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Venture Capital and the Performance of Incumbents

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Abstract

I study the effect of investment in young, private firms by venture capitalists (VC) on public firms in the same industry. I construct an instrument for VC investment that relies on individual VC's investment histories, holdings of equity stakes in IPO firms, and aggregate market returns immediately following those IPOs. I find that increased VC investment has a large effect on incumbent profitability. The effect arises due to higher costs and not depressed sales. The effect is short lived as firms respond by reallocating resources away from treated markets and by reducing their use of labor.

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What effect does venture capital (VC) investment have on incumbent firms? VCs have financed several of the largest companies in the United States - including Amazon, Apple, Facebook, and Google - and the success of these firms has led directly to the decline of previous industry leaders. More broadly, VC-backed firms grow and innovate at much higher rates than other firms; while Puri and Zarutskie (2012) find that only 0.13% of firms founded between 1991 and 2005 ever received VC investment, VC-backed firms accounted for 35% of IPOs, 8% of granted patents, and received 14% of patent citations between 1991 and 2007. This strong growth suggests that VC investment may create important competition for established firms.

At the same time, the nature of the industry - investing in young firms with little to no revenue - means that VC investment typically results not in industry leaders but instead in failed firms. For instance, VCs invested approximately $100 billion in firms in 2000 but only 6% of those firms grew large enough to go public. Moreover, 43% of firms that first received a VC investment between 1998 and 2000 failed by 2005 (Puri and Zarutskie 2012). The frequent failure of these firms suggests that VC investment might have little effect on incumbents.

In this paper, I study the effect of VC investment on the profitability of public incumbent firms. Estimating this effect is complicated by the fact that the econometrician does not observe the true set of investment opportunities but VCs and firms do. When there is a positive shock to investment opportunities, the expected future performance of incumbent firms is strong. At the same time, VCs respond with increased investment in new, high-growth firms. Therefore, both incumbent performance and VC investment are correlated with unobservable investment opportunities, a correlation which leads to a biased ordinary least squares (OLS) estimate of the effects of VC investment.

To estimate the effect, I create an instrument for VC investment based on the value of the VC's stake in firms at the time of the IPO and the returns of the aggregate stock market during the 180 days following the IPO. Because lockup agreements forbid VCs from selling equity during this period, the VC's holdings (and therefore the returns to the VC's fund) are exposed to movements in the broader market. As a result, when market returns are high during the lockup period of a given IPO, returns to the VC's fund are higher for reasons beyond its control. These large return shocks enable VCs to raise more money from investors chasing returns.[1]

Moreover, VCs tend to invest in the same industries and MSAs over time.[2] This tendency means that, when a VC raises additional money, they increase investment in the industries and MSAs in which they have prior experience. Therefore, I calculate the instrument, which I refer to as the VC return shock, as the sum of IPO level return shocks for VCs active in the industry and/or MSA.

I find that the VC return shock strongly predicts aggregate VC investment. This relationship is highly significant statistically and economically. The industry level analysis implies that a \$25 million increase in the VC return shock increases VC investment in the industry by approximately \$2.2 million. Similarly, the MSA-industry analysis suggests that a \$5 million increase in VC return shock increases MSA-industry VC investment by \$0.4 million.

For the VC return shock to be a valid instrument, it must affect the performance of incumbents only through its effect on VC investment. In particular, the identifying assumption is that the instrument must be orthogonal to industry and firm investment opportunities. In support of this assumption, I find no relationship between the instrument and several mea-

[1]Previous research documenting persistence in VC-level returns such as Kaplan and Schoar (2005) and Harris et al. (2013) provide evidence that such return-chasing behavior is rational.

[2]VCs play an active role in the firms in which they invest, including assisting in the hiring of new executives (Hellmann and Puri (2002), Kaplan, Sensoy, and Stromberg (2009)). As a result, previous experience and the network that results play an important role in investment performance (Hochberg, Ljungqvist, and Lu (2007)).

sures of investment opportunities, including book to market ratio, previous profitability, changes in profitability, stock market returns, and investment at both the industry and firm levels. The results are also robust to alternative formulations of the instrument that address concerns about the validity of the instrument. Finally, several specifications exploit geographical variation in the instrument across firms within an industry. This geographical variation, which arises not just as a result of firm location but also the distribution of firm resources across locations, allows for a rich set of fixed effects to control for shocks to industry and MSA-industry investment opportunities. In all of these specifications, the results mirror the industry-level analysis. These series of results therefore provide strong support for the identifying assumption.

Using the VC return shock as an instrument, I find a significant effect of VC investment on the performance of public firms. At the industry level, industry profitability, as measured by return on assets, declines by 0.5 percentage points in response to an additional $25 million in VC investment.

One concern with the instrument is that VCs may exploit return predictability in timing IPOs - VCs may take their investments public when expected market returns are higher and the propensity to do so varies with the investment opportunity set. I address this potential violation of the exclusion restriction with two alternative versions of the instrument that minimize the ability of VCs to time the market. First, I generate a time series of expected market returns and construct the instrument using residual market returns. Second, I use an indicator variable equal to one if the VC return shock is positive. In both cases, the results are qualitatively similar to the main results.

There is also a strong effect of VC investment on firm profitability. The estimates imply that an additional $5 million of investment in the MSA-industry reduces the profitability of firms with employment in the MSA by approximately 0.2 percentage points. Moreover, this effect is stronger for firms with a higher proportion of payroll in the MSA; while \$5 million of VC investment in an MSA-industry has no effect on the profitability of a firm with 5% of payroll in the market, it decreases the profitability of a firm with all of its payroll in the market by 0.4 percentage points.

The effects of VC investment on profitability are not due to increased product market competition but rather due to increased costs. In particular, I generally find a positive and insignificant effect of VC investment on sales relative to assets. Instead, operating costs relative to assets experience a positive and significant increase due to VC investment; the estimates imply that a \$25 million increase in industry-level VC investment leads to an approximately 1.8 percentage point increase in industry-level operating costs. At the firm level, an additional \$5 million of VC investment in an MSA-industry in which the firm has five percent of its payroll has no effect on its operating costs while for a firm located only in the market, costs increase by approximately 0.6 percentage points.

The increase in costs appears to be due at least in part to an increase in employee compensation; VC investment has a positive and significant effect on pay per worker. The estimates suggest that \$25 million of VC investment increases industry pay per employee by 0.7%. Similarly, additional \$5 million of MSA-industry VC investment increases compensation by firms in the market by 0.3-0.5%.

Next, I study the long term effects of VC investment. I find that, at both the industry and firm level, the effect on profitability and operating costs decays quickly and disappears within three years.

Survivorship bias does not appear to account for the reversal as VC investment does not lead to an increased probability of delisting. Instead, it appears to be driven by the reallocation of resources by affected firms. I find that MSA-industry VC investment causes firms whose resources are concentrated in the market to reduce the share of payroll in the market. In addition, increased VC investment leads incumbents to substitute away from labor and towards capital in response to the increase in employee compensation.

My work contributes to the literature on the determinants of VC fundraising and investment. Gompers and Lerner (1998a), Jeng and Wells (2000), and Kaplan and Schoar (2005) all document that fundraising is positively related to public market valuations while Gompers, Kovner, Lerner, and Scharfstein (2008) find that the industry-specific investment behavior of VCs is strongly correlated with public market signals of investment opportunities in that industry. I also find that the public market is important for subsequent investment. The mechanism that I exploit differs from these studies as it focuses on aggregate market returns during very specific times and their effects on subsequent investment across industries.

