Inside Rounds and Venture Capital Returns

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Abstract

We study sequential investment decisions in the venture capital (VC) industry. VC-backed companies typically need to raise several rounds of funding from VC funds. The decision whether to provide further funding to the company and the terms of the new funding determine VC fund returns. We show that investment outcomes in the VC industry can be predicted by whether a round of funding is provided by only VCs who previously invested in the firm, or new VCs join the syndicate of investors. With asymmetric information, financial intermediaries are often thought to "hold up" firms and earn rents on their inside knowledge. However, we show that inside rounds, in which only existing investors participate, lead to a *higher* likelihood of failure, *lower* probability of IPOs, and *lower* cash on cash multiples than rounds with new investors. Inside rounds also appear to be negative NPV, suggesting that investors make inefficient continuation decisions. The findings are both consistent with the phenomenon called escalation of commitment and a manifestation of a novel agency problem driven by changing opportunity costs in the VC fund life-cycle.

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1 Introduction

Venture capital has evolved over time to fill a gap in the financing of high-growth entrepreneurial firms left by traditional sources of capital. This funding gap stems from frictions in the selection and monitoring of entrepreneurial firms. Staged investment emerges from the extreme information asymmetry about the quality of the idea or founder. Staging provides a platform to learn (Bergemann and Hege (1998)), introduces valuable abandonment options and helps mitigate hold-up by the entrepreneur with inalienable capital (Neher (1999)).[1] Staging itself can produce conflicts of interest, which several authors show gives rise to another major feature of venture capital: syndication. Admati and Pfleiderer (1994) show that staging can facilitate an entrepreneur's future capital raises from the market, while Fluck, Garrison, and Myers (2007) shows that commitment to syndication can mitigate the standard financier hold-up problem. Although we have an understanding of staging (Gompers (1995)) and syndication (Lerner (1994a)), we do not yet know empirically how information asymmetry and bargaining power interact in VC financings. This paper asks how the composition of syndicates and decisions of informed investors relates to pricing and outcomes of entrepreneurial firm investments.

This paper addresses an important gap in our current knowledge of the VC industry by studying to what extent these sequential decisions are made optimally and how it affects outcomes and returns of VC investments. We start by showing that for many VC investments *only* those VC funds that previously invested in a given start-up take part in the next round. We call these 'inside' rounds. In our sample, there were 8,570 entrepreneurial firms from 1992 to 2014 that received investment in a total of 20,186 investment rounds (excluding the initial investment rounds). Of those rounds 5,853 were inside rounds. These are investment rounds in which *all* investors in that round already invested in that start-up before. Thus, approximately 30% of all venture financings are inside rounds.

Does it matter? Inside rounds are potentially quite different than those with new investors. Given the likelihood of asymmetric information between insiders and outsiders about a young

[1]The importance of abandonment options in venture capital is noted in much work on VC (see Gompers, 1995, Cornelli and Yosha, 2003, Bergemann and Hege, 2005, Fluck, Garrison, and Myers, 2007, Bergemann, Hege, and Peng, 2008)

private firm, the inside venture capitalists may "hold up" the firm and extract information rents. There is a large banking literature suggesting the potential for this type of extraction by financial intermediaries.[2] This "hold up" would allow the inside venture capitalists to generate higher returns when the entrepreneur was unable to find/convey the inside information to outside investors. This is not what we find.

When we examine the data, inside rounds are 20% more likely to lead to failures, are less likely to lead to IPOs, and generate 10-17% lower cash on cash multiples than outside rounds. These findings persist when we control for a number of company-specific and time-series variables. We also provide evidence that those VC funds that participate in inside rounds have lower returns on their inside investments than their rounds with new investors. These results are important because they both shed light on the determinants of VC returns, and show that there is a certain degree of cross-sectional predictability in the venture industry.

A potential explanation could be the opposing hold-up problem that is the center of several theoretical analyses of staged financing (e.g. Admati and Pfleiderer (1994) and Fluck, Garrison, and Myers (2007)). The entrepreneur can walk away from the startup and likely lead to failure of the investment. In this work, the existing investors stage their investment in order to counter this issue. It is not clear from a theoretical standpoint which hold-up problem will dominate. Potentially, inside rounds are those where the entrepreneur is "holding up" the current investors, so of course new investors do not participate. However, the effects we find here do not simply concern price. These rounds predict higher failure rates and poor exit valuations, which would also be detrimental to the entrepreneur.

Alternatively, venture capitalists, who often sit on boards and interact frequently with the founders and executives, may form a personal attachment to their companies. A large psychological literature shows that these interactions frequently lead to the so-called escalation of commitment. It is closely related to the sunk cost fallacy and the endowment effect. Effectively, in making future decisions an agent cannot ignore the past decisions that were made and the costs that were sunk. In dynamic situations, escalation of commitment can lead to throwing good money after bad, in industry's parlance.

[2] See Sharpe (1990), Rajan (1992), Houston and James (1996) and Von Thadden (1995).

Escalation of commitment is an important problem recognized by the VC industry. A potential solution is to seek new investors to participate in each subsequent round of funding. By investing, as well as negotiating the terms of the investment round, new investors signal to the market the fair value of the company as well as an unbiased opinion about its potential. In fact, many limited partners will ignore any mark-up (increase in the reported value of an investment) of an entrepreneurial firm that does not include at least one outside investor and VCs typically only mark up an investment if priced by a new investor. The perceived wisdom in the industry is that sequential transactions that involve outsiders leads to the resolution of the escalation of commitment problem, while the deals that involve only those investors that already invested in the start-up previously may lead to lower returns and are thus actively avoided.

While the perceived wisdom in the industry would suggest that the escalation of commitment is the leading mechanism at play, an alternative is that a principle-agent problem is causing VC investors to knowingly participate in low return rounds. We propose a novel principle-agent problem driven by the institutional details of the venture market. This novel problem demonstrates the powerful effects of opportunity costs.

In a venture capital investors may initially invest in new companies or make follow-on investments into companies in which they previously invested (this is called the investment period). However, after raising a new fund, the previous fund closes to new investments - and now only make follow-on investments. This rule is intended to prevent conflicts between the funds as to which fund invest in any new company found by the VC. New funds are typically raised 3-4 years after the previous fund. At this point the old fund has made initial investments in enough new companies that its remaining capital is reserved support these investment through to exit.[3] However, this change has an effect on the decision to continue to support a company. During the investment period a VC can either support an old company *or* find a new one. After the investment period the VC can only choose among old companies. This change potentially creates a dramatic downward shift in the opportunity cost of making a follow-on investment. Remember that the VC earns a fee whether or not the remaining capital is invested, but earns a carry on any positive return. Thus,

[3]The remaining capital is often significant (30-60%) as existing companies need capital as they grow so investors have to stand ready to support them.

during the investment period the VC's choice is between a new investment, an old investment, or not investing at all, while after the investment period the VC's choice is between an old investment, or not investing at all - and any investment with a positive return earns the VC a carry.

When we examine the data, the propensity to do inside rounds is much higher immediately after the investment period ends. Furthermore, the return to inside rounds is higher during the investing period. Investors seem to do fewer inside rounds and make better decisions about when to participate in them during the investment period when they have a much higher opportunity cost. These findings are a novel demonstration of both the impact of opportunity costs and a novel principle-agent problem.

Of course multiple effects may be occurring at once, including escalation of commitment and multiple principle-agent problems. Therefore, we also ask whether VCs window-dress their fund performance by keeping firms alive long enough to raise a new fund. Peek and Rosengren (2005) shows that banks do this in Japan with poorly performing loans - a practice referred to as ever-greening. We do not find support for this among venture capitalists. Alternatively, VCs may have incentives to gamble for resurrection if they are currently not performing well.[4] We find that VCs are more likely to participate in inside rounds before they have had a successful exit.

Our paper builds on both theoretical and empirical research in finance and psychology. Escalation of commitment is defined in psychological and organizational literature as a greater tendency to continue an endeavor once an investment in money, effort, or time has been made, even if circumstances should dictate otherwise. It is closely related to the sunk cost fallacy and the endowment effect. See Arkes and Blumer (1985) for experimental evidence and Staw and Hoang (1995) for empirical evidence of sunk costs (in the context of NBA games).[5] It also could be due to "rational overcommitment" (Adner (2007)), the tendency of individual managers to continue projects with the hope of improving the outcomes, especially when their personal interests are at stake.

[4] A related effect is gambling in the presence of losses if there is a chance to break even (Thaler and Johnson (1990))

[5] There are also two interesting studies of organizational escalation that use the case studies of very large non-profit projects: Expo86 World Fair and the Shoreham Nuclear Power Plant (Ross and Staw (1986), Ross and Staw (1993)). In that literature, escalation effects have been typically explained by prospect theory, self-justification concerns, inside view, the desire to avoid wasting resources, etc. From the economic viewpoint, escalation effects are irrational if they lead people to take negative NPV projects.

Two related papers, Guler (2007a) and Guler (2007b), show that VCs, as a group, tend to make sequential investments in deals even if objective criteria suggest the deals need to be abandoned. In an experimental paper, Tan and Yates (2002) study how financial budgets affect termination decisions. They find that escalation of commitment declines as financial budget gets binding.[6] This suggests that in relation to the VC industry, the extent of the escalation of commitment should depend on dry powder (i.e. capital left in fund). However, we find that inside rounds and their performance levels off later in the fund's life. This is a time when the budget constraint is most binding but the opportunity cost of an investment is at its lowest. Thus, the evidence suggest the opportunity cost effect is the dominate force.

In related work, Broughman and Fried (2012) also study inside rounds and ask whether insiders use the financings to dilute the equity stakes of the entrepreneur. They find evidence instead that VCs use these financings as "backstops" when firms struggle to raise capital. Our paper improves the analysis with a more representative sample of financing and richer pricing and returns data. The additional data allows us to address several potential explanations for inside rounds that are not available in their sample. For example, the larger sample suggests that backstop financings are not the main driver of both inside investments or their underperformance. Our data also allows us to address several sources of unobserved heterogeneity unavailable is smaller datasets. We find evidence that the backstop financing is consistent with an escalation of commitment and the opportunity costs shift rather than legal frictions in term sheets.

The paper proceeds as follows. Section 2 describes the data and variables. Section 3 presents empirical tests of the relationship between inside rounds and several return measures. Section 5 follows with a set of robustness tests. Section 4.2 studies the decision to participate in an inside round and Section 6 concludes.

2 Data and variables

This section describes our data and introduces main variables of interest.

