Thinning the Herd:
The Impact of Venture Capital on Firm 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 test three economic hypotheses on the connection between venture capital investment and subsequent performance. We find that lagged VC investments scaled by industry assets are negatively related to subsequent firm stock return and operating performance after adjusting for other factors. However, not all firms are equally impacted. We find that financially constrained firms and firms in competitive industries suffer the most when new VC money pours into an industry. Overall, our results are consistent with venture capital lowering the value of existing firms through increased competition.

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I. Introduction

Over 1980-2005, the aggregate amount of venture capital disbursements made in U.S. firms, according to VentureXpert, totaled $394.2 billion. Venture capitalists play an increasingly important role in the U.S. economy. Highly successful firms like Apple Computer, Sun Microsystems, Yahoo, eBay, and Google all had venture capital funding before going public. The venture capitalist not only provides cash investment to young firms, but often serves on boards of directors and can provide critical support to allow entrepreneurs to transform small start-ups into large publicly traded firms.

Prior work has shown 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 (2008) report that the most experienced VCs make the most money and are most responsive to investment opportunities signaled by financial markets.

Little attention, however, has been paid to how the public equity markets respond to VC investments. VC investments could serve as an endorsement of an industry and increase investor optimism about the industry's prospects. This would increase the value of established public companies. In this case, we would expect VC investment to forecast higher firm returns in a particular industry, at least in the short term. This appears to be a commonly held view. A December 27, 2006 article in the Wall Street Journal states:

"Venture capitalists, who fueled the previous Internet bubble, are pumping money into the new crop of Web startups."[1]

Alternatively, new VC money may signal trouble for existing firms in the form of increased competition. An example of how new firms can harm industry performance is the Telecommunication sector during 1999-2001. 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, well-capitalized phone and cable firms (i.e., Comcast, Time Warner, BellSouth, 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 and 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 efforts. Similarly, Carolina Broadband raised $402 million in May of 2000 only to lay off most of its employees by June, 2001.

Although firms like Comcast, Time Warner, and BellSouth suffered poor stock returns and operating performance as a direct result of the influx of VC money, these firms had the financial resources to compete. They all had large amounts of total assets and long-term credit ratings which allowed for access to the debt market. Smaller telecommunications firms like the Chell Group and Nucentrix Broadband Networks

[1] Is 'Web 2.0' Another Bubble?, Wall Street Journal, December 27th, 2006.

which lacked long-term credit ratings were not able to effectively compete with the new capital investments.

In industrial organization, “overbuilding” stories center around situations in which decentralized decision makers independently decide to invest and do not recognize that many (too many) others are following the same strategy that they are. Only later do the various market participants realize that the aggregate impact of their actions is substantial over-investment. 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 adjusts downward the stock prices of publicly traded firms in anticipation of increased competition in the future.

Further, firms with access to credit markets should be better able to compete with the increased competition. As new private investments pour into young, illiquid, and non-publicly traded firms bent on achieving innovative techniques and patents, the returns of companies that are already public should suffer as a result. VC money generally flows into an industry undergoing technological change, which hurts firms who lack the resources or access to credit markets to continue technological investments. Hence, if public firm valuations are lower after high VC funding and this is due to competition, we would expect more financially constrained firms in more competitive industries to suffer more.

Prior empirical research in related areas of finance suggests that venture capital investment in an industry may be related to public firm performance. Cooper, Gulen, and Schill (2008) find that the higher is a public firm’s growth in total assets; the lower are the firm’s subsequent returns. The three authors state that their asset growth effect is most consistent with over extrapolation of past gains to growth by financial market participants.

In a related paper, Hoberg and Phillips (2008) show that a strong negative effect of investment, valuation, and new financing on returns during boom and bust cycles exists, though it is concentrated in competitive product markets. Their work provides evidence that investors and firms in competitive industries systematically underestimate the negative externality that their investment creates. They show that this can be a rational response because in competitive industries, firm-specific information is hard to gather. Thus, firms are more likely to rely on industry-wide signals and to herd in their investment decisions.

One might expect VC funding to have a stronger per dollar effect on subsequent returns than total investment or even asset growth in public firms. As individual firms issue equity or debt to build new factories, industry stock returns might suffer from the increased competition or overcapacity from the new investment. However, venture capital money rarely goes toward increasing capacity; the venture capitalist often creates a new technology which has the potential to destroy or severely damage the existing firms in the industry (think of the creative destruction explanation of Schumpeter (1942)). It is conceivable for millions of venture capital dollars invested to lower the values of existing firms by billions of dollars.

Our paper makes three contributions. First, in a sample from VentureXpert of over 200,000 firm-quarter observations during 1980-2005, we show that, contrary to the belief of many, VC investment has no perceptible endorsement effect and forecasts sharply lower returns for the existing public firms in the same industry. We find evidence that higher levels of quarterly venture capital investments scaled by Fama-French industry assets are associated with significantly lower subsequent quarterly firm returns in a particular industry.[2]

That is, if a high amount of VC dollars are invested in the telecommunications industry in a particular quarter, the next quarter, telecommunication firm stock returns will be lower. This is even after adjusting for factors like the prior volume of telecommunication IPOs, prior firm year return, asset growth of the firm, and book-to-market. Our results are generally significant both including and excluding the internet bubble period, for small, medium, and large firms, and for early, middle, and late rounds of VC financing.

Our results are also economically significant. A one standard deviation increase in change in VC Dollars/Assets is associated with almost a 4% decline in stock returns on an annualized basis. This is after controlling for other factors known to explain stock return patterns.

We also investigate whether firm operating performance is affected by the influx of VC dollars. Using annual operating income scaled by total assets (ROA) across different industries, we find a strong negative relation between VC investments and subsequent public company operating performance. Consistent with our hypothesis, we find that more VC funding precedes lower ROA values for publicly-traded firms in the next calendar year.

Firms saddled by financial constraints should be less able to adapt to change in their industry than financially healthy firms. Firms with excess cash may actually be able

[2] 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)).

to acquire the fledgling VC-funded firms and profit from their innovations. Our second contribution is to show that firms that are more financially constrained, using three financial constraint measures from Hahn and Lee (2009) plus divided yield, suffer worse performance when the venture capital flows into their industry.

Specifically, firms with less access to credit markets, lower assets in place and lower payout yield are hurt more by VC investment than are financially healthy firms. These effects are economically significant as well. For example, a change in our long term credit rating measure from zero (constrained) to one (not constrained) results in a reduction by half of the negative effect of VC investment.

Third, as further evidence that VC-funded firms lower existing public firms' valuations due to competition, we show that venture capital investment in an industry has a more negative impact on public firms when the industry is more competitive, as measured by the Herfindahl index. A change in industry Herfindahl from zero to one is associated with negating the VC dollars effect on subsequent returns.

We find that the effect of VC dollars on returns lasts about a quarter and is permanent. Why do the financial markets take this long to incorporate the news of the venture capital investments into industry stock prices? First, the exact disbursement day in VentureXpert is not always accurate. Second, even though the venture capitalists have disbursed the money, uncertainty still exists in exactly how the managers will execute the projects. As noted in Hong, Torous, and Valkanov (2007), information may flow slowly across markets possibly due to the limited information-processing capacity of investors. Thus, it is not surprising the information of VC investments into privately held firms might slowly seep into the values of publicly traded industry companies.

The paper proceeds as follows: Section II presents the sample and section III presents the estimation. Section IV reports the empirical results and section V concludes.