This paper also is closely related to the literature on the real effects of financing events on incumbent firms. In particular, Hsu, Reed, and Rocholl (2010) show that IPOs are associated with stock price declines for industry incumbents, while industry stock prices appreciate following withdrawn IPOs. In addition, they find that the operating performance of incumbents declines following IPOs in their industry. Hsu, Reed, and Rocholl (2012) find similar effects on industry incumbents when looking at private equity investments. While I find negative effects of VC investment on incumbent performance, the effects that I document are temporary and are tied to labor market, rather than product market, competition.

Another contribution this study makes is to the literature on the real effects of asset pricing. Much of this literature has focused on the relationship between valuations and equity issuance and merger activity.[3] The most similar to this paper is Bernstein (2013), who finds that aggregate market returns affect the decision of individual firms to go public, which then leads to changes in innovative activity. Similarly, I document the effect of aggre-

[3]For instance, Loughran, Ritter, and Rydqvist (1994) and Pagano, Panetta, and Zingales (1998), document the relationship with equity issuance while Dong et al. (2006), Bouwman, Fuller, and Nain (2009), and Rhodes-Kropf, Robinson, and Viswanathan (2005) focus on merger activity.

gate returns on subsequent investment by VCs, which then has important implications for incumbent firms.

The outline of the paper is as follows. Section 1 describes the empirical strategy. Section 2 describes the data. Section 3 presents results on the identification strategy. Section 4 presents the main results. Section 5 concludes.

1 Empirical Strategy

Identifying the effect that VC investment has on incumbent firms is complicated by the likelihood of omitted variable bias. When there is a positive shock in industry investment opportunities, incumbent firms will increase investment in response. Because these investments have positive net present value, the future performance of incumbents improves. At the same time, entrepreneurs start new firms in response to the same shock. Some of these new firms will rely on VCs for financing, leading to higher levels of VC investment. If firms and VCs observe the true set of investment opportunities while the econometrician only has noisy proxies, the OLS estimates of the effect of VC investment on incumbent performance will likely be biased. In other words, in the case of industry-level data, consider a regression of the form:

$$Y_{it} = \alpha + \beta_1 VCInvest_{i,t-1} + \beta_2 X_{i,t-1} + \beta_3 Oppor_{i,t-1} + \eta_{it} \quad (1)$$

where Y_{it} is a measure of the aggregate performance of firms in industry i in year t such as profitability, $VCInvest_{i,t-1}$ is the dollar amount of investment by VCs in industry i in year $t-1$, $Oppor_{i,t-1}$ measures the quality of the investment opportunity set for industry i in year $t-1$, and $X_{i,t-1}$ is a set of controls for industry i in year $t-1$. However, the econometrician cannot observe $Oppor_{i,t-1}$ and must use proxies such as the industry book to market ratio instead. Therefore, instead of estimating equation 1, the econometrician estimates:

$$Y_{it} = \alpha + \beta_1 VCInvest_{i,t-1} + \beta_2 X_{i,t-1} + \beta_3 (Proxy_{i,t-1} + \nu_{i,t-1}) + \epsilon_{it} \quad (2)$$

z If $\nu_{i,t-1}$ is correlated with VC investment $VCInvest_{i,t-1}$, then β_1 will be biased.

To eliminate this bias, I create an instrument that affects the level of aggregate VC investment but is plausibly uncorrelated with $\nu_{i,t-1}$. This instrument, as described below, is based on variation in VC returns due to aggregate public market movements following VC-backed IPOs. Using this instrument, I then estimate the following first stage regression:

$$\begin{aligned} VCInvest_{i,t-1} &= \delta + \gamma_1 VCReturnShock_{i,t-1} + \gamma_2 IPOEquity_{i,t-1} \\ &+ \gamma_3 X_{i,t-1} + \eta_{i,t-1} \end{aligned} \quad (3)$$

where $VCReturnShock_{i,t-1}$ is the shock to VC returns due to public market returns, described in more detail below. $IPOEquity_{i,t-1}$ is the total value of equity at IPO held by VCs who have previously invested in the industry and $X_{i,t-1}$ is a set of control variables. Using the results of the first stage, I then estimate the second stage regression:

$$Y_{it} = \alpha + \beta_1 \widehat{VCInvest_{i,t-1}} + \beta_2 IPOEquity_{i,t-1} + \beta_3 X_{i,t-1} + \eta_{it} \quad (4)$$

If $VCReturnShock_{i,t-1}$ is a valid instrument, then $\hat{\beta}_1$ is an unbiased estimate of the effect of VC investment on incumbent performance.

While $\hat{\beta}_1$ will measure the industry-level effects of VC investment, there is a large degree of geographical variation in VC investment. In particular, investment is heavily concentrated in specific MSAs. If the effects of VC investment are local due to segmented input or product markets, firms operating in MSAs with high levels of VC investment will be affected significantly more than firms that only operate in MSAs with low levels of VC investment.

Therefore, I also use firm data and allow the effects of MSA-industry specific VC investment to vary according to the firm's presence in the MSA, which I measure using the fraction of the firm's payroll in the MSA. If the econometrician were able to observe the true set of investment opportunities for firms, the effect of MSA-industry VC investment could be identified by estimating:

$$\begin{aligned} Y_{ikt} &= \alpha + \beta_1 VCInvest_{ij,t-1} \\ &+ \beta_2 PayShare_{ijk,t-1} * VCInvest_{ij,t-1} \\ &+ \beta_3 PayShare_{ijk,t-1} + \beta_4 (Oppor_{ik,t-1}) + \beta_5 X_{ik,t-1} + \epsilon_{ikt} \qquad (5) \end{aligned}$$

where Y_{ikt} is a measure of performance of firm k in industry i in year t, $VCInvest_{ij,t-1}$ is the dollar amount of investment by VCs in industry i and MSA j in year $t-1$, $PayShare_{ijk,t-1}$ is the fraction of payroll for firm k in industry i paid to employees in MSA j for year $t-1$, $Oppor_{ik,t-1}$ measures the quality of the investment opportunity set for firm k industry i in year $t-1$, and $X_{ik,t-1}$ is a set of controls for firm k in industry i in year $t-1$.

However, just as $VCInvest_{i,t-1}$ is endogenous in the industry analysis, so too are $VCInvest_{ij,t-1}$ and $PayShare_{ijk,t-1} * VCInvest_{ij,t-1}$ in the firm analysis. Therefore, I construct two instruments - the MSA-industry VC return shock and its interaction with the firm's MSA payroll share - and estimate two first stage equations:

$$
\begin{aligned}
VCInvest_{ij,t-1} &= \delta_1 + \gamma_{11} VCReturnShock_{ij,t-1} \\
&+ \gamma_{12} PayShare_{ijk,t-1} \\
&+ \gamma_{13} PayShare_{ijk,t-1} * VCReturnShock_{ij,t-1} \\
&+ \gamma_{14} IPOEquity_{i,t-1} \\
&+ \gamma_{15} PayShare_{ijk,t-1} * IPOEquity_{i,t-1} \\
&+ \gamma_{16} X_{i,t-1} + \eta_{it} \qquad (6) \\
PayShare_{ijk,t-1} * VCInvest_{ij,t-1} &= \delta_2 + \gamma_{21} VCReturnShock_{ij,t-1} \\
&+ \gamma_{22} PayShare_{ijk,t-1} \\
&+ \gamma_{23} PayShare_{ijk,t-1} * VCReturnShock_{ij,t-1} \\
&+ \gamma_{24} IPOEquity_{i,t-1} \\
&+ \gamma_{25} PayShare_{ijk,t-1} * IPOEquity_{i,t-1} \\
&+ \gamma_{26} X_{i,t-1} + \psi_{it} \qquad (7)
\end{aligned}
$$