[6] There is also now a broad recognition of emotional biases and the importance of affect in decision-making (see Loewenstein and Lerner (2003) and Lucey and Dowling (2006)).

2.1 Data sources

We start with the venture capital database VentureSource from Dow Jones. The data includes information about entrepreneurial firms, their investors, and individual financing rounds. We then augment and improve VentureSource with data from Correlation Ventures, a quantitative venture capital fund.[7] Valuation information of financings and exits is augmented with data from Thompson VentureEconomics and Pitchbook. Further, Correlation Ventures collects information on financings from their investment partners. This additional data improves the quality and coverage of VentureSource along a number of dimensions. For our purposes, financing-level and exit valuations are most important.

To construct the main dataset, we select all the non-first round financings, where we can track venture capitalist investors' reinvestment decisions, and apply a number of filtering criteria. An entrepreneurial firm is in the sample if it raised its first round of financing between 1990 and 2008. The upper bound allows ample time for an exit event for the investment. The lower bound is chosen based on the data coverage of VentureSource. We exclude all firms that were founded prior to 1978. The second financing event must follow a previous equity financing, in which at least one of the investors is an institutional venture capital investor. Such an investor raises the fixed-life fund (10–12 years) from institutional investors such as endowments, pension funds, and trusts. In VentureSource, this includes institutional venture capital, diversified private equity, and SBIC (government grant-backed) funds. Hedge funds, mutual funds, investment banks, and corporate VC arms are excluded from this definition. We drop financings with small investment amounts to avoid potential hidden bridge financings or incorrectly split equity tranches, where "small" is defined by financings in the lower 5% of investment size within each of the seven major industries over the sample period. We also exclude rounds that are classified as corporate, bridge, or debt financings. Finally, if a company has a set of financings a less than a month apart, we have to drop the company from the sample, because we are unable to number the rounds confidently. The main sample includes 20,186 financing rounds in 8,570 entrepreneurial firms.

[7] Ewens and Rhodes-Kropf are advisors to and investors in the fund.

2.2 Variable construction

A critical variable of interest is the degree of round's "insidedness." The notion of an inside round concerns the dynamic identities of investors and the staging of financings. In each financing round t, for $t \geq 2$, investors that contributed capital in at least one prior round are called "Inside" investors or simply insiders. If an investor in round t did not participate in any of the prior financings of this company, that investor is called an "Outside" investor in round t. A dummy variable "Inside Round" equals one for financing round t if all investors contributing capital in this round are insiders. If there is at least one outside investor, then the round is "Outside Round." All equity financing rounds can therefore be classified as either "inside" or "outside" rounds. In robustness tests, we also use other definitions of insidedness. "Inside VC Round" equals one if all VC investors in this round are insiders. If at least one VC investor is new, it is then called an "Outside VC Round." Clearly, all rounds, for which "Inside Round" equals one, will also have "Inside VC Round" equal one, but the reverse is not necessarily true.

We also consider two continuous counterparts to these dummy variables. First, we specify the fraction of dollars provided by inside investors in financing round t of entrepreneurial firm i, KI_{it}:

$$KI_{it} = \frac{\sum_{j \in I_{it-1}} K_{ijt}}{K_{it}}, \tag{1}$$

where I_{it-1} is the set of inside investors (i.e., all investors that contributed in at least one round prior to round t), K_{it} is the total capital raised in financing t and K_{ijt} is the capital contributed by investor j (which can be zero).

Second, we also specify a similar fraction based on the number of investors. Let C_{it} be the set of all investors in financing round t. Then,

$$\text{FracInside}_{it} = \frac{\sum_{j \in I_{it-1}} 1[j \in C_{it}]}{\#C_{it}} \tag{2}$$

is the fraction of those investors that are insiders. The indicator $1[j \in C_{it}]$ is one if investor j is an investor in round t.

As a stronger alternative to the presence of outside VCs, we also consider the identity of lead investors in the financing round. Lead investors are those that contribute the most capital to the round and are in reality the drivers of bringing together the funding syndicate. We identify leads in two ways. First, VentureSource may flag an investor or multiple investors as leads. Second, if such a flag is not available, then we identify the lead as the investor who provides the most capital. The division of capital within a round and across investors is often missing for a subset of investors, so we split capital equally to those with unknown contributions. A round may be considered an outside round even though new investors may have contributed a small fraction to the financing. The presence of an inside lead VC investor is thus a strong indicator of insidedness. With this lead investor flag, a round is considered having a new lead investor if there is at least one new investor (i.e. outsider) who is also identified as a lead in the round.

To estimate the value of investments, we use the so-called "Pre-money" and "Post-money" valuations of entrepreneurial firms. The post-money valuation, V_{it}^{Post}, values company i in financing round t taking into account the capital K_{it} contributed in that round by investors on an as-converted-common equity basis. In venture capital transactions, investors typically receive convertible preferred stock, a security that is converted into common stock if the exit valuation is sufficiently high but is essentially a debt security if the exit valuation is low. In other words, the valuation assumes that all the securities issued to investors will be converted to common equity upon exit. Although it is a standard valuation technique in the VC industry, it is important to note that the valuation on an as-converted basis assumes that the eventual exit will be successful and all convertible preferred securities which VC investors typically receive will convert into common equity. We address these issues in Section 5. "Pre-money" valuation, V_{it}^{Pre}, is the valuation of the company in round t before the capital injection is taken into account. In other words,

$$V_{it}^{Post} = V_{it}^{Pre} + K_{it}. \tag{3}$$

We define the financing round t to be an "up" ("down", "flat") round, if the pre-money valuation in round t increases (decreases, is not changed) relative to the post-money valuation in round $t-1$

(that is, if $V_{it}^{Pre} > V_{it-1}^{Post}$, $V_{it}^{Pre} < V_{it-1}^{Post}$, $V_{it}^{Pre} = V_{it-1}^{Post}$, respectively). In empirical analysis, we often will combine the "down" and "flat" rounds.

We use entrepreneurial firm exit outcomes and investor returns as proxies for investment success. For outcomes, all deals can be classified as failed, non-failed, or still active. We consider a deal to be failed if the company is listed as out of business, in bankruptcy, or has been identified as not active through additional research.[8] In our sample, we also define a company as failed if it received the first VC funding prior to 2004 and is still registered as private in VentureSource. In other words, if the VC-backed company has not exited in twelve or more years after receiving its first funding, we consider it a failure. A company is considered non-failed if it had an IPO or was acquired. Finally, there are a number of companies founded in the past twelve years that have not exited yet and are labeled as "private."

An IPO dummy is used as one proxy for success. The IPO dummy is very popular among researchers (e.g. Lerner (1994b) and Sorensen (2007)) and is the most frequent measure of success used in the VC literature. However, the variable does not capital the many acquisition exits that are also great successes in terms of the exit valuation. Indeed, it is well known that there are more successful M&A outcomes where investors earn significant returns than IPO outcomes in the VC industry since 2000. We therefore define another dummy, "Good exit," which equals 1 if the outcome is either an IPO or an acquisition, in which valuation V_i is known and at least two times all the capital invested. While the exact threshold used in the definition of M&A "success" is necessarily ad hoc, our results are robust to using a higher threshold. Finally, we also use the eventual exit valuation V_i as an indicator of success. We have the value of this variable only in cases of IPO or M&A, i.e. the results are conditioned on non-failure. To control for the presence of many outliers, we use the log of exit valuation. Specifically, "Log exit valuation" is the log of the reported valuation at sale or IPO. For the latter, the valuation is the market capitalization of the firm at the offering price.

To calculate the return on a deal for non-failed investments, we require the final exit valuation (i.e., IPO valuation or acquisition price) and the dilution of equity due to subsequent financing

[8] We searched for active websites or founders with LinkedIn profiles that listed the entrepreneurial firm as still active.

events. We follow the literature on investment-level VC returns (e.g., Cochrane (2005), Korteweg and Sorensen (2010)) and focus on the "gross multiple" variable M_{it} for firm i in round t, which is defined as:

$$M_{it} = \frac{V_i}{V_{it}^{Post}} \prod_{s=t+1}^{T} D_{is},$$

where T is the total number of equity financing rounds, and the sequence D_{is} are the dilutive factors. Any time an entrepreneurial firm raises outside equity, the positions of previous investors are diluted by one minus the fraction of equity sold. That is, D_{is} is calculated as $1 - K_{is}/V_{is}^{Post}$, where K_{is} is the total capital raised in financing s. Future financings directly impact the equity stake of the investor in round t and therefore need to be taken into account. For example, suppose a second round financing is followed one year later by a new equity round that raises capital in return for 30% of the equity. The equity stakes of the investors in the second round financing will all fall by 30%, so that D_{it+1} is .7.

To calculate a return M_{it} for non-failed investments, one requires all the interim valuations between rounds t and T. Most cases, for which V_i is known but the interim valuations are missing, are the acquisitions, where V_i is less than the total capital invested. Here, we assume investors receive their capital back with the most recent investors being more senior for those exits where the exit valuation does not exceed total capital invested. That is, the last investors are first made whole, followed by the previous investors, as long as the capital is available. This approach assumes that each investor has the so-called senior $1X$ liquidation preference, a typical provisions in VC contracts.[9]

Throughout the analysis using returns, we winsorize the gross multiple at the 99th percentile as some of the right tail outcomes appear to be unrealistic (Cochrane (2005)). Another empirical problem is the positive selection of returns. Investments that eventually have an initial public offering have a relatively higher probability of their valuation reported. On the other hand, acquisitions are much less likely to have prices and returns reported, leading to positive selection in any venture capital returns data. For example, while only 10% of investment have an IPO, over

[9] We gain approximately 1,900 returns from this, however, the results are similar if we continue to treat these returns as missing.

35% of all observed returns in our data come from IPO outcomes. Conversely, acquisition returns are underrepresented in the sample of observed returns. We address this concern by following the Korteweg and Sorensen (2010) approach of re-weighting the observed returns using the true exit weights in the full sample. We first calculate the probability that any financing in the full sample has one of the three exit outcomes: IPO, acquisition, or failure. Next, we calculate the same exit rates in the sample of financings where we can calculate returns. It is here that the IPO exit rate is significantly higher than observed in the full sample. The regression weights are then the ratio of the true exit probability divided by the fraction of exits in the returns sample. This approach thus effectively removes the IPO bias in the returns sample by down-weighting IPOs and up-weighting the acquisition returns.

