The Impact of Venture Capital Investments On Industry Performance

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ABSTRACT: The aggregate amount of venture capital investments in non-publicly traded firms since 1980 is more than $390 billion. We find that lagged VC investments scaled by industry assets are negatively related to subsequent quarterly industry returns after adjusting for other factors. Thus, money invested in non-publicly traded firms appears to lower the subsequent valuations of publicly traded companies in the same industry. The return on assets of an industry is also negatively related to lagged VC funding. It appears that there are systematic biases in how the market values new investments by venture capitalists. As more money pours into a hot industry, increased competition and technological innovation dampen subsequent industry stock returns and operating performance.

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Over 1980-2005, the aggregate amount of venture capital investments (i.e. disbursements rather than commitments) made in U.S. firms, according to VentureXpert, totaled $394.2 billion. Venture capitalists play an increasingly important role in the U.S. economy. Technologically savvy firms like Apple Computer, Sun Microsystems, Yahoo, eBay, and Google all had venture capital funding before going public. Yet the venture capitalist provides much more than simply cash for young firms. VCs often serve on boards of directors and can provide critical support to allow entrepreneurs to transform small start-ups into large publicly traded firms.

There is evidence in the literature that venture capitalists have skill at responding to valuation signals provided by the market. For example, Lerner (1994) suggests venture capitalists are quite good at selecting times when public market valuations are especially high to take young firms public. Brav and Gompers (1997) provide evidence that venture capital-backed initial public offerings have substantially higher long-run returns after an IPO than non-VC backed IPOs. Gompers, Kovner, Lerner, and Scharfstein (2007) report that the most experienced VCs make the most money and are most responsive to investment opportunities signaled by financial markets.

Little attention has been paid to the implications of VC investments for subsequent industry returns. What is the effect on public companies when venture capitalists invest in their industry?

There are three different possibilities. First, VC investments could reduce the value of established companies, assuming increased competition and innovation by newly funded firms in the future. Second, VC funding could have no effect on valuations, if it is anticipated or if it simply conveys no information. Finally, VC investments could serve as an endorsement of an industry and increase investor optimism about the industry's prospects, thus increasing the value of established public companies.

We use Fama and French (1997) classifications to create quarterly industry stock returns for all publicly traded operating companies.[1] Our data source for 73,346 rounds of venture capital funding is VentureXpert. Some venture capital is for seed or startup financing while other capital is for expansion or later stage financing prior to taking the firm public. Historically, the majority of VC funding is directed to expansions while the lowest dollar amount is directed towards seed financing.

In a panel of 3,502 quarterly industry observations over 1980-2005, we find evidence that higher levels of quarterly venture capital investments scaled by industry assets is linked with significantly lower subsequent quarterly returns in a particular industry. That is, if a relatively high amount of VC dollars are invested in the telecommunications industry in a particular quarter, the next quarter telecommunications industry stock return will be lower. This is even after adjusting for factors like the volume of telecommunication IPOs and the book-to-market ratio of the telecommunications industry.

Our results are generally significant for both equal-weighted and value-weighted industry returns, and both including and excluding the internet bubble period. When the results are categorized by funding type (i.e., seed, startup, or expansion), we find negative and statistically significant coefficients (except for seed financing with value-weighted industry returns) for all regressions; with quarterly industry returns as the dependent

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[1] There have been several recent papers which have used the Fama-French industry classifications to gauge stock return patterns (see for example, Hou (2007) and Hong, Torous, Valkanov (2007)).

variable. As seed financing never accounts for more than 9% of all quarterly VC investments, the lack of a strong relationship in this case should not be very surprising.

The vast majority of VC investments are made in five different industries. In these regressions, there are only 103 quarterly observations. Even with the small sample size, a number of the coefficients on VC dollars scaled by total industry assets are negative and statistically significant when either value or equally weighted returns are the dependent variable. The highest and most significant coefficients occur in the chips industry. For robustness, we also examine only technology firms according to the Loughran and Ritter (2004) tech classifications and obtain significant coefficients on VC dollars scaled by assets.

We also examine if industry operating performance is affected by the influx of VC dollars. Using annual return on assets (ROA) across different industries, we find a strong negative relation between VC investments and subsequent public company industry operating performance. Consistent with increased competition caused by venture capital overinvestment, more VC funding precedes lower industry ROA values in the next calendar year.

Cooper, Gulen, and Schill (2007) report that firm asset growth has strong predictive power in explaining the cross-section of stock returns. Their variable, the year-on-year change in total assets, in annual Fama-MacBeth regressions is more important than book-to-market, firm size, momentum, and accruals in explaining stock returns. They find that the higher is a firm’s growth in total assets; the lower is the firm’s subsequent returns. Cooper, Gulen, and Schill state that their asset growth effect is most consistent with over extrapolation of past gains to growth by financial market participants.

Expanding the premise contained in Cooper, Gulen, and Schill (2007) that there might be systematic biases in the capitalization of new investments, our paper documents the negative ramifications of high VC funding. As new investments pour into young, illiquid, and non-publicly traded firms bent on achieving innovative techniques and patents, the returns of older companies already public suffer as a result. VC money generally flows into an industry undergoing technological change, which hurts firms that have already invested in an old technology.

At the industry level, one might expect VC funding to have a stronger effect on subsequent returns than an industry-wide asset growth variable. As individual firms issue equity or debt to build new factories, industry stock returns might suffer from the increased competition/overcapacity from the new investment. However, venture capital money is not always investing to build a new factory; the venture capitalist sometimes creates a new technology which has the potential to destroy or severely damage the existing firms in the industry. It is conceivable for millions of venture capital dollars invested to lower the values of existing firms by billions of dollars.

As an example, in December of 1999, Merck employed 62,300 workers and had a market value of $157 billion. Yet, for all its size, Merck was dependent on a few highly successful drugs which addressed either elevated cholesterol (Zocor and Mevacor) or hypertension/heart failure (Vasotec). If a young bio-tech firm with VC funding created just a single product which proved more efficient than one of Merck's existing drugs, the giant Merck would suffer a decline in market value.

Our empirical results are consistent with the capital market myopia work of Sahlman and Stevenson (1985). Overoptimism on the part of venture capitalists leads directly to overfunding of a few key industries which precedes a decline in both industry stock returns and operating performance. For the individual VC, investing in the business services industry at the peak of the internet bubble may seem reasonable. Yet in aggregate, the investments hurt not only the VC's non-public projects, but also the valuations of the already public business services companies.

The rest of this article is as follows. In Section I, we describe our sample. In Section II, we motivate our estimation procedure. Section III reports our empirical findings. We conclude in Section IV.

I. Sample

A. Data

Our source for the venture capital data is VentureXpert (Thomson Financial Economics). We use data on all venture capital investments between 1980 and 2005.[2] The VentureXpert database classifies industries in its own way, so we re-code them according to the Fama and French (1997) 48 industry classifications by comparing individual VentureXpert industry codes and SIC codes. The Appendix reports how the VentureXpert classifications were categorized into Fama and French industries.

Fama and French industries with no VC funding, such as tobacco products, toys, and textiles, are excluded from analysis. A total of 34 of the 48 industries remain in the

[2] Although venture capital investment started in the U.S. shortly after the end of World War II, it really took off after 1979 when a "prudent man" ruling allowed pension plans to invent in VCs. Hence, we use a starting point of 1980 for our sample.

sample (including all 48 industries in the analysis does not change the empirical results). Information on all accounting variables comes from Compustat.

Four main classifications of funding are available in VentureXpert: early stage (seed, startup, and other early stage); expansion; later stage; and other stage (acquisition, special situation, and VC partnership). According to Thomson Venture Economics, early stage seed capital supports an entrepreneur in developing their idea to the stage where it could qualify for startup capital financing. This includes creation of a business plan, product development, and market research.

Expansion financing is for companies making and selling products with a growing customer base, but that might not be profitable yet. Later stage financing is for companies that have achieved a stable growth rate and are more likely to be profitable or to have positive cash flow. We exclude the final other stage category because it is not clear that funding of such enterprises represent the creation/expansion of new enterprises by the venture capitalist. Including these other stage categories does not change the results, however.