where $VCReturnShock_{ij,t-1}$ is MSA-industry VC return shock and $IPOEquity_{ij,t-1}$ is the total value of equity at IPO held by VCs who have previously invested in the MSA and the industry. Using the results of the first stages, I then estimate the second stage regression:

$$
\begin{aligned}
Y_{ikt} &= \alpha + \beta_1 \widehat{VCInvest_{ij,t-1}} \\
&+ \beta_2 \widehat{PayShare_{ijk,t-1} * VCInvest_{ij,t-1}} \\
&+ \beta_3 IPOEquity_{i,t-1} + \beta_4 PayShare_{ijk,t-1} \\
&+ \beta_5 PayShare_{ijk,t-1} * IPOEquity_{i,t-1} \\
&+ \beta_6 X_{i,t-1} + \eta_{it} \qquad (8)
\end{aligned}
$$

If $VCReturnShock_{ji,t-1}$ is a valid instrument for MSA-industry VC investment, then $\hat{\beta}_1$ and $\hat{\beta}_2$ are an unbiased estimates of the effect of VC investment.

The construction of $VCReturnShock_{i,t-1}$ and $VCReturnShock_{ij,t-1}$ exploits several characteristics of the VC industry. When a firm in its portfolio goes public, the VC's stake in the firm is automatically converted into common equity. While VCs eventually distribute this equity to their limited partners, lockup agreements generally prohibit such distributions for the 180 days immediately following the IPO (Gompers and Lerner (1998b), Brav and Gompers (2003)). Therefore, large increases in the value of the VC's equity increase fund returns and the wealth of the VC's limited partners. Post-distribution, limited partners will seek opportunities to reinvest the proceeds. Moreover, because the returns prior to the distribution are included in the VC fund's return and are a very visible signal, large returns will attract additional, return-chasing investors. As a result, VCs with large increases in the value of their IPO equity can more easily raise money. This naturally leads to higher levels of subsequent investment.

Moreover, this additional investment will occur in predictable industries and geographical areas. Because investing imparts important industry-specific knowledge, VCs tend to invest in industries in which they have been active in the past (Gompers et al. 2008). In addition, distance plays a key role in the ability of VCs to monitor their investments (Bernstein, Giroud, and Townsend (2015)). This implies that a VC's investments will be geographically concentrated and subsequent investments will tend to be located in the same geographic areas as previous investments. Therefore, larger increases in equity value will lead to increased investment in the industries and MSAs in which VC has previously invested. By aggregating the IPO-level return shocks of VCs with experience in the industry and MSA, I generate a variable that predicts aggregate (i.e., industry and MSA-industry level) VC investment.

For the VC return shock to be a valid instrument, they must be orthogonal to unobserved investment opportunities. One reason that this assumption may be violated is that, because VCs tend to remain on the board of directors following the IPO, they continue to exert some influence on the firm. As a result, they may have some ability to affect the firm's stock price, such as through earnings management. Alternatively, given that they frequently serve as directors, VCs may have inside information about the firm's future performance. Given the relationship between IPO returns and fundraising, VCs benefit from increases in the firm's stock price. Moreover, this benefit could vary with investment opportunities if, for example, VCs are more likely to exploit this relationship when opportunities are poor and they would otherwise have difficulty raising money. To eliminate this issue, I use the market return during the lockup period rather than individual firm returns. The market return will be correlated with firm specific return but VCs will have no meaningful ability to influence the return nor will it include firm- or industry-specific information.

An additional concern is that the market return may reflect changes in expected future performance. That is, when aggregate market returns are high, it may be due to an expectation of higher profits for incumbent firms in the future. However, year fixed effects minimize this concern. Because I control for the aggregate equity value at the time of the IPO in all specifications, the primary source of variation in the instrument is the variation in the aggregate market return. Due to year fixed effects, this cross-sectional variation across industries is a result of the non-overlapping subsets of the lockup periods. In other words, the exclusion restriction is violated only if the market return during specific months within a year captures information about industry- or firm-specific investment opportunities. This is unlikely to be the case.

In Section 3, I provide evidence of the strong effect that the VC return shock has on subsequent industry investment as well as evidence supporting the assumption that the instrument is orthogonal to investment opportunities.

2 Data and Summary Statistics

2.1 Data

I use data on VC activity from 1991 to 2007 from Thomson Reuters' VentureXpert database. This database provides information on the firms that receive venture capital financing, including their financing history, industry, location, and founding date, as well as information on the VCs themselves. Because VentureXpert contains data on buyout and growth equity deals in addition to VC investments, I restrict the sample to US-based firms whose status at financing is classified as "Startup/Seed," "Early Stage," "Expansion," or "Later Stage" and US-based investors who are classified as VC funds. Using this sample, I calculate industry VC investment as the total dollar amount (in constant 2005 dollars) invested in the industry, where industries are defined used three digit SIC codes. Similarly, MSA-industry investment is the total amount investment in the MSA-industry in a given year.

As discussed above, I construct an instrument for aggregate VC investment based on the public market returns of recent VC-backed IPOs. To construct this instrument, I first identify the universe of VC-backed firms that go public using data from VentureXpert and SDC Platinum. For each IPO, I calculate the cumulative total market return, using VWRETD from CRSP, over the first 180 days following the IPO, the period during which underwriter agreements generally prohibit VCs and other investors from selling any equity in the firm.[4]

I also collect data on each VC's holdings in the firm prior to the IPO from IPO prospectuses.[5] Combining these data with the offering price yields

[4]Approximately 98% of IPOs for which I have data have a lockup period of 180 days.

[5]Firms are only required to report the holdings of insiders and entities with a stake of at least 5% of the pre-IPO equity. While some firms report the holdings of all of its VCs, most do not. While I calculate the value of equity holdings based only on the holdings reported in the prospectuses, the results are robust to assuming unlisted stakes are equal

the value of the VC's equity at IPO. The IPO-level return shock, that is, the change in the VC's equity value due to the market, is the product of the cumulative market return and the value of the VC's holdings at IPO.

To generate instruments for aggregate VC investment, I map the levels and changes in equity values for specific IPOs in the following way. For the industry-level measures, if a VC has ever made an investment in the industry, then that VC is considered to be a potential investor in the industry and its recent IPOs are assigned to that industry. For the MSA-industry measures, the recent IPOs of VCs who have previously made an investment in the industry and an investment in the MSA are assigned to that MSA-industry. IPOs are assigned to the year after the lockup period; in other words, if an IPO occurs in January of year $t-1$, the level and the change in equity value are assigned to year t.[6]

The aggregate VC return shock is calculated as the sum of the IPO-level return shocks for every IPO mapped to the industry-year or MSA-industry-year, depending on the level of aggregation. Similarly, the total equity value at IPO is the sum of all equity values as of the IPO mapped to the industry-year or MSA-industry-year.

I then match these measures of aggregate VC activity to data on public firms from CRSP and Compustat from Wharton Research Data Services (WRDS). The sample of public firms is restricted to all AMEX-, NASDAQ-, and NYSE-listed firms with share codes 10 and 11 contained in the intersection of the CRSP monthly reuturns file and the Compustat fundamentals annual file between January 1991 and December 2007. Firms are assigned to industries on the basis of their Compustat three digit SIC code.

