predictions for average returns are

$$\bar{r}_i = \alpha_i + \beta_i \bar{r}_M$$

Thus the average return \bar{r}_i is higher for riskier stocks with higher β_i .

The β_i of a portfolio is the value-weighted average of the β s of the stocks in the portfolio. These β s are provided by many financial services firms. Further, financial science has developed more elaborate versions of the CAPM with factors apart from the market return. All these models deliver the capability to calculate the *average risk adjustment*, $\beta_i \bar{r}_M$ or its generalization, over a given span of time.

The CAPM makes the sharp prediction that the intercept, α_i , should be zero. This is obviously the case for a portfolio that matches the market, where $\bar{r}_i = \bar{r}_M$ and thus $\alpha_i = 0$ and $\beta_i = 1$. It is a fundamental conclusion of finance theory that, in a market where all traders share the same information, $\alpha_i = 0$ no matter what is the risk of the portfolio. A single trader with better information or superior ability to analyze information may achieve a positive value of α_i . After calculating the β_i of a portfolio, one can calculate α_i from

$$\alpha_i = \bar{r}_i - \beta_i \bar{r}_M$$

This is the *risk-adjusted average return*. It is the standard metric of performance for portfolios of traded securities. It takes full account of the fact that a manager can earn a higher return by taking on more risk. A positive risk adjusted return signals strong performance, while a negative return signals below-market performance.



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If outside measures of β_i are not available, another procedure gives essentially the same estimate of the metric α_i . Treat the equation $r_{i,t} = \alpha_i + \beta_i r_{M,t}$ as a regression and estimate the intercept and slope by standard regression methods. The intercept is the risk-adjusted average return.

The basic lessons of portfolio evaluation derived from modern finance theory are 1. the appropriate measure of performance is the average over a longer time interval of returns measured over relatively brief intervals, and 2. the risk adjustment $\beta_i \bar{r}_M$ or its generalization is the appropriate way to standardize the performance metric for the critical factor of risk.

The importance and relevance of beta, β_i , is now so well accepted that Yahoo Finance reports a company beta for all publicly traded companies along with the most basic highlights of a company's balance sheet and income statement. Morningstar and other services report betas and alphas for mutual funds.

Limitations of Current Methods of Venture Performance Evaluation

Performance evaluation for venture investing has not tracked modern developments in portfolio evaluation of traded securities because no periodic benchmark of venture value has been available. Investors have used investment multiples and IRRs. The information provided by an IRR is useful. But the IRR has some limitations.

First: the comparison of one fund's IRR with an average IRR benchmark cannot account for risk. In a rising market, is an investment over-performing, or just more risky than average? And is an under-performer actually over-performing, when properly adjusted for risk? A true risk-adjusted performance captures this, and an IRR comparison does not.

Second: the IRR benchmarks are stale because they are computed from stale valuations. The IRRs are computed from VC estimates of value, which lag market-wide changes by roughly 6 months. This phenomenon is established by analyzing the time series properties of the Sand Hill Index returns in comparison with reported averages of GP quarterly returns. The latter are sometimes call *time weighted IRRs*.

Third: the computation of internal rates of return is inconsistent across portfolios holding still-private companies because there is no generally accepted method for estimating the remaining value of these companies or for computing partial internal rates. Practice varies with respect to this key element.

Fourth: current available IRR benchmarks – vintage year averages – are biased upwards because they miss data from the less successful investments. A company-based approach to benchmark construction better lends itself to bias correction because individual companies generally seek publicity when they raise money even if they do not report the valuation implied by the terms of the funding, and because additional research can be done to establish the



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status of those who cease reporting. Companies generate public information while funds do not. This information makes it possible to correct for bias from unreported values.

Fifth: with the exception of the pooled-cash-flow IRRs, current benchmarks are not value-weighted. Tiny funds carry just as much weight in the average as do big funds.