The VCs are interested ultimately in taking the firms they invest in public, although selling out to another firm can also be a successful exit.[3] Gompers and Lerner (2002) report that 20% to 35% of VC-funded firms are eventually taken public. Google Inc. is an example. It had two rounds of venture capital funding according to the VentureXpert database. On June 4, 1999, Kleiner Perkins Caufield & Byers, and Sequoia Capital, and a group of angel investors, invested a total of $25 million in an “other early

[3] Using a large sample of privately-held firms, Brau, Francis, and Kohers (2003) find that a large liquidity discount (about 22%) exists for takeovers. That is, they find that IPOs get a 22% premium over the average acquisition price paid for privately-held companies. Bayar and Chemmanur (2007) provide a theoretical framework that can explain this IPO valuation premium puzzle.

stage" financing round. On September 1, 2000, both KPCB and Sequoia Capital invested a combined $15.175 million in an "expansion" round of financing. The final prospectus listed three venture firms as already having seats on Google's nine member board well before its August 2004 IPO.

Probably the best example of how venture capital investments can harm industry stock returns is the Telecommunication sector during the internet bubble time period. VC-funded firms like Digital Access, Carolina Broadband, Knology, and Altrio Communications became known in the press and the industry as "overbuilders." These companies raised billions of dollars to construct redundant infrastructure to compete with the existing phone and cable firms (i.e., Comcast, BellSouth, Time Warner, Adelphia Communications, and AT&T). By laying thousands of miles of fiber optic cables to offer consumers high-speed internet, digital television, and phone service, the overbuilders forced the incumbent phone/cable firms to lower prices and invest heavily in upgrading their own infrastructure.

In late December of 1999, Digital Access raised $450 million in Startup funding from venture capitalists to target only four minor markets dominated by Time Warner Cable. By March of 2001, Digital Access shut down and only had completed limited construction in Lenexa, Kansas to show for all of its effects. Similarly, Carolina Broadband raised $402 million in May of 2000 only to layoff most of its employees by June, 2001.

The stock market often adjusts prices on the anticipation of future events. As the venture capital money flows into young firms, it is possible that the stock market slowly adjust downward the stock prices of publicly traded firms in anticipation of increased competition in the future.

Figure 1 presents the time series of quarterly venture capital investments compared to the quarterly level of Nasdaq. Figure 2 reports the relation between Nasdaq levels and VC investments scaled by industry total assets. Scaled VC investments experienced a slight decline over 1984-1995, but then both they and Nasdaq saw a tremendous spike in the internet bubble period of 1998-2001. These two figures show aggregate venture capital funding patterns. In the rest of our analysis, we focus on investment patterns within a particular Fama-French industry.

Table I provides descriptive statistics of VC investment rounds by stage and Fama and French (1997) industry classifications. Over the sample period, there was an aggregate $394.2 billion in investments by venture capitalists made in 73,346 separate rounds. Thus, there were over 73,000 separate investments by venture capitalists in non-publicly traded firms during the period. We focus on the dollar amount invested scaled by industry assets, not on the number of rounds that venture capitalists engaged in. Thus, in a quarter for a particular industry, five rounds of $1 million each will count the same as one round of $5 million.

Not all industries are equally likely to attract financial interest from venture capitalists. Over 83% of the total venture capital investments went to only five industries: business services (37.3%), telecommunications (24.4%), pharmaceutical products (9.2%), computers (6.6%), and chips and electronic equipment (5.7%). Figure 3 shows the time series trend in investments in these industries.

In the early 1980s, the computer industry attracted the most funding, accounting for over 45% of all investments in the second quarter of 1982. In the late 1980s, business services surpassed computers as the most heavily funded industry. During the bubble period, business services accounted for almost half of VC dollars, while telecommunications received approximately 30% of all dollars.

B. Summary Statistics

Table II reports the summary statistics for our sample. There are a total of 3,502 industry-quarter observations during the sample period (34 Fama-French industries multiplied by 103 quarters). Since we are using lagged quarterly VC investments, the analysis starts at the end of the first quarter in 1980. The average venture capital investment per industry-quarter is $110.1 million. The maximum is $15,174 million (first quarter of 2000 in the business services industry), while the median amount of quarterly funding per industry is $7.3 million. For a number of industries, there were no VC investments in a particular quarter. When VC dollars are scaled by industry total assets, the mean value over the 103 quarters is 0.21% compared to a median of 0.01%.

We obtain both value- and equal-weighted quarterly industry-level stock returns from Kenneth French's website. The average equal-weighted industry stock return is slightly higher than the corresponding value-weighted return (4.1% versus 3.8%). We chose quarterly time intervals for our stock return analysis to smooth out the noisy pattern of VC investing and allow a long enough time period for the market to incorporate the news of the VC investment.

In our analysis, it is critical to control for other factors that have been shown to influence stock returns. It might be that VC dollars are attracted to high growth industries. Prior evidence by Fama and French (1992, 1993) has shown that firms with low book-to-market ratios (i.e., growth firms) experience lower subsequent returns than value firms. Hence, it is important to adjust for the book-to-market ratio of the particular industry at the time of the VC investment to document that our findings are not merely showing that growth firms experience low stock returns.

For control variables in our regressions, we include 1) industry total asset growth, 2) the book-to-market ratio of each Fama and French industry, 3) the natural log of the number of IPOs in an industry-quarter plus one, and 4) a measure of industry competition, the Herfindahl index. We do not include lagged industry returns lagged dependent variables have been shown to bias the coefficients in fixed effects regressions (see Andersen and Hsiao (1981)). We have included them in untabulated regressions, and their coefficients are usually not statistically significant and they do not change our results.

Following Cooper, Gulen, and Schill (2007) we control for the asset growth of an industry. The three authors document a strong negative relationship between a firm's asset growth and its subsequent stock returns. Unlike Cooper, Gulen, and Schill (2007) who focus on firm level asset growth, we will examine the average asset growth of an industry.

For each firm, we compute the annual percentage change in assets of the latest fiscal year from the one before. We then equal- and value-weight these measures across the Fama-French industries. All asset data is from fiscal years ending before June of the prior calendar year as in Fama and French (1992). Prices and number of shares are from CRSP and are from the end of each firm's fiscal year. We eliminate firms with prices below $1 and we do not use the first two years of a firm's existence on Compustat to avoid potential backfilling biases (Fama and French, 1993).

Both the mean and median asset growth values for our industries are relatively large. On a value-weighted basis, the average asset growth is 21.6% compared to a median value of 14.9%. The high asset growth rates are because we are only focusing on the successful industries that venture capitalists made investments in. Recall that slow asset growth industries like toys and textiles are not included in our analysis.

We obtain both value- and equal-weighted individual industry book-to-market ratios from Kenneth French's website. The average value-weighted quarterly book-to-market ratio across all the Fama-French industries is 0.58 compared to 0.54 for the equal-weighted time series. At the extreme values, both of which occur in 2000, the highest value-weighted book-to-market ratio (1.81) is for the coal industry while the lowest reported ratios (0.09) are for the business services and computer industries.

To eliminate very small IPOs from the Thomson Financial Securities Data, we require IPOs to have an offer price of at least $5.00 per share. In the analysis, we also exclude: best efforts offers; American Depository Receipts (ADRs); closed-end funds; real estate investment trusts; limited partnerships; and firms not listed in the Center for Research in Securities Prices files within six quarters of the offering. Lowry (2003) provides the motivation for using the number of IPOs as a control variable. She shows that quarterly IPO volume is positively related to investor sentiment.

The Herfindahl index is computed by dividing the sum of the squares of the sales (Compustat item #12) in a Fama-French industry by the squared total sales of that industry. A high value for the Herfindahl index indicates a low level of competition in an industry. In our sample, the industry with the lowest quarterly Herfindahl index is computers (0.01) while the industry with the highest quarterly index is mines (0.73). In the top five VC funded industries, the average quarterly Herfindahl indexes range from 0.01 to 0.23.

The last row of Table II reports that the mean Herfindahl index across all industries of 0.14 compared to a median quarterly value of 0.10. Hou and Robinson (2006) show that the Herfindahl index is related to subsequent industry returns.