I use Compustat data to construct a variety of accounting variables. As

to 1% or 2.5%.

[6]For IPOs in the latter half of the calendar year, which results in the lockup period spanning two calendar years, I separate the change in equity value into the change from the IPO date to the end of the calendar year and the change from the beginning of the year to 180 days post-IPO. Therefore, the IPO is mapped to two different years.

the measure of profitability, I use return on assets (ROA), defined as income before extraordinary items (IB) divided by assets (AT). Capital to labor ratios are defined the net property, plants, and equipment (PPENT) divided by employment (EMP). Investment is defined as capital expenditure (CAPX) divided by assets while R&D investment is research and development expense (XRD) divided by assets. Net sales (SALE) and total operating expenses (XOPR) are also deflated by assets. Book to market ratios are calculated as the log of book equity, defined following Davis, Fama, and French (2000), divided by market capitalization at the end of year t, calculated using SHROUT and PRC from CRSP.[7]

I obtain data on the domestic employment and payroll as well as establishment locations of public firms from the the Census Bureau's Longitudinal Business Database (LBD) using the Compustat-SSEL bridge.[8] The LBD contains information on location, employment, and payroll for all business establishments in the U.S. with at least one employee. Thus, the LBD allows me to calculate industry and firm employment and payroll as well as the fraction of employment and payroll in each MSA for each firm.

Aggregating the data to the industry-year level yields a final dataset with 4,602 observations, consisting of 325 industries, with VC data covering years 1991 to 2007 and performance data covering years 1992 to 2010. Aggregating the data to the firm-MSA-level level yields a data set of 1,185,400 observations over the same time period.[9] To limit the effect of outliers, I winsorize all variables at the 1st and 99th percentiles.

[7]Specifically, book equity is calculated as the book value of stockholders' equity (depending on availability, SEQ, CEQ + PSTK, or AT - LT) plus balance sheet deferred taxes (TXDITC or TXDB) minus the book value of preferred stock (PSTKL, PSTKRV, or PSTK)

[8]The current version of the Compustat-SSEL bridge is only available through 2005. I extend the bridge using employer name and EIN following the procedure described in McCue (2003).

[9]The number of observations for some samples have been rounded to the nearest hundred following disclosure guidelines by the U.S. Census Bureau.

2.2 Summary Statistics

Summary statistics for key variables for the two samples are presented in Table 1. As Panel A shows, in the average industry, there is VC investment approximately every two years. There is approximately $38 million invested on average, and with a standard deviation of almost $151 million, there is a large degree of variation among these industries as well. Approximately 22% of industries never have any VC investment during the sample and an additional 16% have an average of less than $1 million invested annually. In contrast, 5% average more than $100 million of investment annually.[10]

The data on the aggregate VC equity holdings and return shocks also shows a similarly skewed distribution. While the mean IPO equity value is $1.2 billion, 26% of industries have no associated VC equity holdings. In addition, the median is only $213 million. Similarly, the mean VC return shock is $34 million but the median is only approximately $1 million.

Panel B presents summary statistics for the firm-MSA level data. Only 7% of observations have positive VC investment. As a result, the average level of VC investment, at $3.6 million, is relatively small. However, firms in markets where there is VC investment can face significant levels of VC investment; conditional on a positive level of VC investment, the average is approximately $51 million. The data on VC equity holdings is similar. Only 13% of observations have non-zero levels of VC IPO equity holdings. The average IPO equity and return shock are correspondingly low, at $113 million and $3.3 million, respectively. Conditional on positive VC IPO equity, however, the average values are $854 million and $25 million.

There are a few important considerations when comparing VC investment levels to the VC return shock. On one hand, the return shock may overstate the additional capital that VCs have to invest. In the sample, the average VC invests in 6.4 industries prior to the IPO. Because VC return shocks are

[10]Restricting the sample to industries with a non-zero level of VC investment between 1981 and 1990 does not affect the results.

mapped to all industries and all MSA-industries, they are likely to spread any additional capital across many industries and MSA-industries. On the other hand, the return shock likely understates the additional capital that VCs have on hand. Because of performance persistence, investors in VC funds benefit from chasing returns. As a result, better performance not only provides the VC's existing investors additional capital to reinvest, but it also attracts new investors. This means that a $1 dollar increase in a VC fund's return may yield significantly more than a $1 increase in the VC's next fund. In this case, the return shock would understate the amount of additional capital that VCs have to invest.

3 Market Returns, IPO Equity, and VC Investment

In section 1, I describe how market returns and the equity in IPO firms held by VCs affect aggregate VC investment activity. In this section, I provide empirical evidence of this relationship as well as evidence in support of the exclusion restriction.

Table 2 presents estimates of equation 3 and demonstrates a strong effect of the return shock on VC investment. As described above, the dependent variable is total VC investment in the industry and all specifications include the total value of VC equity holdings at IPO, industry profitability, the log industry book to market ratio, the log of industry assets, the industry return for years t and $t-1$, year fixed effects, and time-varying industry fixed effects.[11] In column 1, I find that a positive and highly significant coefficient on

[11] In all industry-level specifications, I include three sets of industry fixed effects - one for 1991-1997, one for 1998-2001, and one for 2002-2007. The decision to allow the fixed effect to vary over time is driven by the fact that total VC investment grew greatly during the sample period and the growth rates varied greatly across industries. Allowing industry fixed effects to vary in this way does a significantly better job describing the data than the case where industry fixed effects are constant across time.

the instrument. The estimate suggests that an increase in VC return shock of \$25 million will increase VC investment in the industry by \$2.2 million. Moreover, the F-statistic of 23 suggests that the second stage results are unlikely to be biased towards the OLS estimate (Stock and Yogo 2005).

In columns 2 through 4, I use three alternative formulations of the instrument. One concern about the instrument is that VCs may exploit return predictability to take their investments public prior to periods of relatively high returns. By doing so, they are able to raise and invest more money in the future. If true, this could lead to a relationship between the instrument and investment opportunities in one of two ways. First, VCs may exploit return predictability to raise more money when investment opportunities are particularly strong, leading to a positive relationship between the instrument and investment opportunities. Second, when opportunities are particularly weak, VCs have trouble raising capital and therefore exploit return predictability to raise more money during these times. If so, the instrument would be negatively correlated with investment opportunities.

To address this concern, I construct the VC return shock using residual market returns based on a model of expected returns rather than actual returns. I generate expected returns using two predictive variables: the dividend-price ratio and the consumption-wealth ratio. To use only the information available at the time, I use rolling regressions, using data from January 1952 to the previous month, to estimate parameters. I calculate the expected market return using those parameters and the current month's values and then use the residual return to construct the instrument.

The results using this construction of the instrument, presented in column 2, continue to show a strong relationship between the instrument and VC investment activity. The point estimate and standard error are virtually unchanged from those in column 1, suggesting that the effect of the return shock is not driven by VCs exploiting return predictability.[12]

[12]This analysis assumes that, if VCs are exploiting market return predictability, they are using the same model to generate expected returns. While this is unlikely to be the

In column 3, to reduce the potential information about investment opportunities contained in the instrument, I use a dummy equal to one if the change is positive. The estimate remains positive and highly significant with an F-statistic of 22. Industries where the VC return shock is positive experience an increase in VC investment of $1.0 million on average.