II. Sample

Our source for the venture capital data is VentureXpert (Thomson Financial Economics). We use data on all venture capital investments between 1980 and 2005.[3] 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. Information on all accounting variables comes from Compustat.

A. VC funding classifications

The main classifications of funding available in VentureXpert are: early stage (seed, startup, and other early stage); expansion; later stage; and other final stage (acquisition, special situation, and VC partnership). We exclude the other final stage category because it is not clear that funding of such enterprises represent the creation/expansion of new enterprises by the venture capitalist. Including this other stage category does not change the results, however. In the paper, we include all VC funding

[3] 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.

directed at the following stages: seed, startup, other early stage, expansion, and later stage.[4]

B. Time series of venture capital investments

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 1998-2000. These two figures show aggregate venture capital funding patterns.

Table 1 provides descriptive statistics of VC investment rounds by 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.

Also, we focus on the level of investment, not the change in investment, as the critical determinant of VC impact. Like asset growth, VC investment divided by assets already represents a flow of investment into the industry. VC investments are fairly

[4] Across the five stages, on average, over 57% of total venture capital money is in the expansion stage. The lowest amount of VC dollars (only 1.87% of all VC dollars) is directed towards seed stage financing.

volatile,[5] and sometimes zero, making an expected change fairly arbitrary to compute, and a percent change difficult to interpret.

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.

C. Summary statistics

Table 2 reports the summary statistics for our sample. Although only 34 Fama-French industries have VC investment at some point in the sample period, we use all 48 industries in our analysis. Since we are using lagged quarterly VC investments, the analysis starts at the end of the first quarter in 1980. When VC dollars are scaled by industry total assets, the mean value over the 103 quarters and 13,385 firms is 0.09%.

We compute quarterly returns using the monthly returns provided by CRSP. The average stock return including distributions is 3.04%, with a median of 2.28%. We chose quarterly time intervals for our stock return analysis to smooth out the noisy pattern of

[5] In our data, the AR(1) coefficient is statistically and economically different from one, so a raw difference would not represent an expected change.

VC investing and allow a long enough time period for the market to incorporate the news of the VC investment. 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).

In our analysis, it is critical to control for other factors that have been shown to explain stock return patterns. In all cases, we only use data that is available before the start of each quarter. Regarding Compustat data, we only use data that is publicly available in an annual report that is published at least six months before each quarter’s beginning date.

We also include payout yield, firm asset growth, public firm financing, the Herfindahl index of the 3-digit SIC code industry of the firm, natural log of the book-to-market ratio of the firm, the natural log of the number of IPOs in an Fama-French industry-quarter plus one, and the prior year return of the firm, as well as quarter and industry dummies. Our results are stronger without the dummies being included in the regressions. Quarterly and prior year stock returns, payout yield, asset growth, Herfindahl, and ROA are all winsorized at the 1/99 percentile level.

The first of our controls is *Payout Yield*. Boudoukh, Michaely, Richardson, and Roberts (2007) show that payout yield is a strong predictor of returns. We compute total payout yield as the total dollars spent on dividends and repurchases during the quarter divided by share price. Specifically, payout yield is (Compustat annual items [26 + (115 / 54)]/Price, where item 26 is dividends per share; item 115 is purchase of common and preferred stock; item 54 is number of common shares; and Price is the end-of-prior-quarter share price from CRSP. The median payout yield in our sample is 1.63%.

Following Cooper, Gulen, and Schill (2008) we control for the asset growth of each stock. The three authors document a strong negative relationship between a firm's asset growth and its subsequent stock returns. For each firm, we compute the annual percentage change in assets of the latest fiscal year from the one before. The median asset growth for firms in our sample is 8.67%.

Following Hoberg and Phillips (2008), we include the public firm financing (sum of net equity and debt issuance divided by the value of assets). We use their measure, which is Compustat items (108-115+111-114)/6 minus the industry wide ratio for each firm. It is important to control for the level of public investment into an industry while we examine the impact of VC investments.

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. Gompers and Lerner (2000) also use industry book-to-market to control for public market valuations. We include the natural log of the *Book-to-Market* ratio of the firm at the time of the VC investment to show that our findings are not driven by growth firms experiencing low subsequent stock returns. Prices and number of shares are from CRSP and are from the end of each firm's fiscal year.

The *Herfindahl* index is computed by dividing the sum of the squares of the sales (Compustat annual item 12) in a 3-digit SIC code 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. Hou and Robinson (2006) show that concentrated, or high Herfindahl, industries have lower returns. The median Herfindahl index is 0.27 compared to a median value of 0.21.

We also include the number of IPOs in the past quarter within each Fama-French industry. 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. Last, we include the prior year stock return on the firm. This is as a proxy for expected return and/or momentum.[6]

III. Estimation

We estimate our models at the firm level using panel regressions with both quarterly and industry dummies. We use firm-level data in order to test hypotheses about the cause of the relation between VC funding and returns, but the results are strong if we use industry-level regressions with either value-weighted or equal weighted returns and explanatory variables. Fixed-effects regressions have the advantage of allowing industry effects. As many of the industry fixed effects are statistically significant, we think they

[6] Other variables that we used in untabulated results are dividend yield, payout ratio (dividends and repurchases scaled by net income), IPO first-day returns, and additional lags of the log number of quarterly IPOs. These variables do not affect the results and we do not include them to avoid using too many potentially correlated variables. In addition, if we control for the contemporaneous Fama-French factors (size, book-to-market, and momentum), we see only minor value changes in the VC dollars/assets coefficients.

should be controlled for. As we show in Table 3, however, our results do not depend on their inclusion.

We also cluster the standard errors by both quarter and firm using 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.

IV. Empirical results

A. Main Results

We want to test whether VC funding in a particular industry is related to industry firm returns in subsequent quarters, controlling for variables that have been shown to have some explanatory power for quarterly returns. The main results are presented in Table 3. The control variables are the firm's payout yield, the asset growth of the stock, the net issuance of debt and equity by public firms, the Herfindahl index, the book-to-market ratio, number of initial public offerings (IPOs) in that particular industry, and firm's prior year stock return. In the fixed-effect regressions, we also include industry and quarter dummies. In all the Table 3 regressions, the dependent variable is the firm quarterly stock return.

Table 3 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.[7]

The regression specification is as follows:

$$Return_{i,t} = a_0 + a_1 VC\ Dollars/Assets_{i,t-1} + a_2 Payout\ Yield_{i,t-1} + a_3 Asset\ Growth_{i,t-1} + a_4 Public\ Firm\ Financing_{i,t-1} + a_5 Herfindahl_{i,t-1} + a_6 Log(Book/Market)_{i,t-1} + a_7 Log(N^{IPOs}+1)_{i,t-1} + a_8 Prior\ Year\ Return_{i,t-1} + Industry\ Dummies + Quarter\ Dummies$$

T-statistics generated from the double clustered errors (i.e., both firm and quarter) are in parentheses under the coefficients. In the first four regressions, the sample size is 204,771 firm-quarter observations.

The coefficient on lagged VC dollars divided by industry assets is consistently negative. The t-statistics for *VC Dollars/Assets* in Table 3 range from -2.24 and -3.35. The coefficients are economically significant as well. If we use the full model in column 4 of Table 3, a one standard deviation change in VC Dollars/Assets is associated with a 0.26% * -3.17 = -0.82%, or an almost one percent decrease in quarterly return. In comparison, a one standard deviation change in asset growth is associated with a 33.46%* -0.02 = -0.67% decrease in quarterly return.