II. Estimation

We estimate our models using panel regressions with both quarterly and industry dummies. We do not run Fama-MacBeth (1973) regressions, because our panel is only 34 industries wide in a given quarter, and at the beginning of the sample time period, there are many zero quarter-industry data points (i.e., VC investments). The first stage of the Fama-Macbeth procedure would involve quarterly cross-sectional regressions, so we would have too few degrees of freedom to obtain any power.

Petersen (2007) observes that the Fama-MacBeth methodology is equivalent to a fixed-effects regression if one properly controls for cross-sectional correlation. Fixed-effects regressions have the advantage of allowing industry effects, which cannot be used with the Fama-MacBeth procedure. Petersen (2007) notes that failure to control for industry effects might bias the standard errors. As many of the industry fixed effects are statistically significant, we think they should be controlled for.

We include both time period and industry fixed effects wherever possible in our analysis. Clustering can be present, however, even after including cross-sectional and time effects according to Bertrand, Duflo, and Mullainathan (2004). Thus, we also cluster the standard errors by both quarter and industry.

To cluster standard errors using non-nested clusters, we use the methodology proposed by Thompson (2006) and Cameron, Gelbach, and Miller (2006). As Thompson (2006) explains, clustering standard errors by just one variable or not clustering them at all can bias the standard errors when both cross-sectional and time series effects are present. Clustered standard errors are always heteroskedasticity-consistent.

III. Empirical Results

Before testing the impact that venture capital funding has on industry stock returns, we run the following simple regression:

$$\text{CRSP Value Weighted Index Return}_t = a_0 + a_1\text{VC Dollars/Assets}_{t-1} + e_t$$

In the regression with a total of 103 observations, the dependent variable is the CRSP value-weighted index quarterly return and the independent variable is the aggregate VC investments across all industries in the prior quarter scaled by the aggregate total assets of all industries. In this regression, the VC dollars/assets variable has a coefficient value of -3,899.7 (t-statistic using robust standard errors of -2.63). The standard deviation of the

VC dollars scaled by assets variable is 0.0004923 over the 103 quarter time period. The mean value of our independent variable is 0.0003748.

Thus, for one standard deviation increase in the VC dollars/assets variable, the change in the value-weighted market index is -1.92% per quarter (0.0004923 * -3,899.7). On an annualized basis, one standard deviation increase in the scaled VC dollars implies a 7.68% decline in the value-weighted index return. So in the aggregate, our variable has both a statistical and economic relationship with returns. Yet, this simple regression does not control for other explanatory variables like book-to-market. Further, one should expect the effect of VC dollars to be strongest on industry returns. That is, when venture capital investments are flowing into the chip industry, this investment should affect the returns of the chip industry more than the stock returns of the overall market.

We want to test whether VC funding in a particular industry is related to industry returns in subsequent quarters, controlling for variables that have been shown to have some predictive power in explaining future returns. In one specification, we also control for contemporaneous Fama and French (1993) factors plus momentum. The control variables are the asset growth of the industry, Fama-French industry book-to-market ratios, number of initial public offerings (IPOs) in that particular industry, and an industry Herfindahl index.

The main results are presented in Table III. In the fixed-effect regressions, we also include industry and quarter dummies. There are 3,502 quarterly observations (34 different industries multiplied by 103 quarters). In all the regressions (except for the ones using the Fama-French factors), the dependent variable is either the value-weighted or equally weighted quarterly industry return. In the regressions with the Fama-French factors, the dependent variable is excess returns over the Treasury risk-free rate. This choice of dependent variable is only for comparability with common practice; using raw or excess returns for any of the models does not change the significance of the results.

Table III uses venture capital dollars scaled by total industry assets as the independent variable of interest. We present different specifications ranging from this variable alone to a purely predictive model using control variables. Scaling the VC investments may provide a better gauge of the effect of the funding amount. That is, $1 billion of investments in a very large industry would likely not have the same impact as a $1 billion investment in a relatively small industry.[4]

The regression specification is as follows:

$$\text{VW or EW Industry Return}_{i,t} = a_0 + a_1\text{VC Dollars/Assets}_{i,t-1} + a_2\text{Asset Growth}_{i,t-1} + a_3\text{Book/Market}_{i,t-1} + a_4\text{Log}(N^{\text{IPOs}} + 1)_{i,t-1} + a_5\text{Herfindahl}_{i,t-1} + a_6(\text{Mkt - Rf})_t + a_7\text{SMB}_t + a_8\text{HML}_t + a_9\text{MOM}_t + \text{Industry Dummies} + \text{Quarter Dummies} + e_{i,t}$$

T-statistics generated from the double clustered errors (i.e., both industry and quarter) are in parentheses under the coefficients. In the models with the Fama-French factors, we could not incorporate quarter dummies because of collinearity with the economy-wide Fama-French and momentum factors. Industry book-to-market and asset growth are value-weighted when the dependent variable is value-weighted and equally weighted otherwise.

The coefficient on lagged VC dollars divided by industry assets is stable across specifications and consistently negative. The t-statistics on the VC dollar coefficient in Table III range from -4.01 to -6.57. The negative coefficients on VC dollars/industry assets are consistent with a conclusion that there is slow diffusion in the stock market of

[4] When we use VC dollars instead of scaled VC dollars by industry assets as the explanatory variable of interest, our results are similar. If unscaled VC dollars are used as an independent variable, the coefficients are always negative and statistically significant in the regressions or included with the other explanatory variables.

the information content of the venture capital investment. Our result is similar to the results in Hong, Torous, and Valkanov (2007), who find that the stock market reacts with a delay to new information embedded in industry returns. Information on fundamentals appears to be diffused only gradually across markets.

Other independent variables that are often significant in the specification include industry book-to-market and asset growth. The positive and significant coefficient on industry book-to-market for the value-weighted industry returns implies that when the industry book-to-market ratio is high (i.e., tilted toward value), subsequent returns are higher, all else being equal. The negative values on the asset growth variable for the equal-weighted returns are as would be predicted by Cooper, Gulen, and Schill (2007).

The coefficient on the log number of IPOs in the industry is mostly negative as might be predicted from Baker and Wurgler (2000), but not significant. The industry Herfindahl index is never significant predictor of quarterly industry returns. This differs from the findings in Hou and Robinson (2006), but they use two-digit SIC code industries which are much more numerous, and they are able to obtain a longer time series.

When we compare the coefficients using the raw industry returns as the dependent variable, columns (2) and (5), with the coefficients controlling for contemporaneous Fama-French factors, columns (3) and (6), we see minor differences. When industry quarterly returns are value-weighted, the coefficient on VC dollars/assets is -32.24 (t-statistic -5.12). When excess quarterly industry returns over Treasuries are the dependent variable, the coefficient on VC dollars is -23.33 (t-statistic -6.57).

A. Time Period Sub Sample Regressions

Might the observations during the bubble period of 1998-2001 be driving this result? We saw in Figures 1 and 2 a spike in both the level of Nasdaq and the level of venture capital investments during the internet bubble period. To test this hypothesis, we divide the sample into bubble and non-bubble periods and re-run the tests in columns (2) and (5) of Table III for each sub sample. The results appear in Table IV.

VC dollars scaled by industry assets are again the explanatory variable of interest. Both industry and quarter dummies are included in all the regressions, and, both value- and equal-weighted industry quarterly returns are the dependent variables.

While the t-statistics tend to be stronger in the bubble period for both value-weighted and equal-weighted returns, the coefficients on VC dollars/assets are lower in the bubble period than in the non-bubble period. The VC investment coefficient is statistically significant at conventional levels in all six regressions in Table IV. Interestingly, coefficients are higher in both bubble and non-bubble periods. Our empirical results are thus not being driven by the unusual return patterns of the internet bubble time period.

B. Types of Venture Capital Funding

Perhaps one particular type of venture capital funding is driving these results. Results, for example, might be driven solely by venture capital expansion financing. We think all types of VC funding should be related to returns, because they can all lead to increased competition and innovation in an industry by funding new firms.