Another concern about the instrument is that it may be unique to the tech boom of the late 1990s. During this period, there was a large increase in the level of VC investment, increasing from $11 billion in 1996 to $105 billion in 2000. The same period also experienced an unusually active IPO market and market returns above historical norms. Thus, it may be the relationship between the VC return shock and subsequent VC investment is unique to this period. To test the generality of this effect, I exclude observations with investment activity between 1998 and 2001 in column 4. The point estimate using this subsample is slightly larger than for the full sample and implies that an increase in the VC return shock of $25 million will increase VC investment in the industry by approximately $2.8 million. The estimate is slightly noisier, however, with an F-statistic of 14.

Across all four specifications, the value of VC IPO equity also enters positively and significantly. The magnitude is large as well; an increase in the IPO equity of $500 million, equal to approximately 0.2 standard deviations, is associated with an additional $3 million in investment. The reason for this result is twofold. First, as with the VC return shock, more and larger IPOs increase the total return of the fund, which increases the wealth of the VC's investors and attracts new investors. Second, Gompers (1996) finds that VCs have an ability to influence when its portfolio firms go public. If investment opportunities are good, VCs may take more of its firms public in the hopes of raising new funds to exploit these opportunities.

In Table 3, I present the estimates of a variation of equation 6 using firm-

case, the similarity in the estimates in columns 1 and 2 provides some evidence that a forecastable component of market returns is not driving the result.

MSA level data. As in Table 2, I find positive and significant effects of the VC return shock on VC investment. In column 1, the estimates suggest that a $5 million increase in equity value increases VC investment in the MSA-industry by approximately $0.4 million. Statistically, with an F-statistic of 31, the instrument is stronger than in the industry-level data. The specification in column 2 uses industry-year and MSA-year fixed effects to control for industry shocks and local geographic shocks. The coefficient remains highly significant and is slightly larger in magnitude. Finally, the addition of firm fixed effects in column 3 has little effect on the economic or statistical significance of the instrument.

In Table 4, I examine the exclusion restriction by estimating the relationship between the instrument and several measures of the industry level investment opportunity set. In each column of Panel A, I regress the measure of industry investment opportunities on the instrument, the aggregate VC IPO equity at IPO, year fixed effects, and time-varying industry fixed effects. I use five measures of the industry investment opportunity set: industry book to market, industry ROA, the growth in industry ROA, the industry public market return, and industry capital expenditures. In all cases, the relationship between the instrument and the measure of investment opportunities is consistently insignificant and small in magnitude. The largest estimated effect is for the industry return, for which increasing the VC return shock by one standard deviation is associated with only 0.03 standard deviation increase. While these variables are imperfect measures, the results provide further evidence that the instrument is not capturing information about the investment opportunity set in the industry.

In Panel B, I regress measures of firm investment opportunities on the MSA-industry versions of the VC return shock and the VC IPO equity value along with industry-year and MSA-year fixed effects. As with the industry level results, I find little evidence that the instrument is correlated with investment opportunities. I consistently find small and insignificant estimates of the relationship between the instrument and measures of investment opportunities.

The results in Tables 2 and 3 provide strong evidence that the VC return shock is a valid instrument for aggregate VC investment. It is highly correlated with subsequent VC investment using both data on industry and MSA-industry data. In the case of the MSA-industry data, this relationship is unaffected even after using industry-year and MSA-year fixed effects to control for industry and local geographical shocks. Moreover, the return shock is not significantly correlated with measures of industry or firm investment opportunities, suggesting that the exclusion restriction is also satisfied.

4 VC Investment and Performance

4.1 VC Investment and Profitability

In this section, I explore the effect of VC investment on industry and firm profitability. First, I use industry-level data to estimate equations 1 and 4 where the dependent variable is the one year change in industry profitability. The same set of controls as in Table 2 are used and the results are presented in Table 5.

The OLS estimates in column 1 show no evidence of a relationship between VC investment and industry profitability. The estimate is insignificant and small in magnitude; an $25 million increase in VC investment is associated with less than a 0.02 percentage point decline in profitability.

The instrumental variable estimates show a very different relationship. In contrast to the estimate in column 1, the estimate in column 2 is negative and significant. Economically, it suggests an additional $25 million of VC investment decreases the profitability of public firms in the industry by approximately 0.5 percentage points. Relative to the average profitability of 3.3%, this represents a decline of 15%. Thus, VC investment has an economically large effect on incumbent firms.

In column 3, I use an alternative form of the instrument where residual market returns are used. As discussed above, VCs may exploit the predictability of market returns to raise additional funds when investment opportunities are particularly strong or weak. The use of residual returns reduces this possibility. As with the first stage, the second stage estimates using this formulation of the instrument is strikingly similar to the main specification. Increased VC investment leads to significant declines in industry profitability, with an additional $25 million in VC investment reducing profitability by 0.5 percentage points.

In column 4, I use an indicator variable equal to one if the return shock is positive as the instrument in the first stage. The estimate remains significant and is slightly larger in magnitude, with an additional $25 million in VC investment reducing profitability by 0.8 percentage points.

Finally, in column 5, I exclude investments made between 1998 and 2001 to test the generality of the results. The estimate remains highly significant and similar in magnitudes to estimates.

Next, I use firm-MSA level data to estimate equation 8 where the dependent variable is the one year change in firm profitability. The same controls as in Table 3 are used and the results are presented in Table 6.

The results on firm profitability also show a large effect of VC investment. In column 1, I find large and significant effects of VC investment. The estimates imply that, for all firms operating in the MSA, an additional $5 million of MSA-industry level investment decreases firm profitability by 0.2 percentage points.

As discussed above, a concern is that the instrument contains information about the investment opportunity set of the firm. So, in column 2, I use industry-year and MSA-year fixed effects to control for industry-specific and MSA-specific shocks. Relative to the estimate in column 1, the estimate is slightly smaller in magnitude but it remains large and significant.

The estimates in columns 1 and 2 imply large effects of VC investment on the profitability of all firms present in the MSA. In column 3, I allow the effect of VC investment to vary with the firm's exposure to the market. I do so by including an interaction between MSA-industry investment and the MSA's fraction of firm payroll.[13]

The estimates in column 3 and 4 show that the effects are localized. The estimate for interaction term is negative, large in magnitude, and highly significant. The estimate for VC investment, on the other hand, is now positive and statistically insignificant. In other words, the profitability of firms with relatively little exposure to a market are essentially unaffected by VC investment in the market. For firms with ten percent of their payroll in the market, an additional $5 million of VC investment decreases firm profitability by .04 percentage points. For firms whose payroll is concentrated in the treated market, on the other hand, are highly effected; increasing VC investment by $5 million decreases firm profitability by 0.4 percentage points for firms with 100 percent of their payroll in the market.

By exploiting variation among firms in the proportion of their payroll in a given market, I am able to control for MSA-industry specific shocks in column 5 with the use of MSA-industry-year fixed effects. The estimates are very similar in magnitude and significance to the estimates in column 4.

The results in Tables 4 and 5 show a large, negative effect of VC investment on the profitability of public firms. The industry-level results are robust to alternative specifications of the instrument that address concerns about the validity of the instrument. In addition, the firm-level results are robust to variety of fixed effects that control for unobservable shocks.

[13] A better measure of the firm's presence in an MSA would be the fraction of the firm's assets. However, while it is possible to get such data for manufacturing firms using the Census of Manufacturers and the Annual Survey of Manufacturers, this data are not available for the full set of firms in the sample. Specifications using the share of employment rather than the share of payroll yield qualitatively similar results. The benefit of using payroll shares rather than employment shares is that it likely more accurately captures the allocation of firm resources.