The negative coefficients on VC dollars/industry assets are consistent with a hypothesis that there is slow diffusion in the stock market of 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

[7] 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.

embedded in industry returns. Information on fundamentals appears to be diffused only gradually across markets.

We can test this hypothesis further by including more lags of *VC Dollars/Assets* in the regression, as we do in column 5 of Table 3. This regression shows that though adding lags take away slightly from the statistical significance of the latest *VC Dollars/Assets*, these lags are not statistically significant in themselves. This means that the effect of *VC Dollars/Assets* is incorporated into prices within a quarter, and does not revert or persist beyond a quarter.

We do not investigate lags smaller than a quarter because of the imprecise nature of the dates available from VentureXpert. Kaplan, Sensoy, and Stromberg (2002) report that VentureXpert's funding date is within one month of the actual funding date in only 107 of 124 financings. Thus, while we are fairly sure about the quarter that the funding takes place in, we do not want to rely on monthly or daily data to provide an event study on the announcement dates. Also, while some of the larger VC-backed deals make it into the *Wall Street Journal*, the smaller ones tend to be disseminated to the market in less widely read sites like the Red Herring (http://www.redherring.com/).

Other independent variables that are often significant in the Table 3 regressions include *Payout Yield, Asset Growth,* and *Log(Book/Market)*. The sign and significance of the coefficient on *Payout Yield* is consistent with the empirical evidence of Boudoukh, Michaely, Richardson, and Roberts (2007). The negative values on the asset growth variable are as would be predicted by Cooper, Gulen, and Schill (2008). The positive and significant coefficient on *Log(Book/Market)* for stock returns implies that when the book-to-market ratio is high (i.e., tilted toward value), subsequent returns are higher, all else being equal.

The coefficients on the log number of IPOs in the industry are negative as might be predicted from Baker and Wurgler (2000), but not significant. The industry Herfindahl index is never significant predictor of quarterly firm returns. This differs from the findings in Hou and Robinson (2006), but they use a different time series, from 1963 to 2001. They also average the Herfindahl index over the past three years.

B. Sub-sample robustness tests

This sub-section reports the results by various partitions of the data. The three groupings are on the basis of bubble/non-bubble time periods, asset size of the firm, and stage of VC financing. Might the observations during the bubble period of 1998-2000 be driving the relation between VC dollars and stock returns? 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 1 and 2 of Table 4 for each sub-sample.

VC dollars scaled by industry assets are again the explanatory variable of interest. Both industry and quarter dummies are included in all eight regressions. The t-statistic is slightly stronger and the coefficient slightly larger in the bubble period than in the non-bubble period. The VC investment coefficient is statistically significant in the first two regressions in Table 4. Our empirical results are thus not being driven by the unusual return patterns of the internet bubble time period.

It could also be that our results are driven by only firms with lower total assets. We replicate the analysis in columns 3, 4, and 5 of Table 4 for Small, Medium, and Large firms in terms of total assets (Compustat item 6). On a yearly basis, sample firms are placed into total assets size terciles. The results show that the VC Dollars/Assets coefficient differs very little across firm size groupings It is slightly larger for medium and small firms, and the t-statistic is slightly larger as well, but the effect remains even for the largest firms.

Finally, are the results present across different stages of funding? This study uses total VC funding dollars, but VentureXpert allows us to break funding down by stage. Across the three stages of venture capital financing (Early Stage, Expansion, and Late Stage), the coefficients on lagged VC Dollars/Assets are negative and statistically significant (with t-statistics between -2.77 and -3.15).

C. Top Fama-French industry 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 in terms of venture capital funding. These five industries 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 5. All the coefficients on VC funding/industry assets are negative and significant.[8]

[8] 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.

D. Financial Constraints and Competition

We have hypothesized that the effect of *VC Dollars/Assets* is due to the increased competition that new capital bring to the industry. To test some implications of the competition story, we find measures of a publicly traded firm's ability to compete against new entrants. A good measure of a firm's flexibility and ability to compete is financial constraints. We use payout yield as a measure of disposable resources that the firm may have, and three measures of financial constraints detailed by Hahn and Lee (2009). These are the log of total assets, long term credit rating, and short term credit rating.

In theory, a firm with deep pockets will be able to invest in new technologies or survive increased competition or an economic downturn against new firms. Thus, if our hypothesis is correct, the interaction terms between *VC Dollars/Assets* and both *Payout Yield* and *Log Assets* will be positive. This means that larger firms and firms with higher payout yields will see less of a stock price decrease due to new *VC Dollars/Assets*. Also, if we construct measures that are positively related to credit rating, the interaction terms between *VC Dollars/Assets* and both *Long Term Credit Rating* and *Short Term Credit Rating* will also be positive. The interaction between *VC Dollars/Assets* and the *Herfindahl* index will allow us to examine if performance differs on the basis of industry concentration.

We construct the *Log Assets* using the log of annual Compustat item 6. Compustat also provides long and short term credit ratings, under data items 280 and 283, respectively. The variable is missing when the firm has no credit rating. Following Hahn and Lee (2009), we construct a variable that is increasing in credit quality. We define

Long Term Credit Rating as 1 if the firm has a credit rating in a given year and zero if there is no rating but there is positive long-term debt (data item 9).

Again as in Hahn and Lee (2009), we define *Short Term Credit Rating* as 1 when there is a rating and zero for no rating but there is positive short-term debt (data item 44). Thus, our credit rating variable will be positively related to credit worthiness. The time period for the credit rating variables is 1985-2005 due to the paucity of variable availability from Compustat prior to 1985.

The results of regressions including the four measures of financial constraints and the interaction terms with *VC Dollars/Assets* appear in Table 6. Column 1 is the original regression from column 4 of Table 3, with all of the prior control variables. The specification in column 2 adds the interaction term with *Payout Yield*. As predicted, this interaction term is positive and significant, meaning that firms with higher payouts (i.e., dividends and share repurchases) have higher quarterly returns to *VC Dollars/Assets*.

Column 3 adds *Log(Assets)* and its interaction term with *VC Dollars/Assets*. The interaction term has a positive and significant coefficient, so larger firms have less of a negative response to VC funding, as our hypothesis predicts.

Column 4 of Table 6 adds *LT Credit Rating* and its interaction with *VC Dollars/Assets*. Again, the coefficient is positive and statistically significant, meaning that higher rated firms are better able to withstand the entrance of new VC money. The coefficient on *VC Dollars/Assets* is -3.51 while it is 2.72 on the interaction of *VC Dollars/Assets* and *LT Credit Rating*. Thus, a change in the long term credit rating from zero (constrained) to one (not constrained) results in a substantial reduction of the VC investment effect.

Column 5 adds *ST Credit Rating* and its interaction with *VC Dollars/Assets*, and reports a positive coefficient which is not significant at conventional levels. Note that the sample size drops in columns 4 and 5 due to sparse Compustat availability for the credit rating variables before 1985.

Although the Herfindahl index does not seem to have much impact in our study thus far, our competition story implies that the most competitive industries may have the most to lose when a new entrant appears. In these industries, firms are already struggling to survive and may be forced out of business by new VC funded firms. Thus, we can examine whether the Herfindahl index, a measure of industry concentration, multiplied by VC Dollars/Assets, positively affects stock returns.

In column 6 of Table 6, we find that it does. The coefficient on *Herfindahl * VC Dollars/Assets* is positive and significant. This is consistent with the Hoberg and Phillips (2008) finding that firms in competitive industries have lower abnormal stock performance following public investment and new financing. Notice the coefficient on the *Herfindahl * VC Dollars/Assets* variable is 4.61 compared to -4.05 on *VC Dollars/Assets*. Hence, a change in industry Herfindahl from zero to one is associated with negating the VC investment effect.