2.3 Descriptive statistics

Table 2 provides descriptive statistics on some basic characteristics of the sample. The standard features of financings such as financing year, industry distribution, and total capital raised are consistent with other research. In terms of final outcomes for firms that receive at least two rounds of financing, 888 or 10% of start-ups eventually become publicly listed companies, 44% are acquired, 31% are failures, and 16% are still private. Given the conservative nature of our definition of failure, the last category consists mostly of failures, too, given that they must have received their first equity financing between 2004 and 2008. Of course, many acquisitions are failures too, because in the VC industry acquisitions span a wide range in terms of valuations, from outright failures (penny sales) to huge successes, as demonstrated by Puri and Zarutskie (2012). We have the exit valuation for 2,343 acquired firms, that constitutes about 61% of the total acquired sample. Of those, 1,315 have an exit valuation that exceeds capital invested.

The average firm is founded in 1998, with the funding year and the company age widely distributed. More than 40% of the firms in the sample are from California, consistent with Silicon Valley being the world-wide hub of venture capital activity. As expected, the Information Technology sector comprises more than half of the sample, with the healthcare being the second largest sector. Other sectors, unreported in the table, include energy and retail. The average firm in the sample raises 4.2 rounds of funding, between the minimum required 2 (by sample construction) and the maximum of 20. Over 80% of the sample features syndicated investment, in which at least two investors provide capital in the round. On average, each round of financing features a participation of four investors and a total capital injection of $14.3 million. While the median round size is nearly $9 million, the amounts vary from insignificant rounds to the maximum of $1.5 billion. It takes on average 1.3 years for the firm to raise its next round of funding, consistent with the prevailing industry notion that most firms raise subsequent funding in about 12 to 18 months.

Valuations are known only for about 54% of the sample and gross multiple can only be estimated for 57%. Unreported, we find that for the subsample with valuations, the average capital raised is $14.9 million, similar to the $14.3 million value reported for the total sample. The average (median) post-money valuation of $86.5 ($38.5) million suggests that this subsample is biased, as expected, towards more successful companies. However, while the average gross multiple is a healthy 1.67, the median gross multiple is 0, indicating that in at least 50% of deals, for which this variable is reported, investors lose all of their money. The positive selection bias in this subsample thus ensures that investors are likely to lose on an overwhelming fraction of their investments. Only the presence of very successful outliers enables some VC funds to make up for losses and deliver positive returns on their portfolios.

Figure 1 shows the prevalence of inside rounds over the sample period along with the number of financings. Outside of the dot-com era, inside rounds account for a little over 30% of all financing events. Table 3 provides descriptive statistics of our main insidedness variables for the main sample (Panel A) and for the subsample, in which the financing valuation is known (Panel B). Inside investors constitute 63% of all the investors and contribute 62% of the capital in the next round of funding in an average deal. Unreported, the outside VCs constitute on average 22% of the financing round. The rest are non-VC new investors, such as corporations, angel investors, individuals or investment banks. In around 30% of cases, however, there are no new investors in the round and 45% of the cases there are no single new outside VC investor. Moreover, in 59% of cases, the round does not feature a new lead investor. Taken together, these findings suggest that the rounds in which only insiders participate are more common in the VC industry than some previous anecdotal evidence may have led researchers as well as industry insiders to conclude. Evidence from Panel B is broadly consistent with these findings.

2.4 Inside vs non-inside rounds

Thus far we have established that inside rounds are surprisingly more prevalent than currently thought. But are these inside rounds truly different? In this section, we provide some preliminary comparisons between inside and outside rounds. Figures 2–3 and Table 4 consider differences in valuation, capital raised, returns, and other financing-related variables.

Figure 2 compares the change in valuation between two subsequent rounds by showing the kernel densities of the ratio of pre-money valuation in the round to the post-money valuation in the previous round, $V_{it}^{Pre}/V_{it-1}^{Post}$, for inside and outside rounds. This ratio captures the relative gain in value for existing investors and is a good indicator of whether the entrepreneurial firm is moving in the right direction. Because the venture capital market typically does not have an established secondary market, these returns are not directly earned by investors, but they represent an implied return to investment. However, they are especially informative in inside rounds, because they represent the differences in prices paid by the same investors over two rounds of financing. A value of 1 is known as the "flat" round (also singled out by the vertical line in the figure), less than one is "down", and greater than 1 is "up." Effectively, for firms experiencing down or flat rounds the news is negative, either because of the idiosyncratic shocks or changes in the macroeconomic situation.

The figure shows that inside and outside rounds experience different valuation dynamics. Inside rounds are much more likely to be down rounds and also have a larger mass at around 1. Moreover, the inside density attenuates much faster, implying lower likelihood of a round with a large increase in valuation. Taken together, the figure clearly shows that inside rounds are relatively worse in terms of valuation dynamics than outside rounds. Assuming that the positive selection is the same for inside and outside rounds, the figure presents a conservative picture of the fraction of down valuation changes. A number of economic mechanisms can be at work here, but one that is consistent with the emerging picture is the hold-up of the founders by venture capitalists, to the extent that VCs exercise bargaining power in inside rounds by diluting non-participating stockholders, including the founders.

To check that the difference between inside and outside rounds indeed persevere, Figure 3 presents kernel densities by the log of capital raised, the financing variable that is available for most of the rounds in our dataset. The vertical line shows the mean log capital invested, which translates to $14.3 million in mean dollars. The figure shows that the two round types differ significantly. Inside rounds raise smaller amounts of money than outside rounds. Small amounts of capital invested in inside rounds could imply that these rounds are quickly completed and may in fact be hidden bridge rounds, as argued by Broughman and Fried (2012). For example, such rounds could be used by insiders to quickly provide capital to startups when facing both internal and external shocks. Unreported results show, however, that when we repeat the analysis that excludes what appear to be bridge rounds (tenth of all financings that raise the least capital and a quarter of all financings that are the earliest to be followed by the next financing), the results remain unchanged.[10]

Table 4 compares inside rounds to outside rounds and to the full sample along a number of other dimensions. Several results that stand out provide further differentiation between inside and outside rounds. Inside rounds raise on average more rounds of funding, are backed by VCs for a longer period of time, and the firms who raise them are older. However, the span of time it takes for start-ups to raise the next round of funding is the same for inside and outside rounds, suggesting that while firms with inside rounds survive longer they do not raise funding at different time intervals. While the round syndicate size is – as expected – significantly smaller for inside rounds, the total number of investors (that includes all previous investors) is virtually the same for inside and outside rounds. Inside rounds are much more likely to be a "down" or a "flat" round. In the subsample, for which we have the valuation data, these value-decreasing rounds comprise 39% of inside rounds but only 20% of outside rounds. Finally, inside rounds feature significantly lower returns than outside rounds. The mean (median) gross multiple for inside rounds is 1.28 (0) versus 1.83 (0.3) for outside rounds. Also, there are more inside rounds with the zero gross multiple.

Taken together, these results suggest that inside rounds are not only surprisingly frequent in the VC world, but are also truly different than outside rounds. They also provide a first glimpse into the economics of inside rounds, suggesting that different economic mechanisms can be at play

[10]See the Internet Appendix for the figure and summary statistics.

in each type of round. In the next sections, we first investigate to what extent inside rounds can be used as a predictor of entrepreneurial firm outcomes and investor returns and then explore in more detail economic mechanisms that could be driving these results.

3 Insidedness as predictor of outcomes and returns

In this section, we explore the impact of insidedness on entrepreneurial firm outcomes, valuation, and investment returns. We find that insidedness is a strong predictor of these economic measures.

3.1 Inside rounds and entrepreneurial firm outcomes

Success in the VC industry is achieved either through an IPO, widely considered to be the major objective in the VC industry, or as a combination of IPO and a highly valued M&A. The first question we tackle is whether insidedness matters for explaining exit outcomes. If inside rounds are a selection of lower quality investments, then we should expect to observe worse outcomes. Alternatively, if the average inside round represents the insiders keeping the best deals to themselves, then we should find the opposite. Finally, if the observable features of the investors at the time of financing have little bearing on investment success, we should observe no relationship between inside rounds and eventual outcomes.

Table 5 reports the results of this analysis, where we regress the eventual outcome of the VC-backed firm on insidedness and control variables. We consider three outcome variables. First, we define an IPO dummy as one proxy for success. While the IPO dummy is very popular among researchers (e.g. Lerner (1994b) and Sorensen (2007)) and is the most frequent measure of success used in the VC literature, an important problem with this dummy variable is that many acquisition exits are also great successes in terms of the valuation. Indeed, there are more successful M&A outcomes where investors earn significant returns than IPO outcomes in the VC industry since 2000. We therefore define another dummy, "Good exit," which equals 1 if the outcome is either an IPO or an acquisition in which a valuation is known and at least two times all the capital invested.[11] All acquisitions with valuations less than two times capital are thus treated as "failures." Finally, we

[11] The results are robust to using a higher threshold.

also use the eventual exit valuation as an indicator of success. We have the value of this variable only in cases of IPO or M&A, i.e. the results are conditioned on non-failure. To control for the presence of many outliers, we use the log of exit valuation. Specifically, "Log exit valuation" is the log of the reported valuation at sale or IPO. For the latter, the valuation is the market capitalization of the firm at the offering price. In all specifications, we control for geographic (the state of entrepreneurial firm headquarters), industry (based on VentureSource's industry classification), and founding year fixed effects.

The first three columns of Table 5 show our benchmark results. The first two columns present results of a probit estimation and show a strong, negative relationship between inside rounds and high-quality exit outcomes. Translated into the marginal effects, these estimates predict a 14% lower probability of an IPO and a 22% of a "Good exit" if the firm had at least one insidedness round.[12] Relative to other explored determinants of VC-backed firm outcomes, participation of new investors in follow-up rounds turns out be economically a very important variable. It is well known that the bulk of returns in the VC industry is a function of a small number of successful exits (e.g. Sahlman (1990)). Given that the difference between funds in top and bottom performance quartiles can be an artifact of a couple of IPOs or good exits, the difference in outcome that we observe can translate into meaningful VC fund outcomes (see Section 3.2.2). The results for the log value are similar, but economically even larger: firms with at least one inside round have a 30% lower exit valuation conditional on not failing. From Table 4 we know that the average firm with an inside round fails more often, so the total difference in exit valuation should in fact be larger than 30%. Columns (4) and (5) repeat the analysis with the alternative measure of insideness – no new lead investors – and the results are similar.