To test if all types of VC funding lead to lower returns, we replicate regressions (2) and (5) in Table III by type of venture capital funding. The results appear in Table V. The model in Table V is:

$$\text{VW or EW Industry Return}_{i,t} = a_0 + a_1\text{VC Dollars/Assets}_{i,t-1} + a_2\text{Asset Growth}_{i,t-1} + a_3\text{Book/Market}_{i,t-1} + a_4\text{Log}(N^{IPOs}+1)_{i,t-1} + a_5\text{Herfindahl}_{i,t-1} + \text{Industry Dummies} + \text{Quarter Dummies} + e_{i,t}$$

where VC dollars/assets is now defined as the dollars in each stage of funding. As before, the errors are clustered by quarter and industry.

The control variables retain fairly stable coefficients, while all the VC funding measures are negatively related to returns. Across the ten regressions in Table V, all the coefficients are negative and statistically significant at conventional levels (except for seed financing using value-weighted returns). Levels of coefficients are inversely related to the amount of funding dollars in that particular category in our sample. Coefficients from the seed financing are highest, followed by the other early stage, later stage, startup, and expansion stages.

C. Industry-level Ordinary Least Squares

To ensure that one industry or an omitted industry-level variable is not driving the results, we test the relation using individual industry-level ordinary least squares tests on the five largest industries, which together make up 83.2% of the VC funding in our sample period. These industries are business services, telecom, drugs, computers, and chips. The results appear in Table VI.

All the coefficients on VC funding/industry assets are negative, but the coefficient for scaled VC funding in the drugs industry is not significant when the dependent variable is value-weighted returns. When equal-weighted returns are used, the coefficient on drugs is significant, but the business services and computers coefficients are not.

In Table VI, we see that in industries with the greatest amount of total funding, additional funding has less of an effect on subsequent returns. For the five industries presented in generally declining order of the amount of VC funding in the sample, the coefficients for the VC funding variable (value-weighted returns) are -51.5, -1,383.9, -1,345.5, -1,714.1, and -9,412.8.

This pattern suggests that the industries with less total VC funding are more sensitive to VC funding when it does come. This could be because in industries with lower levels of VC funding, fewer firms benefit from the advantages that venture capitalists provide, so firms that do secure funding and backing are at a greater advantage.

D. Technology Industry

Our results could be specific to the choice of the Fama and French industry breakdown, especially since venture capital funding is concentrated in some industries, and other industries receive no funding. To investigate this possibility, we use a classification of the technology industry provided by Loughran and Ritter (2004). Using Loughran and Ritter's SIC technology classifications, we divided the technology industry into five sub-groupings (computer hardware, software, electronics, communications equipment, and medical instruments).

The regression results are reported in Table VII. The variable measuring venture capital investment divided by sub-technology industry assets is significant at conventional levels in the panel regressions for both value- and equal-weighted technology industry returns. The other explanatory variables are as in Table VI. As before, we include time and industry dummies, and cluster the errors by industry and time. Industry book-to-market is quite a strong predictor of subsequent technology returns for both regressions. The positive coefficient on book-to-market indicated that when the sub-technology grouping has high values (i.e., tilted towards value), subsequent returns are higher.

E. Additional Robustness Tests

We have included several additional variables in the model for robustness. These variables did not change our results. One variable is the prior 12-month dividend yield, a typical predictor of returns in the asset pricing literature (see Boudoukh, Michaely, Richardson, and Roberts, 2007). This variable is highly correlated with industry book-to-market, and thus was not included in the model, but including it does not change our results.

Other variables that do not change our results include IPO first-day returns, additional lags of the log number of quarterly IPOs, lags of industry returns, and industry market capitalization.

4.6. Industry operating performance

To determine why there is a negative relation between VC funding and stock returns, one could examine the subsequent operating performance of the particular industry. Other authors have examined operating performance using annual data after

IPOs (Jain and Kini, 1994 and Mikkelson, Partch, and Shah, 1997); seasoned equity offerings (Loughran and Ritter, 1997); dismissal of top managers (Denis and Denis, 1995); and stock market liberalization (Mitton, 2006).

If quarterly stock returns are indeed lower with higher levels of VC investments, one might expect to see an industry suffer poorer operating results in the future. That is, poor stock returns and poor operating performance should be expected to go hand-in-hand. When examining subsequent operating performance, the literature typically uses annual data. Hence, to allow for a proper comparison with prior papers, we will focus on annual, not quarterly, accounting data.

In Table VIII, we examine this relation using annual accounting data. Each year, for each industry, during the 1981-2005 time period, we run the fixed-effect regression:

$$\text{Industry ROA}_{i,t} = a_0 + a_1\text{VC Dollars}_{i,t-1} + a_2(\text{VC Dollars/Assets})_{i,t-1} + a_3\text{CAPEX/Assets}_{i,t-1} + a_4\text{R\&D/Asserts}_{i,t-1} + \text{Industry Dummies} + \text{Year Dummies} + e_{i,t}$$

The dependent variable is industry return on assets, defined as the aggregate industry net income before extraordinary items (Compustat item #18) scaled by aggregate industry total assets (Compustat item #6). That is, for each industry in a given year, ROA is defined as the summation of all the net income before extraordinary items in an industry divided by the summation of all the total assets in an industry. The independent variables are all lagged by one year.

Four different explanatory variables are used: industry VC dollars (in millions); industry VC dollars/industry total assets; aggregate industry capital expenditures (Compustat item #30) scaled by industry total assets; and aggregate industry research and development (Compustat item #46) scaled by industry total assets.

In all six regressions, there are 850 observations (34 different Fama-French industries x 25 years of data). Since we are summing the accounting variables across all firms in each industry for every ratio, all the accounting ratios are effectively value-weighted. In column (1) of Table VIII, the only explanatory variable is the prior year's industry VC dollars. The coefficient value of -1.11 on VC dollars is highly significant (t-statistic of -4.08). As before, all t-statistics use errors that are double clustered by industry and year. The negative coefficient implies that the higher industry VC dollars are in the prior year, the lower next year's ROA.

Column (2) reports that the VC dollar coefficient remains significant when industry and calendar year dummies are included in the fixed-effect regressions. The next column reports that the VC dollar coefficient is still negative and statistically significant when CAPEX/assets, R&D/assets, and industry and calendar year dummies are included in the regressions.

In the last three columns of the table, when VC dollars scaled by industry total assets are used instead of VC dollars, we see the main results remain strong. For example, in column (5), the coefficient on VC dollars/assets is -28.47 (t-statistic of -7.94).

This industry operating performance evidence is consistent with our findings for stock returns. All else equal, higher levels of VC investments subsequently leads to poorer stock returns as well as worse subsequent operating performance in the industry. The poor subsequent industry operating performance is also consistent with overinvestment by venture capitalists. As more money pours into a technological-intensive area, increased competition should lead to lower future earnings for the entire industry.

IV. Summary and Conclusion

Venture capitalists play an important role in the U.S. economy. During the 26 years, 1980-2005, venture capital investments totaled $394.2 billion in non-public companies over 73,346 unique rounds of investing. Quite a number of these investments enabled young firms to issue public equity at relatively high valuations. Some lucky investors and managers benefited with the creation of enormous wealth.

Yet what is the effect on publicly traded established firms when VCs fund investments in a particular industry? There are three possibilities: a decline in value; no change in value; or an increase in the value of publicly traded firms.

Our results indicate there may be a downside to high levels of VC funding. VC investment in young non-publicly traded firms appears to precede lower valuations and poorer operating performance for industry firms that are already trading on a major stock exchange. Consistent with the firm level evidence by Cooper, Gulen, and Schill (2007) that mispricings of asset investment are economically meaningful, we find that there is a negative relation between VC funding scaled by industry assets and subsequent quarterly Fama and French industry stock returns.

Our fixed-effect regressions results are generally robust to measurement of industry returns by equal- or value-weighting. Interestingly, the value-weighted return test results are usually more significant than the equally weighted returns. We find this effect in both the bubble and non-bubble periods of our sample.

When the fixed-effect regressions focus on the type of VC funding, the coefficients on VC dollars scaled by industry assets are consistently negative. When regressions are independently run on the five most funded Fama-French industries, the general patterns remain robust. The results also remain when we examine solely technology firms based on the classifications of Loughran and Ritter (2004).