4.2 VC Investment, Sales, and Costs

Next, I turn to the underlying mechanism through which VC investment affects incumbent profitability. To do so, I separate profitability into its components and study how VC investment affects sales and operating costs separately. I do so by re-estimating equation 4 using the one year change in industry sales relative to assets and operating costs relative to assets as dependent variables. I then re-estimate equation 8 using the analogous firm-level measures as dependent variables. The results are presented in Table 7.

The results show that the effect is driven by VC investment increasing the costs of incumbent firms, not by decreasing sales. In column 1, I find no evidence of a negative effect on sales. In fact, the estimate is positive and marginally significant. Rather, as the estimates in column 2 show, VC investment significantly increases operating costs. The estimated effect on costs is large, positive, and significant. The estimate implies that an additional $25 million of industry-level VC investment increases operating costs relative to assets by 1.6%.

The analysis of firm sales and costs in columns 3 through 6 similarly show that the decline in profitability is due to an increase in costs rather than a decrease in sales. First, I find no evidence that VC investment has a significant effect on sales relative to assets. In column 3, the estimates for both VC investment and its interaction with the share of firms payroll are insignificant and positive. In column 4, the estimate on the interaction term is negative but it remains insignificant.

The estimates in columns 5 and 6, in contrast, show a large and significant effect of VC investment on operating costs. Consistent with the profitability results, the estimated effect of VC investment in column 5 is positive but insignificant. The estimates for the interaction term in both specifications, however, are positive, large in magnitude, and significant. As with profitability, operating costs for only the firms with a relatively large share of payroll in the treated market are affected. While a $5 million increase in

VC investment increases operating costs by 0.1-0.2% for firms with 10 percent of payroll in the market, it increases costs by 0.6-1.0% for firms with 100 percent of payroll in the market. Thus, VC investment adversely affects profitability not by decreasing sales but increasing costs.

To understand what specific costs are increasing, I next estimate the effect of VC investment on the log change in industry and firm-MSA pay per employee. The estimates are presented in Table 8. The industry level results in column 1 show a positive and significant effect on employee compensation. The estimate implies that a $25 million increase in industry VC investment increases pay per employee by approximately 0.7%.

I find slightly weaker but still significant effects with the firm-MSA level data. In column 2, the estimated effect of VC investment is significant and implies that an addition $5 million in MSA-industry VC investment increases compensation by 0.5%. The main effect remains significant in column 3 while the interaction with firm MSA payroll share is negative and insignificant. In other words, VC investment increases compensation in the specific market for all firms, not just the most intensely treated firms.

4.3 Long Term Effects

Next, I examine the long term effect on profitability. To do so, I first re-estimate equation 4 using the change in industry profitability from year t to years $t+2$ and $t+3$ as dependent variables. Then, I re-estimate equation 8 using the change in firm profitability from year t to years $t+3$ as the dependent variable. The results are presented in Table 9.

The estimates show that the effect of VC investment is relatively short-lived. The estimate in column 1 is approximately half as large as the estimate in Table 5 and insignificant. Moreover, as the positive and insignificant estimate in column 2 shows, the effect disappears entirely by year $t+3$. In other words, after a large initial effect, incumbents recover approximately half of the decline in profitability by year $t+2$ and the remainder by year $t+3$.

The firm-level analysis, presented in columns 3 and 4, also shows that VC investment has only a temporary effect. In these specifications, VC investment and its interaction with the firm's payroll share in the MSA are negative but insignificant. In addition, the magnitudes are extremely small; using the estimates in column 3, an additional $5 million of VC investment decreases long-term profitability by only 0.1 percentage points for firms with all of its payroll in the MSA while the estimates in column 4 suggest no long-term effect on profitability.[14]

One potential explanation for the absence of a long term effect is survivorship bias. That is, suppose there are two types of firms - those that are strongly affected by VC investment and those that are relatively unaffected. Over time, the former set of firms continues to perform poorly and this poor performance leads them to delist. As a result, they drop out of the sample and, three years later, only relatively unaffected firms remain.

In Table 10, I provide evidence that the survivorship bias does not explain the absence of a long term effect. In the column 1, I examine the effect that VC investment has on the cumulative fraction of firms in an industry that delist by year $t+3$. The estimate is insignificant and, while positive, small in magnitude. The estimates imply that an additional $25 million of VC investment increases the fraction of firms that delist by only 0.2 percentage points, from 2.8% to 3.0% by year $t+3$.

In columns 2 and 3, I estimate the effect of VC investment on individual firms delisting by year $t+3$. I again find little evidence that survivorship bias is responsible. The estimated effects are marginally significant and negative. This result suggests that, if additional VC investment has any effect on delistings, it actually decreases the frequency, although the effect is also small in magnitude.

Thus, survivorship bias does not account for the temporary effect of VC

[14] In unreported results, I find no long-term effect on sales or costs for industries or firms.

investment. Rather, it appears that firms are able to effectively counteract the effect of VC investment in the longer run. I examine two potential reactions. The first explanation is that VC investment in a market leads firms to shift resources away from the market. To test this explanation, I estimate the effect that VC investment has on the fraction of firm payroll in the treated market. The second explanation is that, given the evidence that VC investment increases employee compensation, firms substitute away from labor and toward capital. I test this explanation by estimating the effect of VC investment has on capital-labor ratios. The results are presented in Table 11.

The results in columns 1 and 2 show that the most intensely treated firms do reallocate resources away from treated markets. The estimate of VC investment in column 1 is positive and insignificant while the estimate on the interaction of VC investment with the MSA share of firm payroll is negative and significant. These results suggest that only firms with relatively high levels of payroll in a treated market shift payroll away from the treated market. This is unsurprising given that firms with low levels of payroll do not experience a decline in firm profitability and reallocation likely requires the payment of some fixed cost. Even for the intensely treated firm, though, the effect is small; an additional $5 million in VC investment leads a firm with half of its payroll in the market to decrease its payroll share by only 0.2%. Thus, while there is some reallocation of resources, it appears to be a relatively small effect.

In columns 3 and 4, I find a strong effect on the relative use of labor. In both specifications, I find a significant effect of VC investment on the capital-labor ratios of the most intensely treated firms; the estimate on the interaction of VC investment and the MSA share of firm payroll is positive and significant. The effect is also relatively large; using the estimate in column 4, an additional $5 million of VC investment in the market leads to a 2.4% (5.0%) increase in the firm's capital-labor ratio. In contrast, firms with only five percent of payroll in a treated market increase capital-labor ratios by only 0.2%.

The effect that VC investment has on profitability is short lived, with no effect on industry or firm profitability within three years. This reversal is not driven by survivorship bias. Rather, firms respond by reallocating resources; they reduce payroll in treated markets and they decrease their use of labor, using relatively more capital instead.

5 Conclusion

In this paper, I examine the effects of VC investment on the performance of public incumbents in the industry. I document a large, initial effect. An increase in VC investment leads to a decline in profitability in the following year. This decline in profitability is not due to increased product market competition leading to lower sales. Instead, operating costs increase significantly, at least in part due to an increase in employee compensation.

However, incumbents quickly recover; there is no effect on profitability or costs within three years. This recovery is not due to a survivorship bias but appears instead to be driven by the response of individual firms. In particular, MSA-industry VC investment leads affected firms to shift resources away from the market and to substitute away from labor and towards capital.