One explanation of these findings is that insidedness proxies for struggling companies that are more likely to have poor outcomes, despite receiving follow-up funding injections. Indeed, in unreported regressions, we show that inside rounds have a 15% to 25% lower changes in interim valuations (i.e. valuations between the current round and the previous round) than outside rounds. This implies that inside rounds imply a substantial downward revision of expectations about the

[12] Unreported, the linear probability model implies larger marginal results of a 22% lower probability of an IPO and a 30% of a "Good exit," assuming a constant linear effect.

final valuation of the company. While we cannot use round-level interim valuations in a firm-level regression, an obvious proxy for a poorly-performing VC-backed company is a down round. Recall that a round is called a "down" one if the pre-money valuation in the current round is lower than the post-money valuation in the previous round. Down rounds significantly dilute common shareholders (founders, employees) and typically dilute non-participating existing investors. They clearly indicate that the worsening prospects of a successful outcome. The final three columns include a dummy variable which equals to 1 if the firm had ever at least one down round. As expected, this dummy is significant. For example, if the company ever had a down round, its likelihood of an IPO is lowered by 19%. The inclusion of down rounds, however, has very limited impact on the importance of inside rounds. For example, firms with at least one inside round have a 20% lower exit valuation.

Another explanation of the findings in Table 5 is that inside rounds proxy for years in which the VC funding market was in poor shape. This is difficult to control in a firm-level specification. In unreported regressions, we estimate equivalent models at the round level, where we can controlling for funding year fixed effects. The results stay economically very similar. For example, in the sample of all second round financings, inside rounds imply a 21% (28%) lower probability of an IPO (good exit) and a 40% lower valuation. Last, one concern is that inside rounds investors are lower experienced and lower quality. We repeat the estimation in Table 5 with venture capital firm fixed effects – where an observation is a firm-investor – and the results are unchanged. Taken together, these results suggest that insidedness is an important explanatory variable on its own.

We next take up an important issue of whether this affects investment returns.

3.2 Inside round and investment returns

So far we have shown that inside rounds are characterized by lower success rates and exit valuations. The importance of insidedness for *returns* can stem from a number of economic mechanisms. The null hypothesis is that in the efficient Modigliani-Miller world, the composition of investors should not matter. It can impact the outcome, but not the cash flows of contracting parties. Therefore, studying the cash flows post inside rounds is of crucial importance. In most, if not all, VC transactions, all cash flows materialize at the moment of exit. Studying final returns is thus the best way to capture the financial relevance of insidedness. Of course, the VC industry is full of frictions that give rise to competing conjectures. Importantly, for any friction to have an impact, it should not be fully reflected in prices at the time of the inside round.

One possible explanation is the hold-up problem, in which participating investors use their increased bargaining power to unfairly dilute non-participating investors and common shareholders. The observation that the valuation at the time of the inside round is substantially lower than for similar outside rounds is consistent with hold-up. Hold-up could result from a number of frictions, all of which lower outsiders' desire to invest and increase the bargaining power of the insiders vis-a-vis the entrepreneur. However, for hold-up to work for insiders, participating investors in the inside round should end up with higher returns (and definitely not lower returns) in expectation.

Another possibility is that on the balance inside rounds are suboptimal and should not have been made in the first place, definitely at the realized valuation at the time of the round. In essence, investors are overpaying for the equity in company. This outcome could follow from investor overconfidence or the sunk cost effect. In this case, the expected returns of investment in this round should be negative. There also can be an agency conflict between VCs and their investors that can lead VCs to over-invest, gamble for resurrection, refuse or delay writing down their investments (e.g. Brown, Gredil, and Kaplan (2015) and Chakraborty and Ewens (2015)) or respond to a lower opportunity costs after the investment period. Agency conflicts generate a wedge between the true value of the investment and that of the VC investor. This leads the VC to again overpay for investments, earn lower expected returns and make suboptimal investment decisions.

Finally, the difference in returns between inside and outside rounds can be due to the different risk profile of these investments. We come back to this discussion below.

3.2.1 Studying various investment returns

In this section, we explore whether the returns to investment depend on insidedness. Table 6 reports the results on financing-level returns using the exit-weighting selection correction discussed in Section 2.2. The dependent variable is the log of the gross multiple M_{it}, which measures the return of a hypothetical dollar invested in this financing round accounting for expected future dilution. While this measure ignores the time value of money, it is a good first step of a comparative analysis of returns.[13]

We again use two measures of insidedness, the dummy indicating whether the round is a full inside round and a dummy whether the round did not have a new outside lead investor. The first four columns present the benchmark results. In the first two regressions, we include the full sample of observed gross multiples. For these regressions, we have to make an assumption about the recovery of investors' capital in the case of failure. There is virtually no empirical evidence of the size of this recovery. In principle, investors generate recovery by selling existing assets, such as patents, as well as recouping unspent cash in the bank that was invested in the previous rounds of funding. Existing research uses a wide range of recovery rates (i.e. Cochrane (2005) and Korteweg and Sorensen (2010)). We set the recovery of investors in the case of failure to the log of 25% of capital invested, and our results are robust for a wide range between 10% to 30%. Additional control variables include capital raised in this round, total capital raised prior to this financing, time since last financing, total number of VC investors, and firm age at the time of financing. As in Table 5, the regression includes industry and state fixed effects. We also control for the financing year and round number fixed effects.

The insidedness coefficients imply a 15%–16% lower gross returns in inside rounds. Because our assumption about the recovery rate of investors in the failure cases is inevitably ad hoc, we also consider, in Columns (3) and (4), the subsample that includes only those firms that exited and for which we have the valuation data. For both insidedness variables, returns are now lower by about 10%. Because failures are more likely in inside rounds, a decrease in the wedge between inside and outside rounds after excluding failures is expected.

Note that companies with at least one inside rounds are more likely to exit via an M&A route. In our sample, 42% result in M&A relative to 35% for those companies with outside rounds only. As the valuations of M&A occurrences with lower returns are less likely to be reported, returns of inside rounds are likely even lower than those reported in the table. At the same time, there are several factors that could potentially unfairly lower insider rounds returns. One concern is that

[13] Inside rounds investments exits slightly faster than outside rounds – around 4 months – which we address below with a present value measure.

the measures we employ do not take into account the present value of money. If exits on inside rounds tend to occur quicker, this would lower expected returns. Indeed, unreported in the table, in a regression of time to exit on the insidedness of the round and control variables, having an inside round implies an exit shorter by about four months. The fifth column of Table 6 therefore calculates the return accounting for the time to exit. We calculate a simple net present value of the investment using the realized time to exit and cost of capital r_{VC}:

$$\mathrm{PV} = \frac{K_{it} M_{it}}{(1 + r_{VC})^T} - K_{it}$$

We assume the cost of capital of 20% (see Metrick and Yasuda (2010)'s review of literature), but the results are similar for other sensible values. Column (5) presents the results, again with a negative coefficient on the inside round indicator. The estimated coefficient implies a $2.4m lower present value for inside rounds and more importantly suggests that time to exit is not driving the results in columns (1) - (4). Of course, column (5) assumes that inside and outside rounds have the same risk profile.

Another important concern is the riskiness of venture capital investments. For example, if inside rounds are less risky, then expected returns should be lower. So we next estimate the CAPM regression of log returns for both inside and outside rounds following the methodologies of both Cochrane (2005) and Korteweg and Sorensen (2010). For each financing-level investment, we track the S&P 500, risk-free rate and Fama-French factors from initial capital infusion to exit date (i.e. t to T). From this we can calculate the standard factors in the 3-factor model that sync with the VC investment. As the returns are non-periodic and may span 2-3 years, we follow the generalized least squares procedure of Korteweg and Sorensen (2010). The main difference presented here is a lack of the first-stage selection regression, which likely attenuates the factor loadings. Insofar as inside and outside rounds exhibit similar such selection problems, this should not effect inference. The estimated coefficients on the three-factors are reported Table 7.

First, the full-sample beta is reassuringly quite similar to that reported in Korteweg and Sorensen (2010), which provides evidence that we capture the average correlations found in earlier work. Comparing columns (3)-(4) and (5)-(6), the loading on the market factor is lower for the inside rounds. Thus, the concern that inside rounds appear to be of lower risk is justified. Again, the lack of the dynamic selection correction may dampen the loadings – too low a β and too large a loading on SMB and HML – so we approach these results with caution. Does the difference in factor loadings have a material impact on our estimates in Table 6? The following back of the envelop estimation attempts to adjust for differences in risk. If we assume the base cost of capital of 20%, as well as that alpha is zero, the estimates of the relative betas in the single-factor model from Table 7 imply that inside rounds have an average cost of capital of 15% and outside rounds – that of 21%.[14] This cost of capital differential is arguably economically very substantial. The sixth column in Table 6 repeats the present value estimation assuming the differential risk return profile for inside and outside rounds. The results suggest that the cost of capital is not the main driver of the difference between inside and outside round returns. In fact, only when we assume a cost of capital of 30% for outside rounds and 15% for inside rounds does the difference in column (6) disappear.[15] To summarize, our analysis suggests that the risk is indeed different in inside rounds, but the difference is not large enough to explain the differences in realized returns.

The final column of Table 6 extends the analysis by including VC firm fixed effects. Introducing VC firm fixed effects allows us to address two further major and related concerns about the previous results. First, inside rounds may simply be conducted by relatively worse investors who have more behavioral biases or suffer from worse incentive frictions. Second, VC firm quality is highly correlated with investment quality (e.g. Sorensen (2007) and the importance of deal flow) so the VC firm fixed effect partially addresses the cross-sectional variation of entrepreneurial firm quality by comparing investments in the same VC firm. Inside rounds may simply be done by relatively worse VCs, so we are simply capturing differences in investment quality. A VC firm fixed effect compare inside and outside rounds *within* the VC firm portfolio. Column (7) of Table 6 shows that all the patterns found in the first set of results remain. Thus, VC firm time-invariant quality and, in turn, some unobserved entrepreneurial firm qualities cannot explain the results. More importantly, the

[14] The assumption of zero alpha is sensible. Korteweg and Sorensen (2010) find that an additional "VC factor" materially impacts the abnormal return, suggesting that omitted factors are major drivers for the large alpha.

[15] One possible means of generating a larger factor loading for outside rounds is the dynamic selection correction, which is excluded here. The Korteweg and Sorensen (2010) results show that the selection correction increases the absolute value of most loadings, particularly the market factor. Thus, we would have to believe that the selection issue is relatively *more* severe in outside rounds to increase the expected return estimate from the CAPM.

fixed effects estimates imply that within the average VC firm portfolio, inside rounds are relative underperformers in terms of returns.