In Sum: the traditional venture benchmarks of vintage year IRR and investment multiples are not as informative as the benchmarks for portfolios holding traded securities. They lack the ability to adjust for the risk of the portfolio under evaluation. They suffer in two respects from being based on data from venture funds – they suffer lags in valuation and they fail to include a representative number of disappointments. And for the most part, current benchmarks are not value-weighted. Investors can improve their assessments of portfolio performance by using the Sand Hill Index to evaluate the performance of their venture holdings. This approach and the concepts behind it are not new: only the benchmark is new. Investors already use public market indices to evaluate the performance of their traded securities in the same way they can use the Sand Hill Index.

Calculating the Benchmark

This section describes in more detail the techniques for benchmark construction. The Sand Hill Econometrics approach to building a benchmark for venture performance incorporates the methods now generally used for evaluating portfolios of public equities, described above. The conceptual basis for our approach, therefore, is to construct a time series of the average return on an unbiased, value-weighted, market-wide portfolio of venture companies.

To build the Index, we cumulate the monthly returns into indices of cumulative returns. The Sand Hill Index (as well as the sector indices) has the interpretation of the value that an investor would have in a given month as a result of investing \$100 in January 1989 and reinvesting each month in proportion to the values of the companies at the beginning of the month. Thus each index is a value-weighted index of cumulative returns. To put the point in reverse, the monthly returns can be calculated as the rates of growth of the Index.

One feature of the venture investment that sometimes concerns investors is the role of preferences in determining the value of the financial claims held by the outsiders in a venture-backed firm. The outsiders hold convertible preferred shares, which in principle have a higher value than the common shares held by the insiders. We believe that the preferences have only a small value in practice. We analyze this issue in the Appendix.

Steps in Constructing Average Returns

This section describes the construction of the total Index. Construction of sub-indexes is the same, with the inclusion of companies fitting the definition of the sub-index.



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Step 1 We obtain or estimate a value for every company in every month from its entry into the data to its exit or to the present, in the case of no exit. For exited companies that report value at every round, we use the post-money value of the round at the report date. Between report dates, we interpolate value for the company using an interpolation index, from the post-money value of the prior round to the pre-money value of the next round. For missing data – either missing valuations for known valuation events or for companies of unknown status – we use econometric methods to impute values. One equation fills in missing data for rounds of venture financing where the data sources do not give the valuation of the company at the time of the round. Another fills in terminal values for companies that have not had an identified terminal event.

For exited companies with some reported rounds and some (or possibly none, in the case of some unreported-value acquisitions) non-reported rounds, we use reported values at the round date when they are reported, and we estimate value for unreported-value rounds. For non-exited companies, we use either reported value or estimated value and interpolate as above between rounds.

For dates after the last reported round, we estimate value for every month, depending on company characteristics and the time elapsed since the last round of funding.

A “lost company” is one that has not exited but also has not done a new round of private funding for several years. We have done substantial research on these companies and have found with that many have exited, either by shutdown, acquisition, or IPO. We use the results of Sand Hill’s own research to estimate the likelihood of these outcomes for each company based on whether it was last known to be in development, shipping, profitable, amounts raised, and its other information. The more recent the company’s latest round, the lower is the likelihood that its current status cannot be established.

We interpolate company value between actual (or estimated) valuation event dates to assign every company a value for every month from its entry into the database until its last known round of funding (or for lost companies, its estimated exit date). To do this we use both pre-money valuations (value before new money raised is added) and post-money value (after new money is added).

Step 2 We build a value-weighted index from these values. Our aim, as is the aim of indices for traded securities, is for the index to report the value of a portfolio that 1) invests in every round of every company in proportion to its value, and 2) rebalances when companies exit (takes the resulting cash and re-invests it in the remaining companies) and when their values change.