These results have important implications for both the VC industry and labor market activity. As documented by Harris, Jenkinson, and Kaplan (2013) and Robinson and Sensoy (2013), among others, venture capital as an asset class has underperformed public equities in the 2000s. The effects that I document may partially explain this underperformance. In particular, if VCs do not internalize the effects on wages when making investments, labor will capture a portion of the benefits of the investment, thereby reducing the return to VCs.

The behavior of the labor market in response to the increase in wages is also of interest. The results show that large levels of VC investment can significantly raise wages in an industry. What effects does this have on the labor market? In particular, is there significant reallocation of labor away from related industries as individuals seek out higher wages? To what extent does labor migrate to regions where the wage effects are strongest? These questions about reallocations across industries and geographical regions seems to be a fruitful area for future research.

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Table 1: Summary Statistics

This table presents summary statistics for several key variables. The sample includes data on three digit SIC industries for the years 1991 to 2007.

	N	Mean	Std. Dev.	Median
Panel A: Industry Data				
	N	Mean	Std. Dev.	Median
Any Industry VC Investment	4,602	0.473	0.499	0.000
Industry VC Investment	4,602	38.487	151.055	0.000
Industry VC IPO Equity > 0	4,602	0.742	0.438	1.000
Industry VC IPO Equity	4,602	1176.796	2,523.431	213.343
VC Return Shock	4,602	34.080	139.625	1.064
Panel B: Firm-MSA Data				
	N	Mean	Std. Dev.	Median
Any MSA-Ind VC Investment	1,185,400	0.070	0.255	0.000
MSA-Ind VC Investment	1,185,400	3.600	22.600	0.000
MSA-Ind VC IPO Equity > 0	1,185,400	0.132	0.339	0.000
MSA-Ind VC IPO Equity	1,185,400	112.700	557.300	0.000
MSA-Ind VC Return Shock	1,185,400	3.300	2.290	0.000

Table 2: VC Return Shocks and VC Investment Industry Data

This table presents estimates from industry-year regressions relating industry VC investment to the VC return shock. The VC return shock is constructed differently across specifications. In column 2, the return shock is based on residual market returns. In column 3, it is a dummy variable equal to one if the return shock is positive and zero otherwise. In column 4, the construction is the sample as in column 1 but the years 1998 through 2001 are excluded from the sample. See the text for more detail on the construction of these variables. Controls included in all specifications are VC IPO equity, the initial level of industry profitability, the log of the industry book to market ratio, the log of industry assets, the industry stock market return, and the lagged industry stock market return. In column 3, I also include a dummy equal to 1 if VC IPO equity is positive. Year and time-varying industry fixed effects are also included in all specifications. Standard errors are clustered by industry and are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)
VC Return Shock	0.085			0.113
	(0.018)***			(0.030)***
VC Return Shock (Resid.)		0.084		
		(0.018)***		
VC Return Shock > 0			0.010	
			(0.002)***	
VC IPO Equity	0.006	0.008	0.006	0.007
	(0.002)***	(0.002)***	(0.001)***	(0.003)**
Year FE	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes
Exclude 1998-2001	no	no	no	yes
N	4,602	4,602	4,602	3,511
R-squared	0.93	0.93	0.92	0.95

Table 3: VC Return Shocks and VC Investment Firm-MSA Data

This table presents estimates from firm-MSA-year regressions relating MSA-industry VC investment to the MSA-industry level VC return shock. See the text for more detail on the construction of these variables. Controls included in all specifications are VC IPO equity, the initial level of firm profitability, the log of the firm book to market ratio, the log of firm assets, the firm stock market return, and the lagged firm stock market return. Standard errors are clustered by industry and are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)
VC Return Shock	0.084	0.094	0.090
	(0.015)***	(0.020)***	(0.020)***
VC IPO Equity	0.025	0.026	0.023
	(0.004)***	(0.005)***	(0.005)***
Year FE	yes	no	no
Industry FE	yes	no	no
MSA FE	yes	no	no
Industry*Year FE	no	yes	yes
MSA*Year FE	no	yes	yes
Firm FE	no	no	yes
N	1,185,400	1,185,400	1,185,400
R-squared	0.65	0.71	0.74

Table 4: VC Return Shocks and Investment Opportunities

Panel A of this table presents estimates from industry-year regressions relating proxies for industry investment opportunities to the industry-level VC return shock. Panel B presents estimates from firm-MSA-year level data relating proxies for firm investment opportunities to the MSA-industry-level VC return shock. The proxies used as the log of the book to market ratio, profitability, the change in profitability, the contemporaneous stock market return, and capital expenditures relative to assets. Standard errors are clustered by industry and are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

			Panel A: Industry Data		
DepVar:	B/M	ROA	ΔROA	Return	Capex
VC Return Shock	-0.039	0.013	0.000	0.076	-0.002
	(0.066)	(0.011)	(0.008)	(0.068)	(0.004)
VC IPO Equity	0.010	-0.001	-0.001	-0.022	0.001
	(0.006)*	(0.001)**	(0.001)	(0.005)***	(0.000)***
Year FE	yes	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes	yes
N	4,602	4,602	4,577	4,602	4,596
R-squared	0.72	0.64	0.16	0.37	0.72
			Panel B: Firm-MSA Data		
DepVar:	B/M	ROA	ΔROA	Return	Capex
VC Return Shock	-0.051	0.014	-0.008	0.014	0.004
	(0.116)	(0.026)	(0.006)	(0.116)	(0.005)
VC IPO Equity	-0.001	-0.011	-0.002	-0.003	-0.001
	(0.007)	(0.002)***	(0.000)***	(0.006)	(0.000)
Industry*Year FE	yes	yes	yes	yes	yes
MSA*Year FE	yes	yes	yes	yes	yes
N	1,185,400	1,185,400	1,185,400	1,185,400	1,185,400
R-squared	0.37	0.25	0.21	0.38	0.56

Table 5: VC Investment and Industry Profitability

This table presents estimates from industry-year regressions relating the change in industry profitability to aggregate VC investment in the industry. In column 1, the model is estimated using OLS, and, in columns 2-5, the model is estimated using 2SLS. The first stage estimates are reported in Table 2. Controls included in all specifications are VC IPO equity, the initial level of industry profitability, the log of the industry book to market ratio, the log of industry assets, the industry stock market return, and the lagged industry stock market return. Year and time-varying industry fixed effects are also included in all specifications. Standard errors are clustered by industry and are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	(1) OLS	(2) IV	(3) IV	(4) IV	(5) IV
VC Investment	-0.010	-0.200	-0.203	-0.328	-0.226
	(0.009)	(0.088)**	(0.086)**	(0.154)**	(0.099)**
VC IPO Equity		0.001	0.001	0.002	0.002
		(0.001)	(0.001)*	(0.001)*	(0.001)
Year FE	yes	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes	yes
Exclude 1998-2001	no	no	no	no	yes
N	4,602	4,602	4,602	4,602	3511
R-squared	0.45	0.43	0.43	0.38	0.41