3.2.2 Inside rounds in fund portfolios

The returns studied thus far provide a view of investment outcomes. Investors in venture capital – i.e. limited partners – are concerned with the performance of a fund as-a-whole. Absent rich cash flow data for funds in our data, we now present a rough view of how inside rounds in a fund correlate with total fund performance. We ask whether the prevalence of inside rounds in a VC fund predicts the performance of the remaining outside rounds. As before, the outcome measures are IPO, quality exit and exit valuation. The data buckets all investments in our main sample by five-year increments over a VC investor's life and calculates the fraction of inside rounds as the main independent variable. We count the number of entrepreneurial firms with outside rounds in these "funds" that had one of the outcome variables (or the average exit valuation). If VCs with more inside rounds underperform at the portfolio level, then we would predict relatively worse outcomes for outside rounds. Alternatively, perhaps the underperformance of inside rounds is offset at the fund-level by over-performance of outside rounds. Table 8 presents the cross-section and VC firm fixed effect results for the three dependent variables. Across each specification, more inside rounds within a fund correlate with worse performance of the remaining outside rounds. The models all include fund sequence and vintage year FE, thus control for experience and potential cyclicality across VC funds. Again the VC firm fixed effects results – columns (2), (4) and (6) – show that more inside rounds in a VC firm's fund leads to worse performance within the VC firm collection of funds. Overall, inside round returns are lower in isolation and correlate with lower overall portfolio performance.

4 Explaining inside rounds

In this section, we consider a number of mechanisms that can explain the impact of inside returns on eventual outcomes of returns.

4.1 Is it negative NPV?

The results in Section 3 clearly show that, compared to outside rounds at the same stage of financing, inside rounds lead to worse outcomes. In other words, investors should prefer outside to inside rounds, other things equal. However, these results do not imply that participating insiders made suboptimal continuation or pricing decisions. Although the insiders' past investments are sunk, their existing and active stake is not. In other words, insiders have an additional consideration absent from any outsider's evaluation of the investment opportunity: supporting their current equity position and maintaining their real option. The existing investors face the following trade-off in inside rounds. On the one hand, if they do not reinvest, they avoid lowering their expected return on the new investment and save the capital for allocation to other more profitable opportunities. On the other hand, not reinvesting would likely imply their existing equity stake earns nothing if the round does not proceed and the company fails.

A true metric of insiders' incentives in this case is the NPV analysis that takes into account the full payoff on their new and existing investments. If the NPV is positive, the implication would be that although inside rounds perform worse on average compared to outside rounds, they are rational for insiders given the value of preserving their option. On the other hand, a negative NPV would reveal that the any additional time given to the insiders through reinvestment does not sufficiently increase the expected returns to compensate for the cost of investment. Thus, it is likely some behavioral explanation or agency friction is at play and one could conclude that the average inside round is in fact "good money after bad."

In this section, we perform the NPV analysis of insiders' decisions. Any NPV analysis requires an assumption about two important inputs: cost of capital and recovery rates. Suppose that failing to find outside investors, the inside investor walks away from the investment. Upon doing so, she can recover some fraction γ of her past invested capital. The outside option is the expected return of the VC which according to several studies (e.g. Korteweg and Sorensen (2010)) and a review of the literature (Metrick and Yasuda (2010)) is around 15–20%. Note that the recovery rate can be relatively high for two reasons. First, in the case of liquidation, VC-backed companies typically possess valuable assets, such as patents, equipment, or paying customers that could be acquired by a competitor. Because of liquidation preferences, investors have the most senior position and would receive every single dollar realized from the sale of these assets. Second, if the investors walks away from the deal, the company may still survive by attracting other existing or new investors. Although the existing stake of the non-participating investor is typically heavily diluted, she should expect to recover a fraction of her investment.

If an investor reinvests capital K_{ijt} in the inside round for an equity position K_{ijt}/V_{it}^{Post}, her total equity position is now:

$$e_{ijt} = \frac{K_{ijt}}{V_{it}^{Post}} + \left(1 - \frac{K_{it}}{V_{it}^{Post}}\right) e_{ijt-1},$$

where e_{ijt-1} is her previous equity position. The previous stake is diluted by the new investment. The insider compares the cost of investing in the inside round, which equals to K_{ijt} plus the forgone recovery value from liquidation $\gamma \sum_{s=1}^{t-1} K_{ijs}$, to the expected value conditional on investment $E_t[V_i]$. Let r_{VC} be the VC cost of capital and T the expected years to exit. Then the insider's decision can be summarized as:

$$\frac{E_t[V_i] e_{ijt} \prod_{s=t+1}^{T} D_{is}}{(1 + r_{VC})^T} - K_{ijt} > \gamma \sum_{s=1}^{t-1} K_{ijs}, \tag{4}$$

where $E_t[V_i]$ is the expected exit valuation of the entrepreneurial firm at time t and $\prod_{s=t+1}^{T} D_{is}$ captures the future dilution. All terms including T and D are expectations formed at the investment date t.

As the baseline case, we assume a 25% recovery rate and the cost of capital of 20%. We start with the distribution of observed returns for all inside rounds in our data. We then use simulation to estimate the distribution of expected NPVs for each inside round. The Internet Appendix describes the simulation procedure in detail. Table 9 presents a summary of the resulting NPV distribution. The first row of Panel A shows the baseline case. The average NPV is negative, with 94% of observations resulting in negative expected returns. Note that the average NPV is negative, even though there are some very dramatic positive outliers. Panel A confirms that NPV is negative for various reasonable levels of the cost of capital. Panel B shows that NPV stays negative even if the recovery rate is lowered to 10% (the lowest assumed in Korteweg and Sorensen (2010)). A lower recovery rate makes reinvesting a more attractive option by increasing the cost of walking away. Yet, this is not sufficient to make the average NPV positive.

Overall, the evidence in Table 9 demonstrates limitations in the defense of the average inside round through a real option argument. The average inside round appears to be a suboptimal continuation decision. Insiders are on average unable to sufficiently decrease the chances of investment failure to compensate for the additional capital required and lost recovered investment.

4.2 Potential drivers of inside rounds

The first prediction about inside rounds and returns was that of holdup, where the venture capital can exert their bargaining power to extract surplus from the entrepreneur. The returns results rule out this explanation out as the inside investors underperform their outside counterparts. One would predict that the returns would at least be the same under a holdup argument. We now discuss several alternative explanations driven by a class of agency problems.

Fundraising and reputation-building are an important component of VC investment decisions and compensation (e.g. Brown, Gredil, and Kaplan (2015) and Robinson and Sensoy (2013)). The incentive to gain reputation as a quality investor may change investment strategy through quicker exits (e.g. Gompers (1996)) or delaying the reinvestment in worse companies (Chakraborty and Ewens (2015)).[16] Inside rounds could be another feature of investment strategy that responds to this agency issue. Inside rounds in fact fail at a higher rate, with little evidence of any offset by a higher likelihood of large exits. Nonetheless, perhaps VCs invest in inside rounds in the hopes of salvaging poor recent performance by "gambling for resurrection." This explanation predicts that we should observe more inside rounds when VC firms have suffered worse relative performance. Column (1) of Table 10 presents a VC firm fixed effect regression where the dependent variable is a dummy for whether the VC participates in an inside round.

A unit of observation is an investor and financing for all second round and above rounds. We track the reinvestment or follow-on decisions and round characteristics of inside investors. All specifications include VC firm fixed effects. The variable of interest in column (1) is a dummy

[16] Chung, Sensoy, Stern, and Weisbach (2012) and Hochberg, Ljungqvist, and Vissing-Jørgensen (2013) show that LPs respond to past and interim performance.

variable that is one if the VC investor had an IPO or acquisition that exceeds two times capital invested in the past year.[17] Our prediction is that VCs with weak recent track record may be willing to invest in relatively worse investment at high prices in an attempt to improve returns. The results indicate that a lack of quality exits in the recent past translates to a 20% higher probability of participation or leading an inside round. We conclude that there is some evidence of "gambling for resurrection" insofar as VCs believe that inside rounds have some chance of having a large exit given the high failure rates.

Inside round behavior could also mirror the practice of "evergreening" found in banking, which was particularly pronounced in Japan during their last major recession (Peek and Rosengren (2005)) and in Italy after the Lehman bankruptcy (Albertazzi and Marchetti (2010)). Evergreening results in banks delaying recognition of losses and rolling over relatively worse loans. Banks may have regulatory and signaling incentives to provide refinancing to their worst investments. Similar incentives could exist in venture capital that would lower the effective cost of capital to participating insiders and "justify" the inside round returns. Evergreening in VC would be most pronounced during fundraising, where VCs want to signal their ability to produce high returns and postpone writeoffs. Here we predict relatively more inside rounds during fundraising periods. Column (2) of Table 10 considers the variable "After fundraising" that is one is within one year of successfully or unsuccessfully raised a new fund.[18] We restrict the sample to VC investments in the four year window around a fund closing and find that inside rounds are in fact less likely. This type of evergreening does not appear to be an important predictor of inside rounds.

A final prediction stems from the features of investment and compensation over the VC fund life-cycle. In the first five years of a fund – the investment period – VCs make choices across both new and existing investments. The latter follow-on investments are thus judged relative to new investment opportunities. Post-investment period, VCs are restricted from making new investments and thus must choose among existing opportunities. This shift may change the opportunity cost within a fund. VCs earn management fees regardless of whether the capital is invested (VCs rarely return capital), but they earn a carry on any non-negative return. Thus, in the post-investment

[17]The results are robust to using a two-year window.

[18]See Chakraborty and Ewens (2015) for variable construction.

period fund any positive return earns carry. This explanation predicts that VCs will significantly increase the rate of inside rounds after the investment period and moreover, that the returns to inside rounds will be lower after this period.

Column (3) introduces a variable that captures the stage of the investor's fund. The dummy is one if the fund age is greater than five, which is typically when investors complete making new investments. Column (4) breaks out fund age by year dummies to isolate the dynamics of the participation in inside rounds, where the excluded year is fund age of five. The results show an increasing rate of inside rounds by fund age, which increases dramatically after year five leveling offer thereafter. In an unreported VC firm fixed effects regression, we also find that inside rounds done in the first five years of the fund outperform similar inside rounds done later in the fund. Combined with the estimates in column (2), inside round participation and lower returns stem from the shifting opportunity cost over the VC fund life-cycle.