Analysis of annual Compustat data indicates that higher VC investment is also related to poorer subsequent operating performance for the particular Fama and French industry. The operating performance evidence is consistent with an increased competition explanation for the patterns. It is not simply that the stock market perceptions of an industry fall when venture capitalists invest in industry, future ROA also declines.

As money goes to companies that are not public yet, both operating results and stock performance in an industry suffer. Sahlman and Stevenson (1985) note that capital market myopia can lead to the overinvestment of industries and unsustainable market values for publicly traded companies. For venture capitalists, it may be the case that pouring money into an industry may result in poor future performance for the entire industry.

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Appendix

We assigned each VentureXpert industry code to a Fama-French (1997) industry as follows:

Fama-French Industry Number	Fama-French Industry Name	VentureXpert codes
1	Agric	9500-9699, 4200-4299, 9540
2	Food	7320, 7340-7359, 7399, 7300
3	Soda	7330
4	Beer	7310
7	Fun	7100-7199
8	Books	9450, 9470
9	Hshld	7000, 7400, 7420-7499, 7999
10	Clths	7410
11	Hlth	5400-5499, 5210
12	MedEq	4400-4499, 5000, 5200-5209, 5220-5399
13	Drugs	4000, 4100-4139, 4900, 5100-5149, 5500-5599,
14	Chems	4300-4399, 8150-8199
17	BldMt	7450-7459, 8100-8149, 9520-9530, 9440-9449
18	Cnstr	9700-9799
21	Mach	8000, 8200-8399, 8500-8699
22	ElcEq	3200-3399
28	Mines	9600-9699
29	Coal	6700-6799
30	Oil	6100-6499
31	Util	6000, 6500-6699, 6800-6799, 6900, 9800-9899
32	Telcm	1000-1899
33	PerSv	7540-7559
34	BusSv	2600-2899, 4600-4699, 8700-8799, 9300-9399, 9470-9479
35	Comps	2000-2149, 2200-2599, 2900-2999, 3600-3699, 9415
36	Chips	3000-3179, 3400-3599, 3800-3899
37	LabEq	3500-3599, 3700-3799, 3900-3999, 4500-4599
38	Paper	9410-9419, 9430-9439
39	Boxes	7560-7569, 9100-9199, 9460-9469
42	Rtail	7200-7299
43	Meals	7500-7529, 7599
44	Banks	9200, 9230-9239, 9299
45	Insur	9210-9219
46	RlEst	9220-9229
47	Fin	9240-9259, 9250, 9254, 9255

Figure 1. Quarterly Level of Nasdaq and Venture Capital Investments, 1980-2005

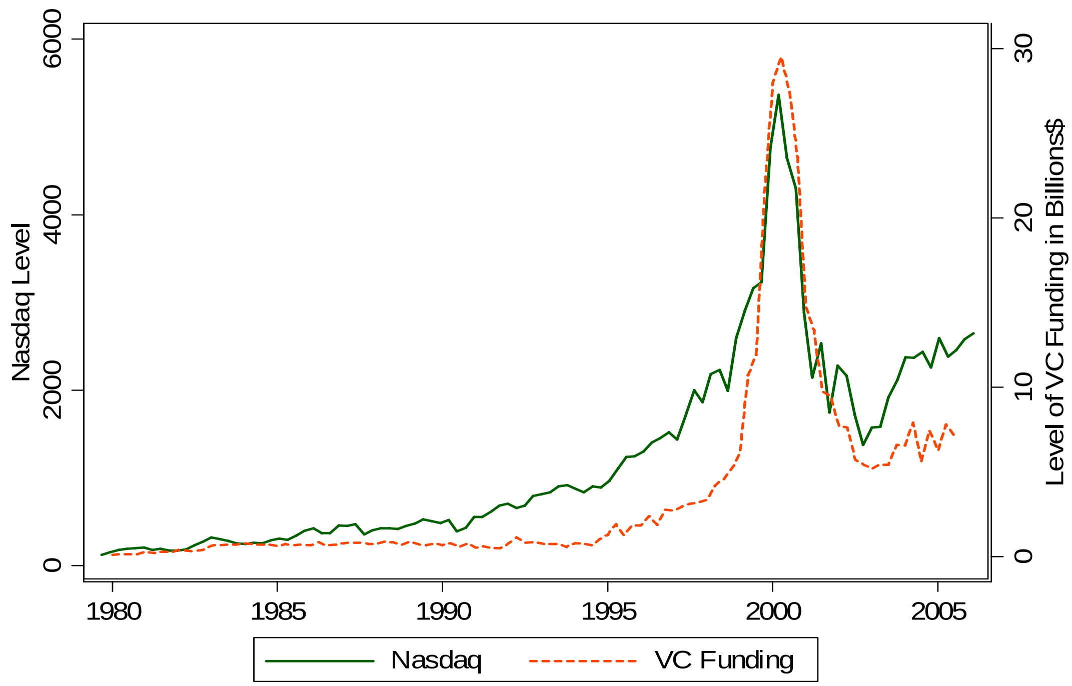

Figure 2. Quarterly Level of Nasdaq and Venture Capital Investments Scaled by Industry Total Assets, 1980-2005

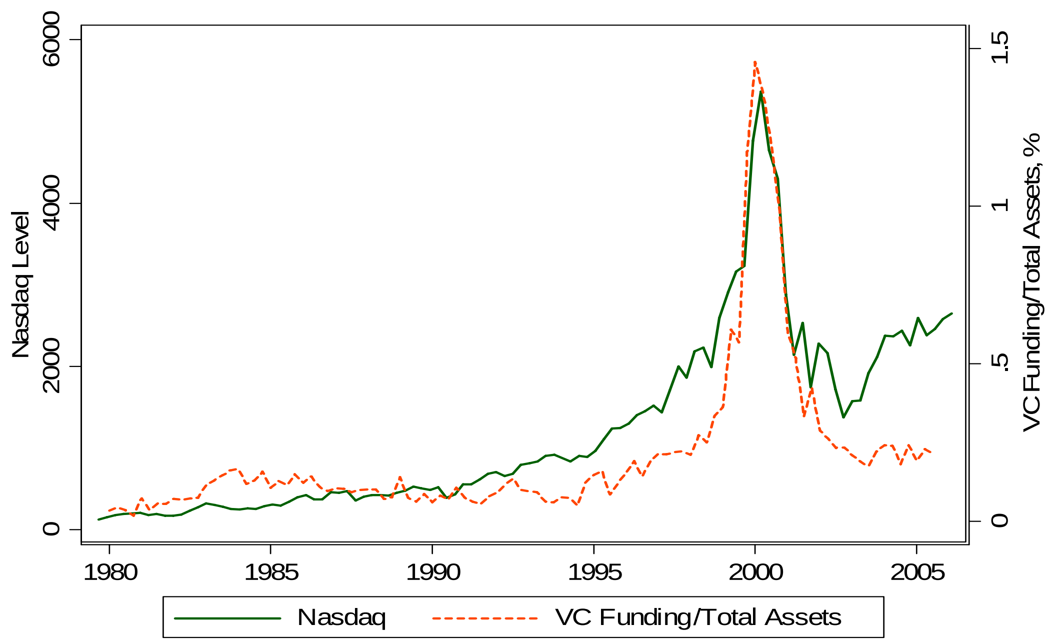

Figure 3. Venture Capital Investments as a Percent of Total Funding for the Five Most-Funded Industries, 1980-2005