The results from Table 6 show that not all firms are equally affected by the VC money. Financially constrained firms as proxied by payout yield, total assets, and long term credit rating availability have lower returns the higher is the VC investments in their industry. Also, firms in concentrated industries appear better to withstand increased VC competition.

E. Firm level operating performance

To determine why there is a negative relation between VC funding and stock returns, we examine the subsequent operating performance of industry firms. 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); stock market liberalization (Mitton, 2006); and prior to a takeover (Agrawal and Jaffe, 2003). 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 stock returns.

If firm stock returns are indeed lower with higher levels of VC investments due to increased competition, one might expect to see a firm suffer worse operating results in the future. That is, poor stock returns and poor operating performance should be expected to go hand-in-hand. We also want to examine whether the operating performance of financially constrained firms suffer more with increased VC funding into an industry.

In Table 7, we examine this relation using annual accounting data. Each year, for each stock, during the 1981-2005 time period, we run the fixed-effect regression:

$$ROA_{i,t} = a_0 + a_1 VC\ Dollars/Assets_{i,t-1} + a_2 ROA_{i,t-1} + a_3 Payout\ Yield_{i,t-1} + a_4 Asset\ Growth_{i,t-1} + a_5 Public\ Firm\ Financing_{i,t-1} + a_6 Herfindahl_{i,t-1} + a_7 Log(Book/Market)_{i,t-1} + a_8 Log(N^{IPOs}+1)_{i,t-1} + a_9 Prior\ Year\ Return_{i,t-1} + Industry\ Dummies + Year\ Dummies.$$

The dependent variable is the firm's return on assets, defined as the operating income (Compustat item 13) scaled by total assets (Compustat item 6). We use operating income as our measure of performance in the numerator because Barber and Lyon (1996) report that it is "a cleaner measure than earnings of the productivity of operating assets" and it is unaffected by interest expense.[9] The independent variables are all available to the public at least six months before the beginning of each year. We use lagged ROA in addition to all of the same explanatory variables as in Table 3. The errors are clustered by firm and year.

Across all the regressions in Table 7, lagged *VC Dollars/Assets* is negative and statistically significant. Hence, higher levels of VC dollars relative to the size of the industry are negatively related to subsequent firm ROA. Column 5 of Table 7 reports that *VC Dollars/Assets, ROA, Payout Yield, Asset Growth, Public Firm Financing, Log(book-to-market),* and *Prior Year Return* are all significantly related to next year's ROA.

The negative and highly significant coefficients on *Public Firm Financing* are consistent with the operating performance evidence of Hoberg and Phillips (2008). Of the independent variables, the lagged ROA value has the highest explanatory power. When lagged ROA is included in the regression, the R^2 values are over 60%.

Table 8 examines if financial constraints have an effect on how firms respond to VC funding in their industry. As is evident, across all of the columns, *VC Dollars/Assets* is still always significant in predicting ROA. The interaction terms with the three measures of financial constraints: *Log Assets, LT Credit Rating,* and *ST Credit Rating* are also positive and significant. The interaction between Payout Yield and VC Dollars/Assets is not significant.

Thus, less financially constrained firms have higher ROAs in the year following larger VC investment. Also, firms that are in high-*Herfindahl* (concentrated) 3-digit SIC code industries have operating performance that is less affected by increased VC spending. These results generally mirror the results of Table 6 with stock returns. They

[9] Using net income (Compustat annual item 18) in the numerator instead does not change our results.

show that the lower stock returns are justified and show up in operating performance in the subsequent year.

The operating performance results are also economically significant. If we use the first coefficient on VC Dollars/Assets in Table 8, -0.56, we find that a one standard deviation change in annual VC Dollars/Assets is associated with a 0.87% * -0.56 = 0.50% change in ROA. This represents almost 5 percent of the mean ROA, 10.48%.

This industry operating performance evidence is consistent with our findings for stock returns. All else equal, higher levels of VC investments subsequently lead to poorer stock returns as well as worse subsequent operating performance in the industry. Financially constrained firms and companies in competitive industries suffer greater declines in subsequent ROA. 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.

V. 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? We find that the effect on subsequent returns and operating performance is negative, which is consistent with the hypothesis that VC investment brings significant competition to the industry.

Similar to Cooper, Gulen, and Schill (2008), who find 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 firm stock returns. Our results are also consistent with the industry boom and bust analysis of Hoberg and Phillips (2008) which focuses on the role of public investments. Our new twist is in highlighting the importance of private capital on subsequent industry performance.

Analysis of annual data indicates that higher VC investment is also related to poorer subsequent operating performance for firms in a 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.

Not all firms are equally affected by the increased competition brought on by the VC dollars. Using four proxies for financial constraint (payout yield, total assets, long-term credit rating, and short-term credit rating), we find that financially constrained firms generally have lower subsequent stock returns and operating performance than non-financially constrained firms in the same industry. Access to credit markets and the resources to withstand increased competition brought on by venture capital dollars appears to play an important role in firm performance. We also find that firms in competitive industries are hurt more when the venture capitalists invest in their industries.

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. On the other hand, billions of dollars in wealth have been created by the innovations of venture capitalist-funded firms. A promising avenue of future research would investigate whether this creative destruction is efficient from a social planner's point of view.

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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

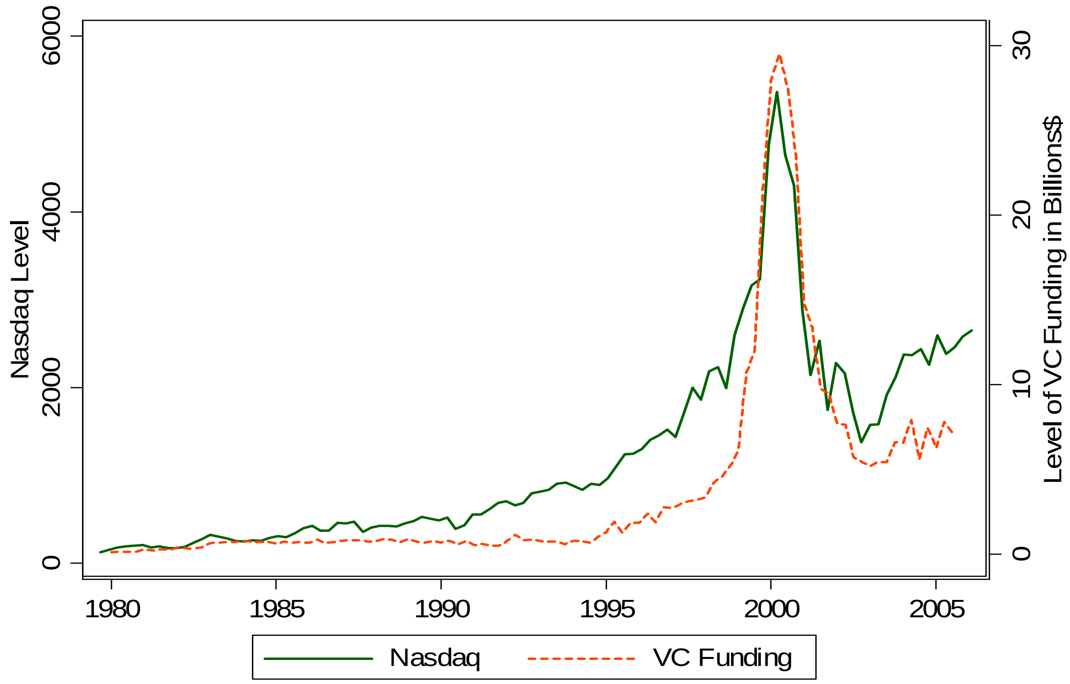

Figure 2. Quarterly Level of Nasdaq and Venture Capital Investments Scaled by Industry Total Assets, 1980-2005