5 Robustness and Discussion

Insidedness plays an important role in the outcomes of VC-backed companies. In this section we explore a number of potential explanations for the observed differences, as well as discuss various robustness tests that deal with measurement issues with investment returns.

5.1 Can preferred stock explain the results?

The gross multiple used above assumes that the investor purchases a share of common equity or, equivalently, the investor's security is converted into common equity upon exit. As is well known, most VCs purchase preferred shares which include participation and liquidation rights. Bengtsson and Sensoy (Forthcoming) show that rounds with flat or lower valuations are more likely to have stronger senior or cash flow rights. Inside rounds are more likely to be both flat or down, so it is possible that these contract features come into play when an inside round occurs. If this is the case, then we could be underestimating the true returns earned by investors in inside rounds. The next two tables address whether inside rounds are more likely to have non-common contract features.

Table 11 uses the database of VC contracts provided by VC Experts. This data set includes a sample of VC-backed companies primarily financed after 2005 and provides information on the contractual provisions of securities held by VCs. The data set comes from extraction of terms from articles of incorporation filed in the state of Delaware and California. For our analysis, we are concerned that the common equity assumption underestimates the true returns earned by the VCs. Several contract features would improve the VC returns. Liquidation preference provides downside protection for a preferred shareholder than can guarantee at least one times capital invested. These preferences can reach two or three times capital invested. Next, preferred stock seniority provides an investor additional downside coverage and priority in lower quality liquidation events. Third, the insider can purchase "Participating preferred" stock that provides both the liquidation preference and the ability to participate in the upside without conversion. Finally, a preferred shareholder can have redemption rights which act as a put on their equity investment after some period of time. This right can provide bargaining power in liquidation events.

Each column of Table 11 asks whether there is a correlation between observed contract features and inside rounds. If insiders are shifting to the contracts that are more friendly to VCs, then the common equity assumption is an underestimate of average returns earned. The merge of VC Experts with VentureSource results in over 1,400 financing events with known contracts. Columns (1) - (4) show that insidedness is not statistically related to these contract features. For example, in Column (2) a dependent variable is a dummy that equals to one if the liquidation preference of the financing is greater than "one times" (known in the industry as "1x"). There is a weak positive relationship between insidedness and liquidation preference, which is not significant. The table also reports the mean of each dependent variable unconditionally and conditional on inside rounds. Again, the inside rounds tend to have slightly friendlier terms than outside rounds, but the difference is small.

5.2 Adjust returns for stronger contracts

As a final check on the measurement of returns, we ask whether better cash flow rights of VCs through strong downside protections can explain the results. In unreported regressions, we impose strong contracts on returns to inside rounds as an attempt to compensate for any switch from standard equity to debt-like returns. In column (4), all inside rounds that have a return greater than 0 and less than two time capital invested are given a two times capital return. Similarly, outside rounds with observed multiples between zero and one are assigned the latter. This adjustment improves the returns on the average non-failed inside round. This is an extreme assumption, because the observed fraction of $2X$ liquidation in the full VC Experts database is less than 15%, while this adjustment results in over 35% of inside rounds having such a feature. As expected, the coefficient on the inside round dummy decreases; however, we still find a statistically significant negative relationship with returns. We conclude from this exercise that it is unlikely that strong preferred contract features would explain away the main differences in financing returns.

5.3 Too little capital?

The amount of capital invested is a strong predictor of outcomes. As Figure 3 shows, inside rounds are on average significantly smaller in terms of capital raised than outside rounds. To better understand if the size of the inside round is driving the lower returns, we construct a dummy variable "Capital ramp down." The variable tracks the sequence of capital raised between two sequential financings of an entrepreneurial firm and equals to one if the change in capital raised is in the bottom quartile of changes across the sample. A small or negative change in capital raised across financings could signal worse prospects or strong financing constraints for the firm. If within-firm capital ramp downs drive poor results, the interaction of this dummy with inside round should be negative. In unreported regressions we find that the while a ramp down predicts worse returns as expected, there is no difference within the sample of inside rounds. Thus, within-firm capital restrictions for inside rounds is unlikely to drive the returns differences. Moreover, the results here show that backstop financing (e.g. Broughman and Fried (2012)) do not explain our main conclusions about return differences.

6 Conclusion

The results above present a view on the relationship between outside investor participation and entrepreneurial firm investment outcomes. We study sequential investment decisions in the venture capital (VC) industry. VC-backed companies typically need to raise several rounds of funding from VC funds, and the decision whether to provide further funding to the company as well as the terms of the new funding determine to a large extent the returns of VC funds and their ability to back successful companies. We show that investment outcomes in the VC industry can be predicted by whether the existing VC investors can attract new outside investors to participate in the next round. Inside rounds, in which only existing investors participate, lead to a higher likelihood of failure, lower probability of IPO, and lower cash on cash multiples than outside rounds. We explore to mechanisms that explain these stylized facts: the escalation of commitment that leads VC investors to irrationally make negative NPV decisions, and shifts in opportunity costs in the VC fund life-cycle that alter investment strategy.

7 Figures and Tables

Figure 1: Inside rounds over time

Notes: The figure reports the fraction of inside rounds from 1995 - 2014 as defined in Section 2.2.

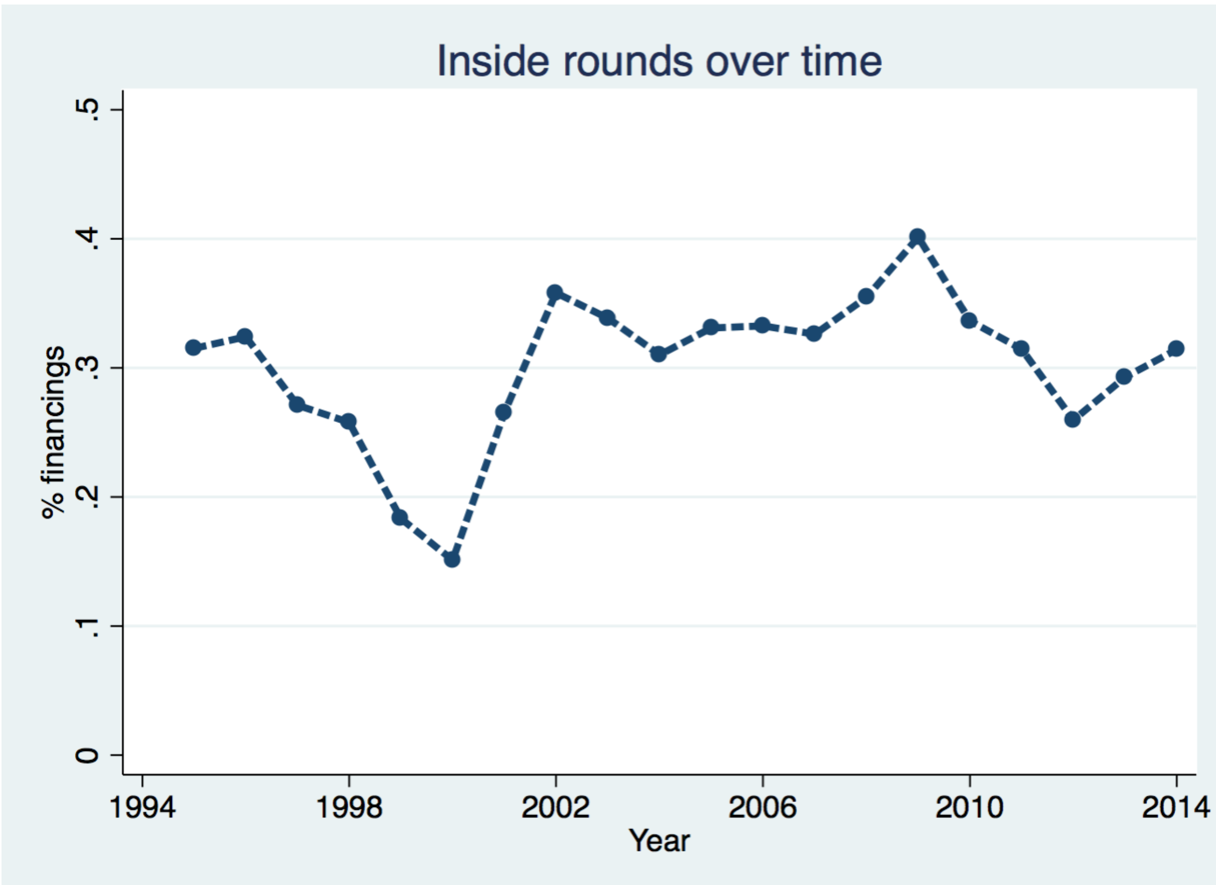

Figure 2: Change in valuation: inside vs. outside rounds

Notes: The figure reports the ratio of the current financing pre-money valuation over the previous financing's post-money valuation $V_{it}^{Pre} = V_{it-1}^{Post}$. We can only calculate this ratio for two financings where valuation is revealed. This sample is positively selected towards high-quality entrepreneurial firms (e.g. those that go public). The red vertical line is for the ratio value of one, which is called a "flat" round.