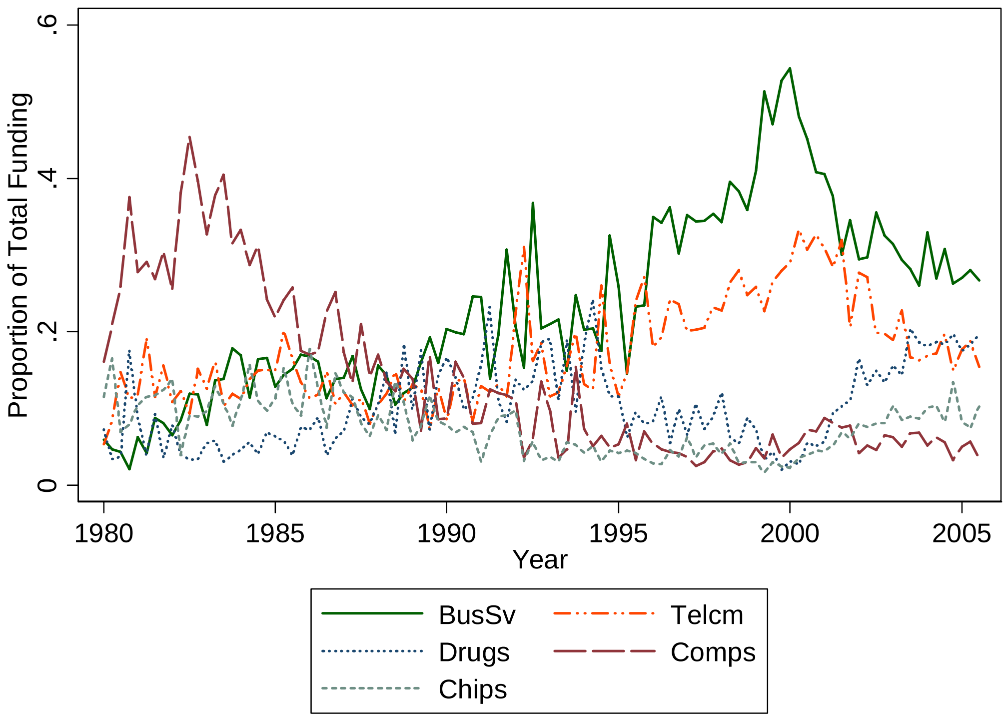

Table I
Aggregate Venture Capital Investments Categorized by Fama and French Industries, 1980-2005

Our data source for the venture capital data is VentureXpert from Thomson Financial Economics. All firms are classified into Fama and French (1997) industries. All investments are in one of five stages: seed, startup, other early stage, expansion, or later stage. Thirty-four different industries have at least one round of VC investments.

FF	Industry	Total in $ Billions	% Total $	Total Rounds	Seed	Startup	Other Early Stage	Expan.	Later Stage
1	Agric	1.7	0.4%	699	2.75%	23.27%	10.01%	47.01%	16.97%
2	Food	2.2	0.6%	674	2.17%	10.69%	9.47%	57.40%	20.27%
3	Soda	0.1	0.0%	63	0.00%	33.86%	6.14%	46.21%	13.79%
4	Beer	0.2	0.0%	69	0.18%	14.26%	2.40%	75.48%	7.68%
7	Fun	3.3	0.8%	818	1.40%	9.91%	3.46%	71.20%	14.04%
8	Books	0.4	0.1%	233	1.64%	25.90%	9.35%	53.55%	9.56%
9	Hshld	1.7	0.4%	636	5.69%	12.74%	4.72%	49.38%	27.46%
10	Clths	0.4	0.1%	259	1.50%	9.98%	8.44%	59.99%	20.08%
11	Hlth	6.2	1.6%	1,600	2.74%	20.28%	6.65%	51.56%	18.78%
12	MedEq	14.9	3.8%	3,553	3.43%	18.71%	5.59%	47.16%	25.11%
13	Drugs	36.1	9.2%	6,248	2.92%	19.84%	7.63%	48.42%	21.19%
14	Chems	1.3	0.3%	477	2.41%	27.43%	9.11%	45.57%	15.48%
17	BldMt	2.0	0.5%	812	4.60%	15.47%	6.75%	51.72%	21.46%
18	Cnstr	0.8	0.2%	360	1.30%	4.22%	7.42%	75.04%	12.01%
21	Mach	3.7	0.9%	1,965	2.27%	16.44%	10.24%	49.23%	21.81%
22	ElcEq	0.8	0.2%	195	1.67%	16.64%	5.41%	63.61%	12.67%
28	Mines	0.5	0.1%	31	0.09%	2.40%	0.64%	96.83%	0.03%
29	Coal	0.1	0.0%	28	0.53%	9.87%	7.80%	81.79%	0.00%
30	Oil	1.6	0.4%	334	0.81%	13.49%	15.28%	64.40%	6.03%
31	Util	1.5	0.4%	398	1.11%	18.39%	7.26%	55.96%	17.27%
32	Telcm	96.2	24.4%	11,926	1.63%	18.51%	5.22%	54.55%	20.08%
33	PerSv	0.7	0.2%	188	0.94%	9.87%	2.27%	67.27%	19.65%
34	BusSv	147.0	37.3%	26,993	2.18%	18.54%	6.73%	53.92%	18.63%
35	Comps	26.2	6.6%	5,556	2.14%	21.51%	6.20%	51.55%	18.59%
36	Chips	22.3	5.7%	4,393	2.47%	20.26%	8.16%	48.40%	20.71%
37	LabEq	5.4	1.4%	1,236	2.10%	15.40%	9.56%	50.39%	22.55%
38	Paper	0.6	0.2%	209	4.85%	28.67%	2.10%	41.29%	23.09%
39	Boxes	3.8	1.0%	888	0.69%	14.25%	4.34%	63.90%	16.83%
42	Rtail	3.2	0.8%	840	1.70%	14.92%	5.94%	61.42%	16.02%
43	Meals	2.0	0.5%	525	2.18%	12.62%	3.77%	64.72%	16.71%
44	Banks	3.1	0.8%	581	2.00%	14.11%	12.68%	62.99%	8.23%
45	Insur	1.0	0.2%	148	0.98%	42.54%	2.59%	42.34%	11.54%
46	RlEst	0.6	0.2%	183	0.37%	20.27%	12.06%	35.36%	31.93%
47	Fin	2.3	0.6%	228	0.20%	8.43%	8.71%	59.22%	23.44%
Total		394.2	100.0%	73,346	1.87%	17.17%	6.89%	57.32%	16.76%

Table II

Summary Statistics by industry and quarter, 1980-2005

VC dollars are the lagged aggregate quarterly VC investments, in millions of dollars, within a particular Fama-French industry. VC dollars/assets are the aggregate quarterly VC investments, divided by total assets (Compustat item #6) within an industry. Asset growth is the lagged annual change in assets (Compustat item #6). Both the value-weighted and equally weighted industry returns are from Kenneth French's website. Book/market is the lagged industry-level average book-to-market ratio provided on Kenneth French's website. $Log(N^{IPOs}+1)$ is the lagged natural log of the number of IPOs in that quarter plus one. The Herfindahl index is computed by dividing the sum of the squares of the sales (Compustat item #12) in each Fama-French industry by the squared total sales of that industry. There are 3,502 observations for each variable (34 Fama-French industries multiplied by 103 quarters).

Variable	N	Mean	Min	Max	Median
VC Dollars (M)	3,502	110.1	0	15,174	7.3
VC Dollars/Assets	3,502	0.21%	0.00%	45.38%	0.01%
VW- Industry Return	3,502	3.8%	-42.2%	68.6%	4.1%
EW- Industry Return	3,502	4.1%	-41.8%	78.8%	3.5%
VW- Asset Growth	3,502	21.6%	-24.2%	862.5%	14.9%
EW - Asset Growth	3,502	21.4%	-19.3%	403.5%	17.2%
VW- Industry Book/Market	3,502	0.58	0.09	1.81	0.51
EW- Industry Book/Market	3,502	0.54	0.08	1.74	0.47
$Log(N^{IPOs}+1)$	3,502	0.28	0	3.43	0
Herfindahl Index	3,502	0.14	0.01	0.73	0.10

Table III

Fama-French industry fixed effects regressions, 1980-2005

The regression dependent variable is the value-weighted (VW) or equally weighted (EW) Fama and French industry raw quarterly return. Columns (3) and (6) use excess returns over the risk-free rate provided on Kenneth French's website. (VC Dollars/Assets)$_{i,t-1}$ are the lagged aggregate quarterly VC investments, divided by total assets (Compustat item #6) within a particular Fama-French industry. Asset growth is the lagged annual change in assets. Book/Market is the lagged industry-level average book-to-market ratio provided on Kenneth French's website. Log(N^{IPOs}+1) is the lagged log of the number of IPOs in that quarter plus one. Book-to-market is value weighted when the dependent variable is value weighted, and equal weighted otherwise. Mkt-Rf, SMB, HML, and MOM are the contemporaneous market return minus the risk-free rate, Small-Minus-Big, High-Minus-Low book-to-market and momentum factors from Kenneth French's website. T-statistics (in parentheses) use errors that are heteroskedasticity-robust and clustered by industry and quarter.