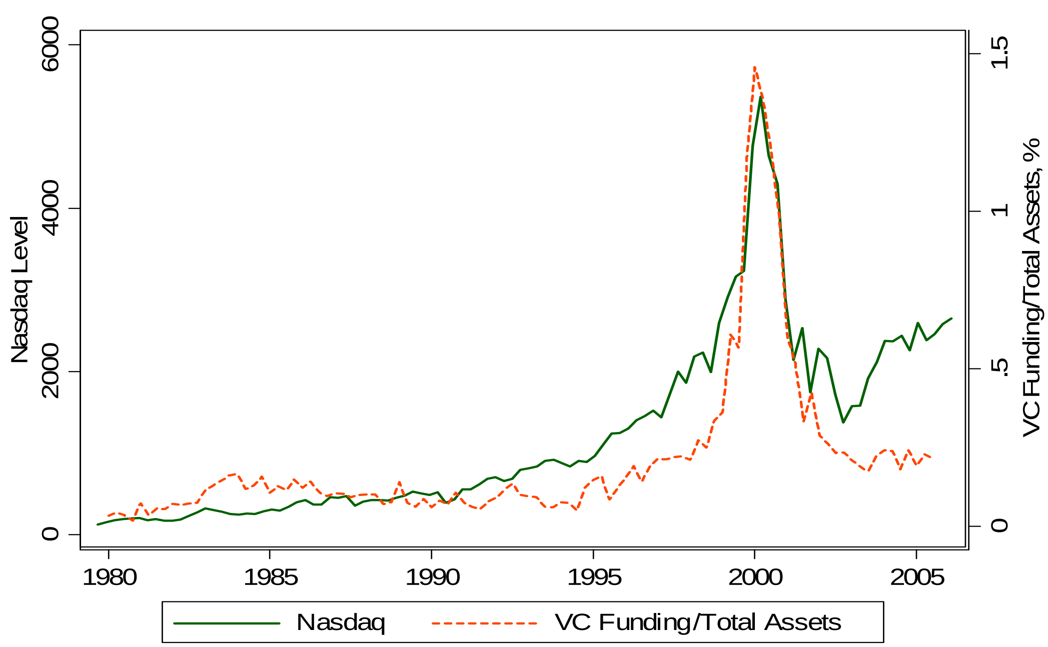

Figure 3. Venture Capital Investments as a Percent of Total Funding for the Five Most-Funded Industries, 1980-2005

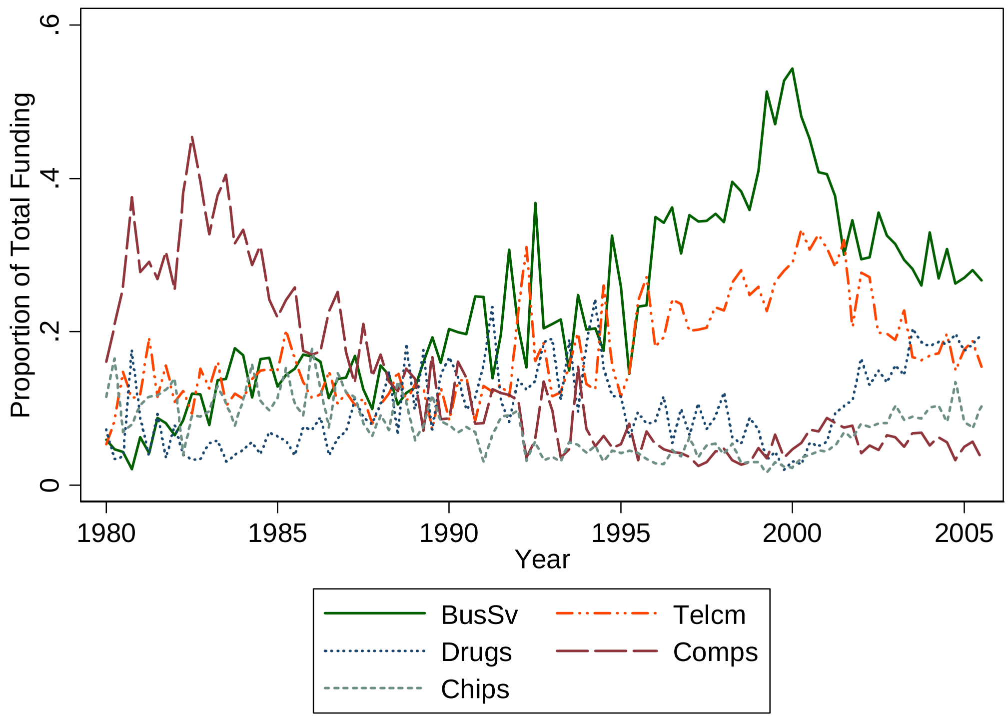

Table 1
Aggregate Venture Capital Investments Categorized by Fama and French Industries, 1980-2005

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
1	Agric	1.7	0.4%	699
2	Food	2.2	0.6%	674
3	Soda	0.1	0.0%	63
4	Beer	0.2	0.0%	69
7	Fun	3.3	0.8%	818
8	Books	0.4	0.1%	233
9	Hshld	1.7	0.4%	636
10	Clths	0.4	0.1%	259
11	Hlth	6.2	1.6%	1,600
12	MedEq	14.9	3.8%	3,553
13	Drugs	36.1	9.2%	6,248
14	Chems	1.3	0.3%	477
17	BldMt	2.0	0.5%	812
18	Cnstr	0.8	0.2%	360
21	Mach	3.7	0.9%	1,965
22	ElcEq	0.8	0.2%	195
28	Mines	0.5	0.1%	31
29	Coal	0.1	0.0%	28
30	Oil	1.6	0.4%	334
31	Util	1.5	0.4%	398
32	Telcm	96.2	24.4%	11,926
33	PerSv	0.7	0.2%	188
34	BusSv	147.0	37.3%	26,993
35	Comps	26.2	6.6%	5,556
36	Chips	22.3	5.7%	4,393
37	LabEq	5.4	1.4%	1,236
38	Paper	0.6	0.2%	209
39	Boxes	3.8	1.0%	888
42	Rtail	3.2	0.8%	840
43	Meals	2.0	0.5%	525
44	Banks	3.1	0.8%	581
45	Insur	1.0	0.2%	148
46	RlEst	0.6	0.2%	183
47	Fin	2.3	0.6%	228
Total		394.2	100.0%	73,346

Table 2
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 lagged aggregate quarterly VC investments, divided by total assets (Compustat item 6) within a particular Fama-French industry. *Prior Year Return* is the last 12 month return of the firm. *Payout Yield* is dividends plus repurchases divided by share price, (Compustat items [26 + (115/54)] / Price. *Asset Growth* is the lagged annual change in assets (Compustat annual item 6). *Public Firm Financing* is Compustat items (108-115+111-114)/6 less industry mean. The *Herfindahl* index is computed by dividing the sum of the squares of the sales (Compustat item 12) in each 3-digit SIC code industry by the squared total sales of that industry. *Log(Book/Market)* is the lagged firm-level natural log of the book-to-market ratio. *LagNIPOs* is the lagged log of the number of IPOs in that quarter in that industry, plus one. *LT Credit Rating* is 1 if the S&P Long Term Domestic Issuer Credit Rating from Compustat exists, and 0 if there is positive long-term debt (Compustat item 9) and no rating. *ST Credit Rating* is 1 if S&P Short Term Domestic Issuer Credit Rating exists, and 0 if there is no rating but there is positive short-term debt (Compustat item 44). *Return on Assets* is operating income (Compustat item 13) divided by total assets (Compustat item 6). There are 103 quarters in the analysis.