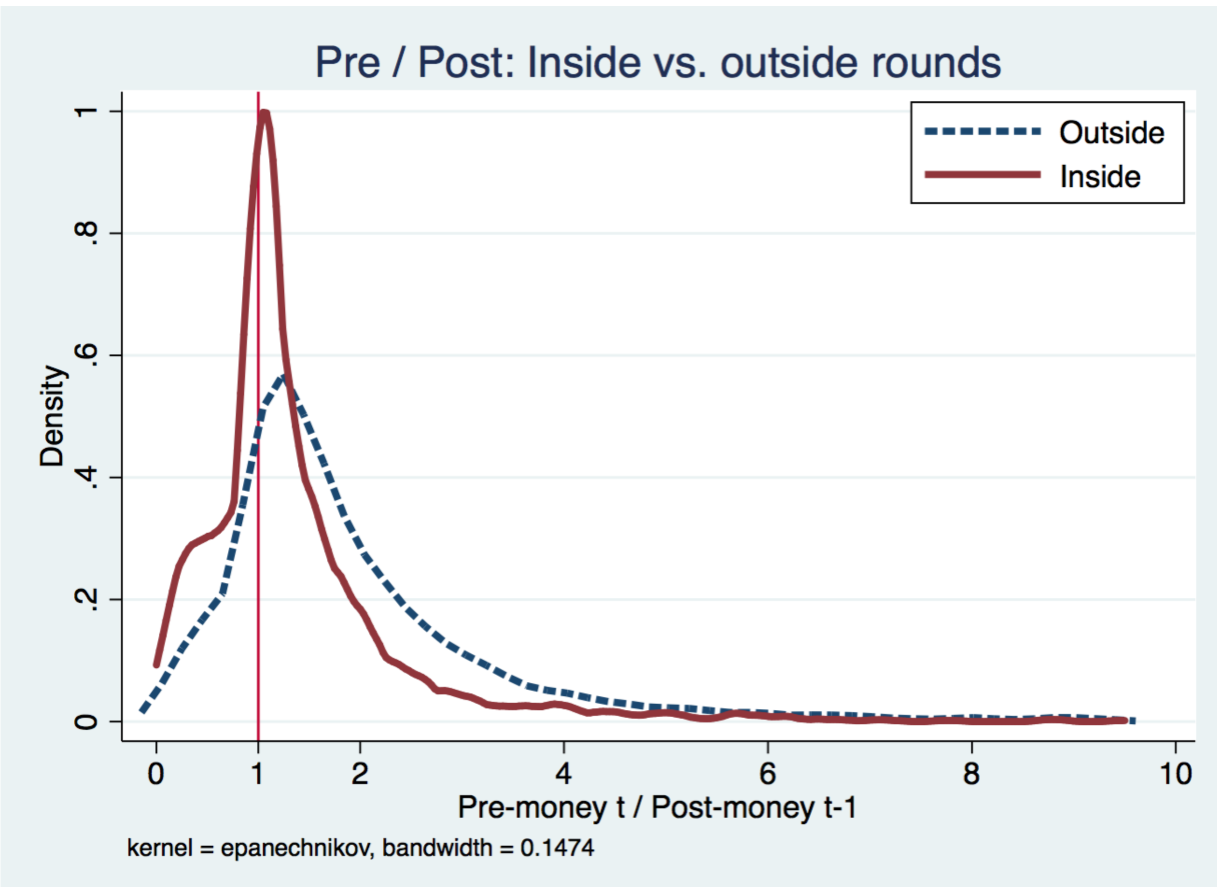

Figure 3: Log capital invested: inside vs. outside rounds

Notes: The figure reports the kernel densities of log of capital invested for a financing event in two samples. “Outside” are those financings with at least one VC investor who is new to the pool of investors. “Inside” are those financings where all investors were previously invested in the firm.

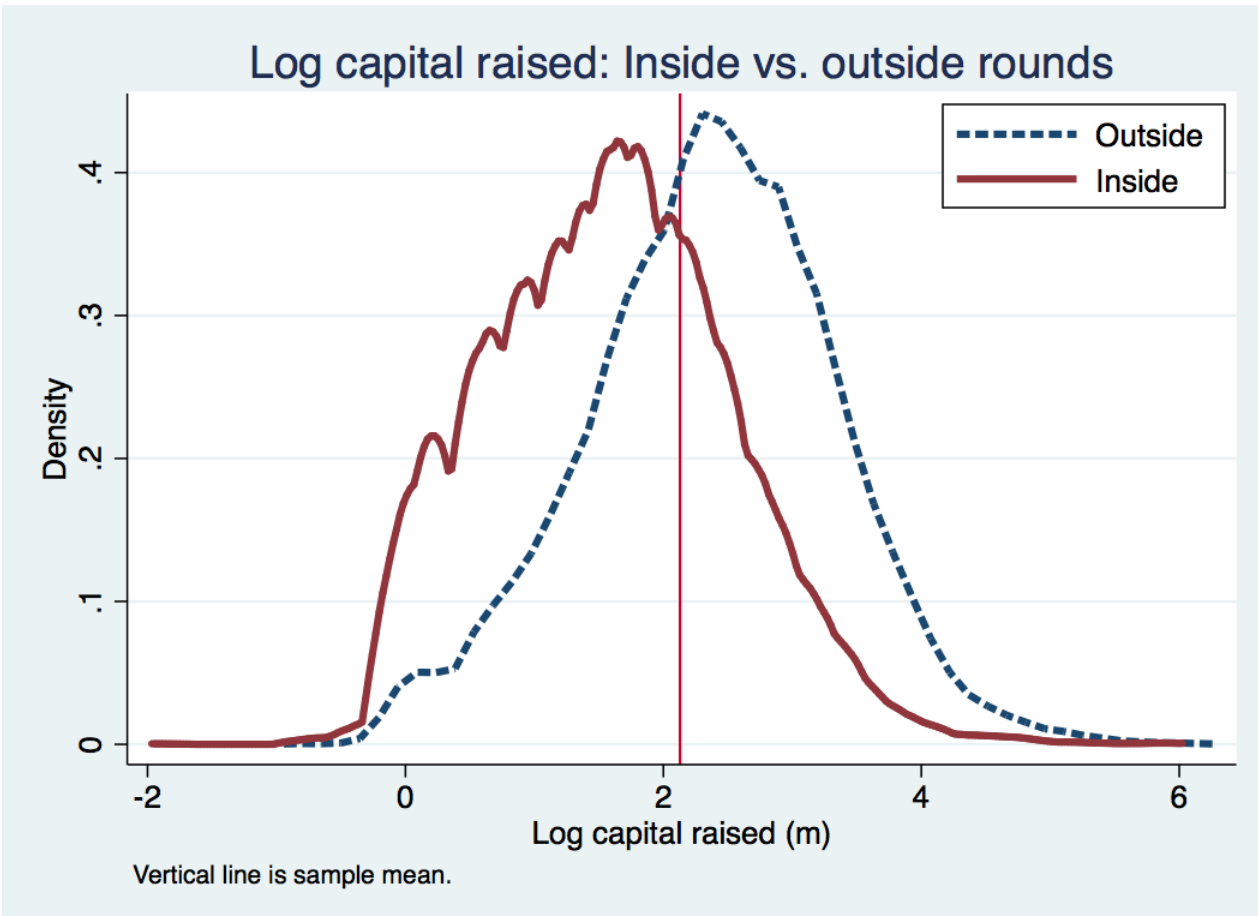

Table 1: Main variable description

Notes: The table defines the major variables used throughout the analysis.

% insider investors	Fraction of investors in financings that are old, where insiders are defined as any previous investor. A new investor has never invested in the company.
% investors that are outsider VC	Fraction of the investors in the financing that are new and VCs, where new investors must not have invested at any point before.
% insider dollars (relative last syndicate)	Fraction of the dollars in a financing provided by the investors in the previous financing syndicate.
% inside dollars	Fraction of the dollars in the financing provided by any existing investor.
Inside round	Equals one if the financing had all existing investors who were from the previous financing.
Full VC inside (no new non-VCs)	Equals one if the financing had no new VC investor in the round.
% insiders participate	The fraction of inside investors that are investing in the current financing.
No new lead?	A dummy variable equal to one if the financing has only a lead investor that was a previous investor.
Years since last financing	Years from the last financing to the current financing.
Round number	The sequence number of the financing event.
Capital raised	The total capital invested at the time of the financing (in millions of USD).
Log total capital	The log of total capital invested in the entrepreneurial firm as of the current round.
Total unique VCs	Total number of unique investors in the entrepreneurial firm as of the current round.
Firm age (yrs.)	Age of the entrepreneurial firm from founding date to current financing date.
Syndicate size	Number of investors in the current financing round.

Table 2: Summary statistics

Notes: Table reports the summary statistics of the firms and financings in our sample. The main criteria for inclusion are post-first financing equity rounds for entrepreneurial firms where they have at least one traditional VC investor and received capital from 1990 to 2008. Panel A summarizes the set of entrepreneurial firms. "Information Technology" and "Healthcare" are firm industry categories. "IPO" is a dummy equal to one if the firm had an IPO by the end of the sample. "Acquired" and "Failed" are dummies for firms that were acquired or failed, respectively, by the end of the sample. "Year founded" is the year the entrepreneurial firm was founded. "First capital raised" is the capital raised in the entrepreneurial firm's first financing (in millions). "Total financings" is the total number of financings raised by the entrepreneurial firm prior to exit. Panel B summarizes the financing event characterstics, valuation measures and returns. "Round number" is the sequence of the financing event. "Years since last fin." is the number of years between the current and previous financing. "Syndicate size" is the count of the number of unique investors in the current financing. "Capital raised" is the total capital investors in the current financing. "Firm age" is the age in years of the entrepreneurial firm by the financing event. "Financing year" is the year of the investment. The valuation measures – pre-money and post-money – are often missing, so the summary considers only a subsample of the data. The returns are also missing for many financings, so "Gross multiple" summarizes the set of financing returns where we observe the exit valuation and financing valuations. "Gross multiple" is the multiple of money earned by a hypothetical dollar invested in the financing accounting for any future dilution (zero for failed firms).

	Panel A							
	Firm characteristics							
	mean	sd	min	p25	p50	p75	max	count
Information Technology	0.53	0.50	0	0	1	1	1	8570
Healthcare	0.23	0.42	0	0	0	0	1	8570
IPO	0.10	0.30	0	0	0	0	1	8570
Acquired	0.44	0.50	0	0	0	1	1	8570
Failed	0.31	0.46	0	0	0	1	1	8570
Still active	0.16	0.37	0	0	0	0	1	8570
Year founded	1998.7	5.14	1978	1996	1999	2002	2007	8570
First capital raised (m)	6.08	8.89	0.10	1.80	3.70	7	232.6	8570
Total financings	4.22	2.08	2	3	4	5	20	8570
California	0.42	0.49	0	0	0	1	1	8570
	Panel B							
	Round-level characteristics							
	mean	sd	min	p25	p50	p75	max	count
Round number	3.26	1.49	2	2	3	4	13	20186
Syndicate size	4.10	2.69	1	2	4	5	25	20186
Years since last fin.	1.35	0.98	0.085	0.74	1.14	1.71	16.6	20186
Capital raised (m USD)	14.3	23.7	0.14	4.20	8.98	17	1500	20186
Firm age (as of financing)	5.02	3.72	0.13	2.33	4.06	6.72	35.5	20186
Financing year	2003.5	5.27	1990	2000	2003	2008	2015	20186
	Valuations (when known)							
	mean	sd	min	p25	p50	p75	max	count
Post-money valuation	86.5	560.6	1.40	20	38.5	79.7	50000	11007
Pre-money valuation	70.5	541.3	0.070	12.4	26.3	60	48500	11007
	Investment returns (when known)							
	mean	sd	min	p25	p50	p75	max	count
Gross multiple	1.67	5.20	0	0	0	1	45.9	11607

Table 3: Characteristics of the various inside variables

Notes: Table reports the characteristics of the main insideness variables. Panel A includes all financings where we could determine the insideness. Panel B restricts the sample to those financings where we observe a post-money valuation. The "inside dollars" variables are missing because we may not observe how much capital was provided by past investors because they are general "buckets" (e.g. "Individual Investors") or lack a VC firm identifier in VentureSource. Variables are defined in Table 1.