For each month, we compute the total value of the companies that have actual or interpolated values for that month at the beginning of the month. Then, for each company, we calculate the ratio of its actual or interpolated value in a



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given month to the total value of all companies in the previous month. This is the company's contribution (weight) to the return ratio for the index level for that month. The return ratio of the index in that month is the sum of the contributions of all the companies. Then, to compute the value of the index for each month, we start with 100 as the value of the index for January 1989. For the next month, we multiply the return ratio for that month by 100. For all subsequent months, we multiply the previous month's index level by the return ratio for the following month.

Step 3 We use the index value calculated in Step 3 as the interpolation index for a second-round calculation of the index. Total return from one event to another is the same, but the route by which the value gets from one event to another has more variation in the second iteration. This step refines the interpolation process and improves the accuracy of the resulting index. This step is then repeated until the index converges, that is, until adjustments to individual company valuations between rounds reaches a small number.

We rejected the more standard ordinary least squares repeat-sales regression approach because our research indicates that the returns to venture are not log-normally distributed. Taking logs of returns and then de-logging the coefficients to recover an index will only yield a satisfactory result if the return distributions are log-normal. The bias inevitably resulting from taking logs can be offset if the distribution is log normal or a member of some other parametric family but not if the distribution is unknown. The data do not pass any test of log-normality. To the naked eye, not only are the distributions fat-tailed, they are mildly bi-modal. To assure that this phenomenon was not coming from dirt in the data (such as typographical errors) we undertook a special review of the 100 companies who contribute the most value (about 35 percent) to the index. All were confirmed to be real events.

Performance Evaluation for Venture Holdings

The standard metric for traded security investments is the risk-adjusted average return. We use the same metric for venture-type investments – the value of α in the regression equation

$$r_i = \alpha + \beta r_{M,t}.$$

We have dropped the subscript i now that we are focusing on the evaluation of the performance of a given portfolio. r_i is the monthly return to the portfolio and $r_{M,t}$ is an unbiased, value-weighted, monthly index of the market – here, the market of venture-type investments. The Sand Hill Index is the first to meet these standards.

To develop data on the monthly returns to a given portfolio, we start with data on valuation events for the portfolio and compute an index for the portfolio using the same basic method as outlined in the previous section. We do not need to impute data for missing round valuations unless this information has not been provided by a venture fund to an investor. As we do in constructing



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the index itself, we use the index to interpolate values for each company in the portfolio between valuation events. We make use of our proprietary data on the current status of individual companies to estimate remaining values and we use the other tools described earlier.

As with traded securities, the regression of the portfolio returns on the index yields estimates of the key parameters β and α . Beta measures for the portfolio's risk relative to the index and α measures the portfolio's risk-adjusted average excess return. These metrics, *beta* and *alpha*, are the *lingua franca* for analysts and investors in traded securities. It is our aim to extend their use to venture-type investments.

The key result of this evaluation is the risk-adjusted average return, α , and its standard error, to assess its statistical reliability. We also estimate equations for multi-factor CAPMs, with the returns from the S&P500 or Nasdaq, or both, as additional factors.

Concluding Remarks

We have built an index for venture capital for two important purposes. First, the Index provides a measure of month-to-month market-wide movements in value. Investors can now compare the returns on their holdings with market-wide returns over exactly the same interval, as well as update the estimates of value for their holdings based on market-wide movements in value. Second, the Index allows the standard methods for performance analysis for traded securities to be applied to their untraded venture-type investments. In the process, we have overcome two major obstacles: First, hard data on company valuations are available only episodically, when the companies sell new rounds of equity or go public, are acquired, or go under. We have developed a sophisticated interpolation method to deal with episodic data. Second, valuation data are not made public in any systematic way and favorable valuations are more likely to become public than unfavorable ones. We have attacked this problem by gathering a large volume of new data. We have also developed sophisticated methods for imputing values to companies with known rounds of funding but missing valuations.

By applying our tools first to our extensive database of venture-type returns to obtain value-weighted market-wide returns to these investments each month since January 1989, and then to the investment history of a portfolio, we can apply the standard approach from finance theory to the evaluation of the performance of the portfolio.