	Mean	Median	St. Deviation	Min	Max
Quarterly VC Dollars/Assets	0.09%	0.01%	0.26%	0.00%	5.30%
Annual VC Dollars/Assets	0.35%	0.03%	0.87%	0.00%	9.66%
Early Stage VC Dollars/Assets	0.03%	0.00%	0.08%	0.00%	2.17%
Mid Stage VC Dollars/Assets	0.04%	0.00%	0.15%	0.00%	3.14%
Late Stage VC Dollars/Assets	0.02%	0.00%	0.05%	0.00%	3.19%
Quarterly return	3.04%	2.28%	20.96%	-91.05%	201.89%
Prior Year Return	24.63%	13.55%	57.67%	-85.26%	311.90%
Payout Yield	2.94%	1.63%	3.87%	0.00%	19.32%
Asset Growth	16.32%	8.67%	33.46%	-46.27%	217.03%
Public Firm Financing	5.13%	-0.32%	23.61%	-28.09%	151.87%
Herfindahl	0.27	0.21	0.21	0	1
Log(Book/Market)	-0.65	-0.56	0.82	-6.91	2.70
Lag log(NIPOs+1)	0.67	0.69	0.78	0	4.33
Log(Assets)	5.90	5.77	2.04	-0.39	14.05
LT Credit rating	0.23	0	0.42	0	1
ST Credit rating	0.10	0	0.30	0	1
Return on Assets	10.48%	12.35%	14.62%	-69.22%	38.75%

Table 3
Stock return regressions, 1980-2005

The regression dependent variable is the firm quarterly return. *VC Dollars/Assets* are the lagged aggregate quarterly VC investments, divided by total assets (Compustat item 6) within a particular Fama-French industry. *Payout Yield* is dividends plus repurchases divided by share price, (Compustat items [26 + (115/54)] / Price. *Asset Growth* is the lagged annual change in assets (Compustat item 6). *Public Firm Financing* is Compustat items (108-115+111-114)/6 less industry mean. The *Herfindahl* index is computed by dividing the sum of the squares of the sales (Compustat annual item #12) in each 3-digit SIC code industry by the squared total sales of that industry. *Book/Market* is the lagged firm-level book-to-market ratio. *LagNIPOs* is the lagged log of the number of IPOs in that quarter in that industry, plus one. *Prior Year Return* is the last 12 month return of the firm. All Compustat data are public at least 6 months before the quarter begins. T-statistics are in parentheses. Errors are clustered by firm and by quarter.

$$Return_{i,t} = a_0 + a_1 VC\ Dollars/Assets_{i,t-1} + a_2 Payout\ Yield_{i,t-1} + a_3 Asset\ Growth_{i,t-1} + a_4 Public\ Firm\ Financing_{i,t-1} + a_5 Herfindahl_{i,t-1} + a_6 Log(Book/Market)_{i,t-1} + a_7 Log(N^{IPOs}+1)_{i,t-1} + a_8 Prior\ Year\ Return_{i,t-1} + Industry\ Dummies + Quarter\ Dummies + e_{i,t}$$

	(1)	(2)	(3)	(4)	(5)
VC Dollars/Assets	-4.42	-3.32		-3.17	-2.81
	(-3.35)	(-3.24)		(-3.22)	(-2.24)
LagVCDollars/Assets					-0.24
					(-0.17)
Lag2VCDollars/Assets					-0.37
					(-0.26)
Lag3VCDollars/Assets					-0.68
					(-0.80)
Payout Yield			0.11	0.11	0.11
			(3.86)	(3.84)	(4.36)
Asset Growth			-0.02	-0.02	-0.02
			(-5.30)	(-5.30)	(-5.02)
Public Firm Financing			0.01	0.01	0.01
			(0.84)	(0.88)	(1.02)
Herfindahl			0.00	-0.00	-0.00
			(0.21)	(-0.03)	(-0.16)
Log(Book/Market)			0.01	0.01	0.01
			(3.61)	(3.60)	(3.46)
LagNIPOs			-0.00	-0.00	-0.00
			(-1.37)	(-1.23)	(-1.35)
Prior Year Return			0.01	0.01	0.01
			(1.42)	(1.46)	(1.17)
N (firm-quarters)	204,771	204,771	204,771	204,771	185,704
Number of firms	6,892	6,892	6,892	6,892	6,547
Quarter and Industry Dummies	No	Yes	Yes	Yes	Yes
R^2	0.00	0.20	0.21	0.21	0.20

Table 4
Robustness – Subsets of the Data

The regression dependent variable is the firm quarterly return. *VC Dollars/Assets* are the lagged aggregate quarterly VC investments, divided by total assets (Compustat item 6) within a particular Fama-French industry. *Payout Yield* is dividends plus repurchases divided by share price, (Compustat items [26 + (115/54)] / Price. *Asset Growth* is the lagged annual change in assets (Compustat annual item 6). *Public Firm Financing* is Compustat items (108-115+111-114)/6 less industry mean. The *Herfindahl* index is computed by dividing the sum of the squares of the sales (Compustat annual item #12) in each 3-digit SIC code industry by the squared total sales of that industry. *Book/Market* is the lagged firm-level book-to-market ratio. *LagNIPOs* is the lagged log of the number of IPOs in that quarter in that industry, plus one. *Prior Year Return* is the last 12 month return of the firm. All Compustat data are public at least 6 months before the quarter begins. T-statistics are in parentheses. Errors are clustered by firm and by quarter. The bubble period is years 1998-2000. The non-bubble period is years 1980-1997 and 2001-2005. On a yearly basis, sample firms are placed into total asset size terciles. All eight regressions include quarter and industry dummy variables.

$$Return_{i,t} = a_0 + a_1 VC\ Dollars/Assets_{i,t-1} + a_2 Payout\ Yield_{i,t-1} + a_3 Asset\ Growth_{i,t-1} + a_4 Public\ Firm\ Financing_{i,t-1} + a_5 Herfindahl_{i,t-1} + a_6 Log(Book/Market)_{i,t-1} + a_7 Log(N^{IPOs}+1)_{i,t-1} + a_8 Prior\ Year\ Return_{i,t-1} + Industry\ Dummies + Quarter\ Dummies + e_{i,t}$$