Table 6: VC Investment and Firm Profitability

This table presents estimates from firm-MSA-year regressions relating the change in firm profitability to MSA-industry VC investment. All models are estimated using 2SLS. Controls included in all specifications are VC IPO equity, the initial level of firm profitability, the log of the firm book to market ratio, the log of firm assets, the firm stock market return, and the lagged firm stock market return. In columns 3, 4, and 5, the interaction of the firm MSA payroll share and VC IPO equity is included as a control. Standard errors are clustered by industry and are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)
VC Investment	-0.476	-0.340	0.081	0.021	
	(0.240)**	(0.105)***	(0.056)	(0.058)	
VC Investment * Firm MSA Payroll Share			-3.900	-0.845	-0.796
			(1.799)**	(0.369)**	(0.298)***
Firm MSA Payroll Share			-0.015	0.005	0.006
			(0.004)***	(0.003)*	(0.003)**
Year FE	yes	no	no	no	no
Industry FE	yes	no	no	no	no
MSA FE	yes	no	no	no	no
Industry*Year FE	no	yes	yes	yes	no
MSA*Year FE	no	yes	yes	yes	no
Firm FE	no	no	no	yes	yes
Industry*MSA*Year FE	no	no	no	no	yes
N	1,185,400	1,185,400	1,185,400	1,185,400	1,185,400
R-squared	0.16	0.32	0.26	0.56	0.68

Table 7: VC Investment and Sales and Expenses

This table presents estimates from industry-year and firm-MSA-year regressions relating sales and operating expenses to aggregate VC investment. In column 1, the dependent variable is industry sales relative to assets and in column 2, it is industry operating costs relative to assets. In columns 3 and 4, the dependent variable is firm sales relative to assets and in columns 5 and 6, it is firm operating costs relative to assets. All models are estimated using 2SLS. Controls included in all specifications are VC IPO equity, the initial level of sales relative to assets, the initial level of operating costs relative to assets, the log of the book to market ratio, the log of assets, the stock market return, and the lagged stock market return. Columns 3-6 also include firm MSA payroll share as an additional control. Standard errors are clustered by industry and are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
VC Investment	0.483	0.655	0.218		0.174	
	(0.267)*	(0.265)**	(0.172)		(0.189)	
VC Investment * Firm MSA Pay Share			0.205	-0.269	1.827	1.284
			(0.725)	(0.509)	(0.804)**	(0.520)**
Firm MSA Pay Share			-0.005	-0.006	-0.013	-0.015
			(0.005)	(0.005)	(0.007)**	(0.006)**
Dependent Variable	Sales	Costs	Sales	Sales	Costs	Costs
Level of Observation	Industry	Industry	Firm-MSA	Firm-MSA	Firm-MSA	Firm-MSA
Year FE	yes	yes	no	no	no	no
Industry FE	yes	yes	no	no	no	no
MSA FE	no	no	no	no	no	no
Firm FE	no	no	yes	yes	yes	yes
Industry*Year FE	no	no	yes	no	yes	no
MSA*Year FE	no	no	yes	no	yes	no
Industry*MSA*Year FE	no	no	no	yes	no	yes
N	4,602	4,602	1,185,400	1,185,400	1,185,400	1,185,400
R-squared	0.29	0.28	0.49	0.61	0.48	0.61

Table 8: VC Investment and Pay per Employee

This table presents estimates from industry-year regressions and firm-MSA-year regressions relating the log change in industry and firm-MSA pay per employee to aggregate VC investment. All models are estimated using 2SLS. Controls included in all specifications are VC IPO equity, the log of initial pay per employee, the log of the book to market ratio, the log of assets, the stock market return, and the lagged stock market return. Column 3 includes the interaction of VC IPO equity and firm MSA payroll share as an additional control. Standard errors are clustered by industry and are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)
VC Investment	0.278	1.005	0.766
	(0.083)***	(0.424)**	(0.363)**
VC Investment * Firm MSA Pay Share			-1.980
			(1.596)
Firm MSA Pay Share			0.186
			(0.015)***
Level of Observation	Industry	Firm-MSA	Firm-MSA
Year FE	yes	no	no
Industry FE	yes	no	no
MSA FE	no	no	no
Firm FE	no	no	yes
Industry*Year FE	no	yes	yes
MSA*Year FE	no	yes	yes
Industry*MSA*Year FE	no	no	no
Firm*Year FE	no	no	no
Obs	4,302	1,185,400	1,185,400
R-squared	0.45	0.16	0.23

Table 9: VC Investment and Profitability Long Term Effects

This table presents estimates from industry-year and firm-MSA-year regressions relating the long term change in industry and firm profitability to aggregate VC investment. Controls included in all specifications are VC IPO equity, the initial level of profitability, the log of the book to market ratio, the log of assets, the stock market return, and the lagged stock market return. Columns 3 and 4 includes the interaction of VC IPO equity and firm MSA payroll share as an additional control. Standard errors are clustered by industry and are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)
VC Investment	-0.114	0.079	-0.087	
	(0.071)	(0.078)	(0.061)	
VC Investment * Firm MSA Pay Share			-0.159	-0.009
			(0.736)	(0.828)
Firm MSA Payroll Share			0.001	0.000
			(0.004)	(0.005)
Level of Observation	Industry	Industry	Firm	Firm
Time Horizon	t+2	t+3	t+3	t+3
Year FE	yes	yes	no	no
Industry FE	yes	yes	no	no
MSA FE	no	no	no	no
Firm FE	no	no	yes	yes
Industry*Year FE	no	no	yes	no
MSA*Year FE	no	no	yes	no
Industry*MSA*Year FE	no	no	no	yes
N	4,533	4,459	1,045,600	1,045,600
R-squared	0.54	0.60	0.68	0.76

Table 10: VC Investment and Delisting

This table presents estimates from industry-year and firm-MSA-year regressions relating the long term change in industry profitability to aggregate VC investment. Controls included in all specifications are VC IPO equity, the initial level of profitability, the log of the book to market ratio, the log of assets, the stock market return, and the lagged stock market return. Standard errors are clustered by industry and are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)
VC Investment	0.046	-0.442	
	(0.071)	(0.229)*	
VC Investment * Firm MSA Pay Share		-1.723	-1.668
		(1.154)	(0.878)*
Firm MSA Pay Share		-0.017	-0.025
		(0.008)**	(0.007)***
Dependent Variable	%Delisted	Delist	Delist
Level of Observation	Industry	Firm-MSA	Firm-MSA
Year FE	yes	no	no
Industry FE	yes	no	no
MSA FE	no	no	no
Firm FE	no	yes	yes
Industry*Year FE	no	yes	no
MSA*Year FE	no	yes	no
Industry*MSA*Year FE	no	no	yes
N	4,602	1,185,400	1,185,400
R-squared	0.62	0.61	0.71

Table 11: VC Investment and Firm Responses

This table presents estimates from firm-MSA-year regressions relating the three year change in firm MSA payroll share and log firm capital-labor ratio to MSA-industry VC investment. Controls included in all specifications are VC IPO equity and its interaction with the initial firm MSA payroll share, the initial level of profitability, the log of the book to market ratio, the log of assets, the stock market return, the lagged stock market return, and the initial firm MSA payroll share. Columns 3 and 4 include the log of the initial firm capital-labor ratio as an additional control. Standard errors are clustered by industry and are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)
VC Investment	0.020		0.017	
	(0.024)		(0.299)	
VC Investment * MSA Payroll Share	-0.622	-0.612	3.687	4.152
	(0.226)***	(0.258)**	(2.017)*	(2.089)**
MSA Payroll Share	-0.051	-0.053	-0.009	-0.016
	(0.003)***	(0.005)***	(0.012)	(0.018)
Dependent Variable	Firm MSA Payroll Share		Capital-Labor Ratio	
Industry*Year FE	yes	no	yes	no
MSA*Year FE	yes	no	yes	no
Firm FE	yes	yes	yes	yes
Industry*MSA*Year FE	no	yes	no	yes
Obs	1,045,600	1,045,600	1,045,600	1,045,600
R-squared	0.15	0.47	0.70	0.78