These evaluation methods represent a step forward from practices venture investors were forced to rely upon because they had no regularly reported benchmark of market-wide value. Information about the mean and variation in IRRs among venture funds is better than no information at all, but it is not as informative as what can be learned by applying the standard tools of portfolio analysis with a true periodic index of value.



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The Sand Hill Index and the tools to apply it can improve venture investors' decisions. They can improve portfolio asset allocations, improve decisions regarding portfolio contributions and disbursements by basing them on more accurate estimates of value, improve risk management, and give investors a better indication of the relative performance of their holdings as well as the relative performance of the past efforts of prospective asset managers.

About Sand Hill Econometrics

Sand Hill was founded by Susan E. Woodward in 2001. Earlier, Woodward served as the Chief Economist of the Securities and Exchange Commission and as Senior Vice President of OffRoad Capital.

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Appendix: The Role of Preferences in Venture Investment

The role of preferences among different classes of convertible preferred stock in individual companies is potentially important in relating the value of an entire company to the price of the most recently issued class of convertible preferred stock. This Appendix discusses what we believe are the issues in assessing the importance of making adjustments in value for preferences.

A venture investment is a contract between outside investors – either individual angel investors or limited partners in a venture fund – and the founders of a new company. Most venture deals have similar terms. Founders hold common stock. Outside investors buy convertible preferred stock, not common stock. The preference requires that the corporation pay available cash to the investors up to a multiple (usually at least double, but sometimes more) of their original investment before any cash goes to the founding shareholders, who hold common shares. Upon a favorable event such as an IPO or a happy sale of the company, the outside investors' convertible preferred stock converts to common stock, equivalent to what is held by the founders.

The primary purpose of the asymmetry of the claims of the founders and the investors is to help offset the danger that the founders might persuade investors to contribute cash to the corporation and then liquidate the corporation in order to gain a share of the cash. The preference cuts off this danger. In principle, the founders will agree to the standard venture deal only if they believe that they have an idea for a company that will generate a payoff well in excess of the amount contributed by the investors.

In the standard venture capital structure, a number of rounds of financing, conventionally labeled A, B, C, and so on, occur before a company becomes self-sustaining or goes out of business. Investors in later rounds typically have the contractual right to receive residual cash to satisfy their preferences before investors in earlier rounds receive any cash. Because of their superior claim, later-round shares are worth more than earlier-round shares, which in turn are worth more than the founders' common shares.

The importance of preferences and the value adjustments they imply rests on how preferences affect investor outcomes. When all shares convert to equally-valued common shares under favorable outcomes, such as an IPO or an acquisition at a good price, the preferences do not matter. If the startup spends all its cash and expires worthless, all shares have zero value and again, the preferences do not matter. Occasionally, a startup reaches a terminal event such as an asset sale at low value or a shutdown before all the cash is spent, in which case the superior claims may influence the distribution of the terminal cash.

When such a liquidation or sale at a low value looms, the original preferences are often re-negotiated to allow a partial recovery of assets. The dynamics are as follows: for the liquidation to occur, a contract-specified majority of the



shareholders must agree to liquidate. Generally, this will require the favorable vote of some shareholders – possibly the founders and some outside preferred investors – who would receive nothing if the liquidation occurred according to the strict terms of the preferences. Because these shareholders have an option value from the continuation of the business, they will vote in favor of the liquidation only if they receive enough of the cash from the liquidation to more than compensate for their option value. The resulting bargain diminishes the value of the liquidation preference enjoyed by the preferred shareholders.

The standard practice in the valuation of venture-backed companies is to neglect the differences in value among the rounds of venture shares and between those shares and the common shares held by the founders. We follow this practice, though it slightly overstates our valuation of entire companies. Our empirical study of these biases suggests they are small. The primary purpose of the liquidation preference is not to tailor the risk characteristics of the shares sold to outside investors, but to prevent the founders from taking cash out of the company through liquidation.



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