$$\text{VW or EW Industry Return}_{i,t} = a_0 + a_1(\text{VC Dollars/Assets})_{i,t-1} + a_2\text{Asset Growth}_{i,t-1} + a_3\,\text{Book/Market}_{i,t-1} + a_4\text{Log}(N^{IPOs}+1)_{i,t-1} + a_5\text{Herfindahl}_{i,t-1} + a_6(\text{Mkt-Rf})_t + a_7\text{SMB}_t + a_8\text{HML}_t + a_9\text{MOM}_t + \text{Industry Dummies} + \text{Quarter Dummies} + e_{i,t}$$

	Value-Weighted Returns			Equal-Weighted Returns		
	Raw	Raw	Excess	Raw	Raw	Excess
Variable	(1)	(2)	(3)	(4)	(5)	(6)
(VC Dollars/Assets)$_{i,t-1}$	-33.10	-32.24	-23.33	-36.00	-36.88	-29.84
	(-4.92)	(-5.12)	(-6.57)	(-4.01)	(-4.21)	(-4.66)
Asset Growth$_{i,t-1}$		-0.65	-0.07		-0.56	-0.60
		(-0.85)	(-0.11)		(-2.23)	(-2.22)
Industry Book/Market$_{i,t-1}$		3.66	4.66		-2.06	0.78
		(2.22)	(6.58)		(-0.99)	(0.56)
Log(N^{IPOs}+1)$_{i,t-1}$		0.02	-0.40		-0.24	-0.54
		(0.04)	(-0.75)		(-0.54)	(-1.15)
Herfindahl$_{i,t-1}$		3.25	2.47		1.89	1.16
		(1.14)	(0.81)		(0.58)	(0.33)
(Mkt-Rf)$_t$			0.95			0.88
			(25.41)			(16.57)
SMB$_t$			0.14			1.05
			(2.09)			(7.63)
HML$_t$			0.14			0.31
			(1.92)			(2.86)
MOM$_t$			4.32			11.02
			(0.87)			(1.68)
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Dummies	Yes	Yes	No	Yes	Yes	No
N	3,502	3,502	3,502	3,502	3,502	3,502
R^2	0.56	0.56	0.52	0.64	0.64	0.58

Table IV
Fama-French industry fixed effects regressions by time periods

The regression dependent variable is the value weighted (VW) or equally weighted (EW) Fama and French industry quarterly return. (VC Dollars/Assets)$_{i,t-1}$ are the lagged aggregate quarterly VC investments, divided by total assets (Compustat item #6) within a particular Fama-French industry. Asset growth is the lagged annual change in assets. Book/Market is the lagged industry-level average book-to-market ratio provided on Kenneth French's website. Log(N^{IPOs}+1) is the lagged log of the number of IPOs in that quarter plus one. Book-to-market is value weighted when the dependent variable is value weighted, and equal weighted otherwise. The bubble period is years 1998-2001. The non-bubble period is years 1980-1997 and 2002-2005. T-statistics (in parentheses) use errors that are heteroskedasticity-robust and clustered by industry and quarter.

$$\text{VW or EW Industry Return}_{i,t} = a_0 + a_1(\text{VC Dollars/Assets})_{i,t-1} + a_2 \text{ Assets Growth}_{i,t-1} + a_3 \text{ Book/Market}_{i,t-1} + a_4\text{Log}(N^{IPOs}+1)_{i,t-1} + a_5\text{Herfindahl}_{i,t-1} + \text{Industry Dummies} + \text{Quarter Dummies} + e_{i,t}$$

	Value-Weighted Industry Returns			Equal-Weighted Industry Returns		
Variable	All	Non-Bubble	Bubble	All	Non-Bubble	Bubble
(VC Dollars/Assets)$_{i,t-1}$	-32.24	-106.10	-73.60	-36.88	-105.55	-82.19
	(-5.12)	(-4.71)	(-7.96)	(-4.21)	(-1.93)	(-12.13)
Asset Growth$_{i,t-1}$	-0.65	-0.39	-3.38	-0.56	-0.39	-6.54
	(-0.85)	(-0.51)	(-1.49)	(-2.23)	(-2.25)	(-1.67)
Indust. Book/Market$_{i,t-1}$	3.66	2.54	12.07	-2.06	-3.15	5.00
	(2.22)	(1.87)	(1.62)	(-0.99)	(-1.96)	(0.36)
Log(N^{IPOs}+1)$_{i,t-1}$	0.02	0.05	-0.50	-0.24	-0.21	-1.39
	(0.04)	(0.13)	(-0.20)	(-0.54)	(-0.46)	(-0.83)
Herfindahl$_{i,t-1}$	3.25	2.93	3.76	1.89	2.38	-16.58
	(1.14)	(0.92)	(0.34)	(0.58)	(0.68)	(-1.20)
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	3,502	2,958	544	3,502	2,958	544
R^2	0.56	0.61	0.47	0.64	0.69	0.53

Table V

Fama-French Industry Fixed Effects Regressions by Type of VC Funding

The regression dependent variable is the value-weighted (VW) or equally weighted (EW) Fama and French industry quarterly return. (VC Dollars/Assets)$_{i,t-1}$ are the lagged aggregate quarterly VC investments, divided by total assets (Compustat item #6) within a particular Fama-French industry. Asset growth is the lagged annual change in assets (Compustat item #6). Book/market is the lagged industry-level average book-to-market ratio provided on Kenneth French's website. Log(N^{IPOs}+1) is the lagged log of the number of IPOs in that quarter plus one. Book-to-market is value weighted when the dependent variable is value-weighted, and equal-weighted otherwise. T-statistics (in parentheses) use errors that are heteroskedasticity-robust and clustered by industry and quarter.

$$\text{VW or EW Industry Return}_{i,t} = a_0 + a_1(\text{VC Dollars/Assets})_{i,t-1} + a_2\text{Asset Growth}_{i,t-1} + a_3\text{ Book/Market}_{i,t-1} + a_4\text{Log}(N^{IPOs}+1)_{i,t-1} + a_5\text{Herfindahl}_{i,t-1} + \text{Industry Dummies} + \text{Quarter Dummies} + e_{i,t}$$

	Value-Weighted Industry Returns					Equal-Weighted Industry Returns				
Variable	Seed	Startup	Other Early	Expansion	Later	Seed	Startup	Other Early	Expansion	Later
(VC Dollars/Assets)$_{i,t-1}$	-544.02	-141.88	-416.02	-56.56	-222.41	-1430.7	-171.35	-432.11	-62.87	-240.81
	(-1.47)	(-4.73)	(-4.67)	(-5.22)	(-5.34)	(-2.67)	(-4.87)	(-3.82)	(-3.83)	(-4.82)
Asset Growth$_{i,t-1}$	-0.64	-0.66	-0.62	-0.66	-0.65	-0.55	-0.56	-0.53	-0.56	-0.57
	(-0.84)	(-0.86)	(-0.81)	(-0.86)	(-0.85)	(-2.21)	(-2.24)	(-2.07)	(-2.24)	(-2.25)
Industry Book/Market$_{i,t-1}$	3.68	3.66	3.65	3.67	3.70	-2.06	-2.06	-2.06	-2.05	-2.01
	(2.23)	(2.22)	(2.22)	(2.22)	(2.22)	(-1.00)	(-1.00)	(-1.00)	(-0.99)	(-0.97)
Log(N^{IPOs}+1)$_{i,t-1}$	0.02	0.02	0.03	0.02	0.03	-0.26	-0.24	-0.23	-0.24	-0.23
	(0.04)	(0.04)	(0.04)	(0.04)	(0.06)	(-0.57)	(-0.55)	(-0.54)	(-0.54)	(-0.52)
Herfindahl$_{i,t-1}$	3.29	3.27	3.25	3.25	3.23	1.84	1.91	1.89	1.90	1.88
	(1.16)	(1.15)	(1.14)	(1.14)	(1.14)	(0.56)	(0.59)	(0.58)	(0.58)	(0.58)
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	3,502	3,502	3,502	3,502	3,502	3,502	3,502	3,502	3,502	3,502
R^2	0.55	0.55	0.56	0.56	0.56	0.64	0.64	0.64	0.64	0.64