	Bubble (1)	Non-Bubble (2)	Small (3)	Medium (4)	Large (5)	Early Stage (6)	Expansion (7)	Late Stage (8)
VC Dollars/Assets	-4.47	-4.07	-3.55	-2.25	-2.05	-9.84	-4.78	-13.76
	(-2.63)	(-2.50)	(-3.20)	(-2.69)	(-2.22)	(-3.15)	(-2.77)	(-2.78)
Payout Yield	0.15	0.10	0.11	0.12	0.08	0.11	0.11	0.11
	(2.36)	(3.35)	(2.70)	(3.61)	(2.72)	(3.82)	(3.84)	(3.88)
Asset Growth	-0.03	-0.02	-0.02	-0.02	-0.01	-0.02	-0.02	-0.02
	(-2.28)	(-5.41)	(-5.05)	(-4.28)	(-2.92)	(-5.28)	(-5.30)	(-5.31)
Public Firm Financing	-0.01	0.01	0.01	0.02	0.00	0.01	0.01	0.01
	(-0.23)	(1.55)	(2.08)	(2.53)	(0.19)	(0.86)	(0.88)	(0.89)
Herfindahl	-0.01	0.00	0.00	-0.00	0.00	0.00	0.00	-0.00
	(-0.43)	(0.21)	(0.54)	(-0.42)	(0.41)	(0.09)	(0.01)	(-0.10)
Log(Book/Market)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	(1.07)	(3.63)	(5.39)	(1.74)	(2.45)	(3.60)	(3.61)	(3.65)
LagNIPOs	-0.02	-0.00	-0.00	-0.00	0.00	-0.00	-0.00	-0.00
	(-1.84)	(-0.51)	(-1.58)	(-1.23)	(0.65)	(-1.27)	(-1.25)	(-1.27)
Prior Year Return	-0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.01
	(-0.88)	(3.09)	(1.37)	(2.67)	(1.60)	(1.45)	(1.46)	(1.44)
N (firm-quarters)	23,488	181,283	67,539	69,552	67,680	204,771	204,771	204,771
Number of firms	3,020	6,693	4,056	3,167	1,890	6,892	6,890	6,890
R^2	0.16	0.22	0.20	0.23	0.25	0.21	0.21	0.21

Table 5
OLS regression results by top Fama-French industries

The regression dependent variable is the firm quarterly return. *VC Dollars/Assets* are the lagged aggregate quarterly VC investments, divided by total assets (Compustat annual item 6) within a particular Fama-French industry. *Payout Yield* is dividends plus repurchases divided by share price, (Compustat items [26 + (115/54)] / Price. *Asset Growth* is the lagged annual change in assets (Compustat annual item 6). *Public Firm Financing* is Compustat items (108-115+111-114)/6 less industry mean. The *Herfindahl* index is computed by dividing the sum of the squares of the sales (Compustat annual item 12) in each 3-digit SIC code industry by the squared total sales of that industry. *Book/Market* is the lagged firm-level book-to-market ratio. *LagNIPOs* is the lagged log of the number of IPOs in that quarter in that industry, plus one. *Prior Year Return* is the last 12 month return of the firm. All Compustat data are public at least 6 months before the quarter begins. T-statistics are in parentheses. Errors are clustered by firm and by quarter.

$$Return_{i,t} = a_0 + a_1 VC\ Dollars/Assets_{i,t-1} + a_2 Payout\ Yield_{i,t-1} + a_3 Asset\ Growth_{i,t-1} + a_4 Public\ Firm\ Financing_{i,t-1} + a_5 Herfindahl_{i,t-1} + a_6 Log(Book/Market)_{i,t-1} + a_7 Log(N^{IPOs}+1)_{i,t-1} + a_8 Prior\ Year\ Return_{i,t-1} + e_{i,t}$$

	BusSv	Telcm	Drugs	Comps	Chips
VC Dollars/Assets	-4.11	-16.20	-36.50	-25.01	-54.78
	(-3.35)	(-3.21)	(-3.30)	(-2.51)	(-3.35)
Payout Yield	0.16	0.20	0.30	0.09	0.11
	(2.63)	(1.45)	(1.83)	(0.79)	(1.02)
Asset Growth	-0.02	-0.02	-0.03	-0.01	-0.03
	(-2.51)	(-2.05)	(-3.21)	(-0.75)	(-1.67)
Public Firm Financing	0.01	0.04	0.03	0.01	0.04
	(0.94)	(2.47)	(2.03)	(0.77)	(2.47)
Herfindahl	0.02	-0.01	1.03	-0.04	-0.02
	(1.05)	(-0.35)	(1.75)	(-0.26)	(-0.70)
Log(Book/Market)	0.01	-0.00	0.01	0.01	0.01
	(1.73)	(-0.14)	(1.94)	(1.16)	(1.51)
LagNIPOs	-0.01	-0.06	-0.03	-0.02	-0.02
	(-0.74)	(-2.89)	(-2.21)	(-2.05)	(-1.00)
Prior Year Return	-0.01	0.00	-0.00	0.00	-0.01
	(-1.10)	(0.17)	(-0.28)	(0.50)	(-0.73)
Constant	0.07	0.09	0.05	0.11	0.13
	(3.57)	(4.19)	(1.10)	(2.43)	(3.54)
N (firm-quarters)	16,564	3,445	5,916	6,231	10,585
Number of firms	916	204	303	292	429
R^2	0.02	0.05	0.04	0.03	0.03

Table 6

Tests of financial constraints and competition

The dependent variable is quarterly firm returns. *VC Dollars/Assets* are the lagged aggregate quarterly VC investments, divided by total assets (Compustat item 6) within a particular Fama-French industry. *Payout Yield* is dividends plus repurchases divided by share price, (Compustat items [26 + (115/54)] / Price. *Asset Growth* is the lagged annual change in assets (Compustat annual item 6). *Public Firm Financing* is Compustat items (108-115+111-114)/6 less industry mean. *Book/Market* is the lagged firm-level book-to-market ratio. *LagNIPOs* is the lagged log of the number of IPOs in that quarter in that industry, plus one. *LT Credit Rating* is 1 if the S&P Long Term Domestic Issuer Credit Rating from Compustat exists, and 0 if there is no rating but there is positive long-term debt (Compustat item 9). *ST Credit Rating* is 1 if *Issuer Credit Rating* exists, and 0 if there is no rating but there is short-term debt (Compustat annual item 44). Columns 4 and 5 use the 1985-2005 time period. The *Herfindahl* index is computed by dividing the sum of the squares of the sales (Compustat item 12) in each 3-digit SIC code industry by the squared total sales of that industry. *Prior Year Return* is the last 12 month return of the firm.

	(1)	(2)	(3)	(4)	(5)	(6)
VC Dollars/Assets	-3.17	-3.62	-9.35	-3.51	-3.11	-4.05
	(-3.22)	(-3.12)	(-3.47)	(-3.44)	(-3.06)	(-3.06)
Log(Assets)			0.001			
			(1.92)			
*Log(Assets)*VC Dollars/Assets*			1.13			
			(3.22)			
LT Credit rating				0.001		
				(0.59)		
*LT Credit rating*VCDollars/Assets*				2.72		
				(3.20)		
ST Credit rating					0.002	
					(0.54)	
*ST Credit rating*VCDollars/Assets*					1.94	
					(1.55)	
Payout Yield	0.11	0.10	0.09	0.10	0.10	0.11
	(3.84)	(3.29)	(3.36)	(4.25)	(4.26)	(3.83)
*Payout Yield*VCDollars/Assets*		19.23				
		(2.01)				
Asset Growth	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
	(-5.30)	(-5.30)	(-5.39)	(-5.72)	(-5.47)	(-5.30)
Public Firm Financing	0.01	0.01	0.01	0.01	0.01	0.01
	(0.88)	(0.94)	(1.59)	(0.81)	(0.82)	(0.87)
Herfindahl	-0.00	-0.00	0.00	-0.00	-0.00	-0.00
	(-0.03)	(-0.08)	(0.08)	(-0.71)	(-0.81)	(-0.96)
*Herfindahl*VCDollars/Assets*						4.61
						(2.13)
Log(Book/Market)	0.01	0.01	0.01	0.01	0.01	0.01
	(3.60)	(3.60)	(3.67)	(2.92)	(2.90)	(3.59)
LagNIPOs	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	(-1.23)	(-1.23)	(-1.20)	(-0.92)	(-0.74)	(-1.23)
Prior Year Return	0.01	0.01	0.01	0.01	0.01	0.01
	(1.46)	(1.48)	(1.74)	(1.68)	(1.49)	(1.48)
N (firm-quarters)	204,771	204,771	204,771	143,044	133,218	204,771
Number of firms	6,892	6,892	6,892	5,563	5,381	6,892
Quarter and Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.21	0.21	0.21	0.20	0.19	0.21