Table VI

Top Five Fama-French industry OLS

The regression dependent variable is the value weighted (VW) or equally weighted (EW) Fama and French industry quarterly return. (VC Dollars/Assets)$_{i,t-1}$ are the lagged aggregate quarterly VC investments, divided by total assets (Compustat item #6) within a particular Fama-French industry. Asset growth is the lagged annual change in assets (Compustat item #6). Book/Market is the lagged industry-level average book-to-market ratio provided on Kenneth French's website. Log(N^{IPOs}+1) is the lagged log of the number of IPOs in that quarter plus one. Book-to-market is value-weighted when the dependent variable is value-weighted and equal-weighted otherwise. T-statistics (in parentheses) use errors that are heteroskedasticity-robust.

$$\text{VW or EW Industry Return}_{i,t} = a_0 + a_1(\text{VC Dollars/Assets})_{i,t-1} + a_2\text{Asset Growth}_{i,t-1} + a_3\ \text{Book/Market}_{i,t-1} + a_4\text{Log}(N^{IPOs}+1)_{i,t-1} + a_5\text{Herfindahl}_{i,t-1} + e_{i,t}$$

	Value-Weighted Industry Returns					Equal-Weighted Industry Returns				
Variable	BusSv	Telcm	Drugs	Comps	Chips	BusSv	Telcm	Drugs	Comps	Chips
(VC Dollars/Assets)$_{i,t-1}$	-51.5	-1383.9	-1345.5	-1714.1	-9412.8	-46.7	-2136.8	-4406.0	-1905.2	-8451.4
	(-2.48)	(-3.18)	(-0.96)	(-2.14)	(-5.73)	(-1.66)	(-1.97)	(-2.42)	(-1.84)	(-3.46)
Asset Growth$_{i,t-1}$	-3.37	2.15	-12.34	-15.15	-2.88	-2.48	-22.66	-31.45	0.48	-3.55
	(-0.36)	(0.08)	(-1.42)	(-1.76)	(-0.19)	(-1.34)	(-0.86)	(-2.79)	(0.58)	(-0.62)
Industry Book/Market$_{i,t-1}$	-7.77	-1.05	-4.01	1.42	10.90	-6.71	-5.56	-40.46	5.32	1.95
	(-0.45)	(-0.43)	(-0.46)	(0.12)	(0.79)	(-0.34)	(-1.30)	(-2.05)	(0.32)	(0.11)
Log(N^{IPOs}+1)$_{i,t-1}$	-3.60	-5.21	-2.00	-2.24	-0.82	-3.76	-7.69	-6.92	-2.62	-1.34
	(-0.98)	(-1.99)	(-1.21)	(-1.37)	(-0.39)	(-0.91)	(-1.91)	(-2.28)	(-0.92)	(-0.44)
Herfindahl$_{i,t-1}$	-32.83	-464.00	11.94	-983.14	-149.82	-15.08	-156.46	156.85	-532.80	-142.21
	(-0.63)	(-1.28)	(0.20)	(-3.12)	(-2.62)	(-0.28)	(-0.31)	(1.33)	(-1.10)	(-1.90)
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	103	103	103	103	103	103	103	103	103	103
R^2	0.08	0.20	0.10	0.11	0.21	0.04	0.06	0.17	0.05	0.10

Table VII
Technology industry fixed effects regressions

The regression dependent variable is the value weighted (VW) or equally weighted (EW) technology industry quarterly return. We use the technology industry classification as defined in Loughran and Ritter (2004). Technology firms are categorized into five sub-industries (computer hardware, software, electronics, communications equipment, and medical instruments). $(\text{VC Dollars/Assets})_{i,t-1}$ are the lagged aggregate quarterly VC investments, divided by total assets (Compustat item #6) within the sub-technology industry. Asset growth is the lagged annual change in assets (Compustat item #6). Book/Market is the lagged technology industry-level average book-to-market ratio. $\text{Log}(N^{IPOs}+1)$ is the lagged log of the number of IPOs within the five sub-industries in that quarter plus one. Book-to-market is value weighted when the dependent variable is value weighted, and equal weighted otherwise. T-statistics (in parentheses) use errors that are heteroskedasticity-robust and clustered by sub-technology industry and year. The number of observations is 515 (five sub-technology industries multiplied by 103 quarters).

$$\text{VW or EW Technology Industry Return}_{i,t} = a_0 + a_1(\text{VC Dollars/Assets})_{i,t-1} + a_2 \text{ Asset Growth}_{i,t-1} + a_3 \text{ Book/Market}_{i,t-1} + a_4\text{Log}(N^{IPOs}+1)_{i,t-1} + a_5\text{Herfindahl}_{i,t-1} + \text{Sub-Tech Industry Dummies} + \text{Year Dummies} + e_{i,t}$$

Variable	VW – Tech Industry Returns	EW – Tech Industry Returns
$(\text{VC Dollars/Assets})_{i,t-1}$	-343.75	-304.72
	(-2.62)	(-2.26)
$\text{Asset Growth}_{i,t-1}$	-0.65	-0.17
	(-0.28)	(-0.75)
$\text{Tech Indust. Book/Market}_{i,t-1}$	8.97	27.85
	(5.22)	(3.58)
$\text{Log}(N^{IPOs}+1)_{i,t-1}$	-1.46	-1.86
	(-1.28)	(-2.89)
$\text{Herfindahl}_{i,t-1}$	4.35	13.10
	(2.00)	(3.01)
Constant	Yes	Yes
Sub-Tech Industry Dummies	Yes	Yes
Year Dummies	Yes	Yes
N	515	515
R^2	0.17	0.22

Table VIII

Annual regressions of industry return on assets on Venture Capital Dollars, 1981-2005

Return on assets (ROA) is the dependent variable in annual regressions. ROA is defined as industry net income before extraordinary items (Compustat item #18) divided by industry total assets (Compustat item #6). VC dollars is the aggregate VC investments in a calendar year. VC dollars/assets$_{i,t-1}$ are the lagged aggregate VC investments, divided by total assets (Compustat item #6) within a particular Fama-French industry. CAPEX/Assets is defined as industry Capital Expenditures (Compustat item #30) divided by industry total assets. R&D/Assets is defined as aggregate industry research and development expense (Compustat item #46) divided by aggregate industry total assets. The coefficients on VC Dollars in columns 1 to 3 are multiplied by 1000. T-statistics (in parentheses) use errors that are heteroskedasticity-robust and clustered by industry and year. Each regression has 850 observations (34 Fama-French industry multiplied by 25 years of data).

$$\text{Industry ROA}_{i,t} = a_0 + a_1\text{VC Dollars}_{i,t-1} + a_2(\text{VC Dollars/Assets})_{i,t-1} + a_3\text{CAPEX/Assets}_{i,t-1} + a_4\text{R\&D/Asserts}_{i,t-1} + \text{Industry Dummies} + \text{Year Dummies} + e_{i,t}$$

	(1)	(2)	(3)	(4)	(5)	(6)
VC Dollars$_{i,t-1}$	-1.11	-0.99	-0.95			
	(-4.08)	(-2.88)	(-3.20)			
(VC Dollars/Assets)$_{i,t-1}$				-38.43	-28.47	-25.41
				(-3.52)	(-7.94)	(-5.59)
CAPEX/Assets$_{i,t-1}$			0.11			0.11
			(1.66)			(1.64)
R&D/Assets$_{i,t-1}$			0.21			0.20
			(1.00)			(0.91)
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	No	Yes	Yes	No	Yes	Yes
Year Dummies	No	Yes	Yes	No	Yes	Yes
N	850	850	850	850	850	850
R^2	0.01	0.47	0.47	0.01	0.47	0.47