Table 7
Annual regressions of firm-level return on assets, 1981-2005

Return on assets (ROA) is the dependent variable in annual regressions. ROA is defined operating income divided by total assets (Compustat item 13/ item 6). *VC Dollars/Assets* are the lagged aggregate quarterly VC investments, divided by total assets (Compustat annual item 6) within a particular Fama-French industry. *Payout Yield* is dividends plus repurchases divided by share price, (Compustat items [26 + (115/54)] / Price. *Asset Growth* is the firm's lagged annual change in assets (Compustat item 6). *Public Firm Financing* is Compustat items (108-115+111-114)/6. The *Herfindahl* index is computed by dividing the sum of the squares of the sales (Compustat annual item 12) in each 3-digit SIC code industry by the squared total sales of that industry. *Book/Market* is the lagged firm-level book-to-market ratio. *LagNIPOs* is the lagged log of the number of IPOs in that quarter in that industry, plus one. *Prior Year Return* is the last 12 month return of the firm. Errors are clustered by firm and year. T-statistics are in parentheses.

$$ROA_{i,t} = a_0 + a_1 VC\ Dollars/Assets_{i,t-1} + a_2 ROA_{i,t-1} + a_3 Payout\ Yield_{i,t-1} + a_4 Asset\ Growth_{i,t-1} + a_5 Public\ Firm\ Financing_{i,t-1} + a_6 Herfindahl_{i,t-1} + a_7 Log(Book/Market)_{i,t-1} + a_8 Log(N^{IPOs}+1)_{i,t-1} + a_9 Prior\ Year\ Return_{i,t-1} + Industry\ Dummies + Year\ Dummies + e_{i,t}$$

	(1)	(2)	(3)	(4)	(5)
VC Dollars/Assets	-1.72	-0.64	-0.56	-0.92	-0.44
	(-3.73)	(-9.91)	(-9.34)	(-3.65)	(-5.37)
Lag 1 yr VC Dollars/Assets				-0.07	-0.12
				(-0.75)	(-1.51)
Last year's ROA		0.77	0.75		0.75
		(69.76)	(73.20)		(73.04)
Payout Yield			-0.03	0.21	-0.03
			(-2.10)	(8.04)	(-2.08)
Asset Growth			-0.02	0.03	-0.01
			(-7.21)	(3.91)	(-5.04)
Public Firm Financing			-0.05	-0.17	-0.05
			(-14.03)	(-12.49)	(-14.00)
Herfindahl			0.00	0.01	0.00
			(0.69)	(1.93)	(0.68)
Log(Book/Market)			-0.01	-0.01	-0.01
			(-12.26)	(-9.97)	(-12.19)
LagNIPOs			-0.00	-0.00	-0.00
			(-1.84)	(-0.45)	(-1.84)
Prior Year Return			0.04	0.04	0.04
			(13.25)	(5.01)	(13.26)
N (firm-years)	57,810	57,810	57,810	57,540	57,540
Number of firms	6,767	6,767	6,767	6,755	6,755
Year and Industry Dummies	No	Yes	Yes	Yes	Yes
R^2	0.01	0.62	0.65	0.20	0.65

Table 8
VC Funding, ROA, and Financial Constraints

Return on assets (ROA) is the dependent variable in annual regressions. ROA is defined operating income divided by total assets (Compustat item 13/ item 6). *VC Dollars/Assets* are the lagged aggregate quarterly VC investments, divided by total assets (Compustat item 6) within a particular Fama-French industry. *Payout Yield* is dividends plus repurchases divided by share price, (Compustat items [26 + (115/54)] / Price. *Prior Year Return* is the last 12 month return of the firm. *Asset Growth* is the lagged annual change in assets (Compustat Data6). *Public Firm Financing* is Compustat items (108-115+111-114)/6 less industry mean. The *Herfindahl* index is computed by dividing the sum of the squares of the sales (Compustat annual item 12) in each 3-digit SIC code industry by the squared total sales of that industry. *Book/Market* is the lagged firm-level book-to-market ratio. *LagNIPOs* is the lagged log of the number of IPOs in that quarter in that industry, plus one. *LT Credit Rating* is 1 if the S&P Long Term Domestic Issuer Credit Rating from Compustat exists, and 0 if there is no rating but there is positive long-term debt (Compustat item 9). *ST Credit Rating* is 1 if *Issuer Credit Rating* exists, and 0 if there is no rating but there is short-term debt (Compustat annual item 44). Columns 4 and 5 use the 1985-2005 time period. Errors are clustered by firm and year. T-statistics are in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)
VC Dollars/Assets	-0.56 (-9.34)	-0.51 (-3.90)	-1.56 (-10.21)	-0.41 (-6.77)	-0.34 (-4.65)	-0.84 (-11.92)
Last year's ROA	0.75 (73.20)	0.75 (72.76)	0.73 (68.81)	0.75 (54.81)	0.74 (60.30)	0.75 (73.45)
Log Assets			0.003 (10.95)			
*Log Assets*VC Dollars/Assets*			0.19 (7.65)			
LT Credit rating				0.01 (5.27)		
*LT Credit rating*VCDollars/Assets*				0.49 (3.48)		
ST Credit rating					0.01 (7.06)	
*ST Credit rating*VCDollars/Assets*					0.79 (3.07)	
Payout Yield	-0.03 (-2.10)	-0.02 (-2.22)	-0.06 (-4.73)	-0.04 (-2.83)	-0.04 (-3.00)	-0.03 (-2.13)
*Payout Yield*VCDollars/Assets*		-1.62 (-0.46)				
Asset Growth	-0.02 (-7.21)	-0.02 (-7.30)	-0.01 (-5.71)	-0.01 (-4.37)	-0.01 (-4.65)	-0.01 (-4.97)
Public Firm Financing	-0.05 (-14.03)	-0.05 (-14.12)	-0.05 (-13.55)	-0.05 (-11.28)		
Herfindahl	0.00 (0.69)	0.00 (0.70)	0.00 (1.31)	0.00 (1.32)	0.00 (0.90)	-0.00 (-1.02)
*Herfindahl*VCDollars/Assets*						1.42 (6.24)
Log(Book/Market)	-0.01 (-12.26)	-0.01 (-12.22)	-0.01 (-12.49)	-0.01 (-8.78)	-0.01 (-9.03)	-0.01 (-12.34)
LagNIPOs	-0.00 (-1.84)	-0.00 (-1.84)	-0.00 (-1.88)	-0.00 (-2.38)	-0.00 (-2.43)	-0.00 (-1.90)
Prior Year Return	0.04 (13.25)	0.04 (13.26)	0.04 (13.73)	0.04 (11.68)	0.04 (11.92)	0.04 (13.36)
N (firm-years)	57,810	57,810	57,810	41,496	39,005	57,810
Number of firms	6,767	6,767	6,767	5,561	5,420	6,767
Year and Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.65	0.65	0.66	0.64	0.64	0.67