	Panel A									
	All financings									
	mean	sd	min	p10	p25	p50	p75	p90	max	count
Inside round	0.29	0.46	0	0	0	0	1	1	1	20186
Inside VC round	0.45	0.50	0	0	0	0	1	1	1	20186
% insider investors	0.63	0.32	0	0.14	0.43	0.67	1	1	1	20186
No new lead	0.59	0.49	0	0	0	1	1	1	1	20186
% inside dollars	0.62	0.35	0	0.083	0.34	0.60	1	1	1	13522
	Panel B									
	Financings with known valuation									
	mean	sd	min	p10	p25	p50	p75	p90	max	count
Inside round	0.24	0.43	0	0	0	0	0	1	1	11007
Inside VC round	0.39	0.49	0	0	0	0	1	1	1	11007
% insider investors	0.63	0.30	0	0.22	0.43	0.67	0.89	1	1	11007
No new lead	0.53	0.50	0	0	0	1	1	1	1	11007
% inside dollars	0.59	0.33	0	0.13	0.33	0.55	1	1	1	7177

Table 4: Inside vs. non-inside financing rounds

Notes: Table compares financings where there the only investors are those with an existing equity stake to those with at least one outside investor of any kind. The numbers are the mean and median respectively, by sub-sample and for the full sample (i.e. "Total"). Sample includes all entrepreneurial firms that were founded prior to 2008 to give ample time for an exit event and who had at least two financing events. The first panel considers characteristics of financings independent of whether we can calculate a return or observe a valuation. The remaining panels require non-missing data on each of these dimensions for sample inclusion. "Years VC-backed" is the number of years from the first observed VC financing to the current. "# VC investors (all)" is a count of the total number in past investors. "Pre$\$_t$ / Post$\$_{t-1}$" is the change in valuation from previous to the current financing. "Up round" is a dummy variable equal to one if this value is greater than one (less than one for "Down round" and 1 for "Flat round"). Other variables are as defined in Table 1.

	Full sample		
	Inside round	Outside round	Total
Capital raised (m USD)	8.000	16.93	14.30
	5	11	8.985
Round number	3.968	3.553	3.675
	3	3	3
Years VC-backed	3.648	3.119	3.275
	2.995	2.338	2.519
Firm age (as of financing)	5.569	4.791	5.020
	4.717	3.811	4.064
Years since last fin.	1.363	1.345	1.350
	1.191	1.120	1.143
Syndicate size	2.655	4.701	4.099
	2	4	4
Total VC investors	4.807	4.440	4.548
	4	3	4
Number Financings	5945	14241	20186
	Financing valuations		
	Inside round	Outside round	Total
Pre$\$_t$ / Post $\$\_t-1$	1.400	2.121	1.944
	1.107	1.547	1.428
Up round	0.612	0.798	0.752
	1	1	1
Down or flat round	0.388	0.202	0.248
	0	0	0
Number observations	1857	5710	7567
	Financing returns		
	Inside round	Outside round	Total
Gross multiple	1.285	1.826	1.672
	0	0	0
Zero multiple	0.660	0.562	0.590
	1	1	1
Number observations	3289	8318	11607

Table 5: Entrepreneurial firm outcomes: inside vs. outside rounds

Notes: Table reports probit and OLS regressions of entrepreneurial firm outcomes on a set of observables. Column (1) uses the dependent variable “IPO” that is equal to one if the firm went public by the end of the sample. Column (2) considers “Good exit” which is equal to one if the firm had an IPO or an acquisition with a reported valuation greater than two times capital invested. “Log exit value” in column (3) is the log of the valuation. The variable “Had inside round” is a dummy variable equal to one if the entrepreneurial firm ever had an inside round in its financings. Columns (3) - (6) introduce controls for whether the firm had a “down” round in its history. Robust standard errors clustered at the financing year reported in parentheses. * , **, *** represent significance at the 10%, 5% and 1% level respectively.

	IPO	Good exit	Log exit value Non-failed	IPO	Good exit	IPO	Good exit	Log exit value Non-failed
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Had inside round	-0.208***	-0.187***	-0.301***			-0.177***	-0.192***	-0.227***
	(0.0474)	(0.0511)	(0.0614)			(0.0508)	(0.0596)	(0.0660)
Had no new lead round				-0.172***	-0.233***			
				(0.0580)	(0.0389)			
Had down round						-0.215***	-0.184***	-0.543***
						(0.0521)	(0.0506)	(0.106)
Log total capital	0.347***	0.0951***	0.574***	0.341***	0.0931***	0.369***	0.138***	0.628***
	(0.0266)	(0.0224)	(0.0335)	(0.0270)	(0.0208)	(0.0280)	(0.0387)	(0.0725)
Total unique VCs	0.00167	-0.000829	-0.0382***	0.00339	0.00174	-0.0215***	-0.0151*	-0.0503***
	(0.00707)	(0.00830)	(0.00991)	(0.00735)	(0.00838)	(0.00763)	(0.00834)	(0.0163)
Constant	-1.553***	-0.0498	3.278***	-1.515***	0.0377	-1.048***	0.110	3.386***
	(0.177)	(0.183)	(0.135)	(0.181)	(0.181)	(0.111)	(0.192)	(0.272)
Observations	8570	8570	2958	8570	8570	3931	3934	1821
Pseudo-R^2	0.169	0.0508		0.167	0.0510	0.133	0.0487	
R^2			0.145					0.150
Model	Probit	Probit	OLS	Probit	Probit	Probit	Probit	OLS
Founding year FE?	Y	Y	Y	Y	Y	Y	Y	Y
Industry FE?	Y	Y	Y	Y	Y	Y	Y	Y
State FE?	Y	Y	Y	Y	Y	Y	Y	Y

Table 6: Differences in returns: log gross multiple

Notes: Table reports regressions of a the log of the gross multiple when known on a set of observables. The dependendent variable is the financing-level return (logged) assuming common equity for a dollar invested in the round. If the company exits via an acquisition and the reported price is less than total capital raised, we assume that the last investors receive all their capital back before earlier investors share in the return. The first four columns are OLS regressions at the financing-level. Columns (3) and (4) consider only those financings where the firm did not fail. "Full inside round " is a dummy equal to to one if all the investors were insiders. Column (5) has the dependent variable that is the present value of the cash flow to the investor who invested in the current round, discounted using a 20% cost of capital for both inside and outside rounds. Column (6) considers the same variable, but sets the outside round cost of capital to 21% and inside round cost of capital to 15%. Column (7) repeats column (1) with a unit of observation an investor-financing and introduces VC firm fixed effects. "Log total capital" is the log of the sum of total capital raised. "Log raised (m USD)" is the log of capital raised in the current round. All fixed effects are as defined in Table 5. Robust standard errors clustered at the financing year reported in parentheses. * , **, *** represent significance at the 10%, 5% and 1% level respectively.

	Log gross multiple				PV $r = .2$	PV $r = .21, .15$	Log gross multiple
	All returns	All returns	Non-fail	Non-fail	All returns	All returns	All returns
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Inside round	-0.146***		-0.0990**		-2.449***	-1.641**	-0.0782***
	(0.0312)		(0.0451)		(0.752)	(0.752)	(0.0156)
No new lead		-0.159***		-0.0943**			
		(0.0385)		(0.0471)			
Log raised	0.0837**	0.0832**	-0.210***	-0.208***	-4.774***	-4.756***	0.0873***
	(0.0380)	(0.0356)	(0.0365)	(0.0293)	(0.501)	(0.500)	(0.00873)
Years since last fin.	-0.0749**	-0.0732**	-0.0362	-0.0353	-0.588**	-0.595**	-0.0611***
	(0.0299)	(0.0299)	(0.0455)	(0.0351)	(0.264)	(0.264)	(0.00828)
Total VC investors	-0.00250	-0.00156	-0.0197**	-0.0192**	0.0242	0.0261	0.00690***
	(0.00825)	(0.00816)	(0.00843)	(0.00826)	(0.113)	(0.113)	(0.00252)
Log firm age (yrs.)	-0.173**	-0.178**	-0.208***	-0.209***	-1.060	-1.075	-0.120***
	(0.0763)	(0.0757)	(0.0730)	(0.0784)	(0.798)	(0.798)	(0.0260)
Log total capital	0.164***	0.163***	0.111*	0.112***	-0.584**	-0.587**	-0.0468***
	(0.0399)	(0.0399)	(0.0564)	(0.0276)	(0.273)	(0.273)	(0.0102)
Constant	-1.559***	-1.497***	2.681***	2.693***	1.364	0.594	-2.311***
	(0.438)	(0.430)	(0.515)	(0.574)	(7.352)	(7.314)	(0.297)
Observations	11607	11607	4762	4762	11590	11590	49697
R^2	0.228	0.229	0.209	0.210	0.188	0.189	0.154
Number firms	4942	4942	2156	2156	4936	4936	4930
Number VCs							4270
VC FE?	N	N	N	N	N	N	Y
Industry FE ?	Y	Y	Y	Y	Y	Y	Y
Year FE ?	Y	Y	Y	Y	Y	Y	Y
Round # FE?	Y	Y	Y	Y	Y	Y	Y
State FE?	Y	Y	Y	Y	Y	Y	Y

Table 7: CAPM: inside vs. outside

The table reports the log-CAPM estimates for the following model:

$$\log M_{it} - \log R^f_{t\to T} = \delta(T-t) + \beta_1(\log R^m_{t\to T} - \log R^f_{t\to T}) + \beta_2 \log SMB^f_{t\to T} + \beta_3 \log HML^f_{t\to T} + \epsilon_{it}$$

where each term is divided by $\sqrt{T-t}$ or the square root of the years to exit (see Korteweg and Sorensen (2010) for discussion of this GLS correction). The intercept δ does not represent a traditional CAPM α, however, the coefficient β do map to the traditional factor loads from a standard returns regression. Standard errors reported in parentheses. * , **, *** represent significance at the 10%, 5% and 1% level respectively.

	Full	Full	Inside	Inside	Outside	Outside
	(1)	(2)	(3)	(4)	(5)	(6)
RMRF	2.221***	2.111***	1.727***	1.677***	2.422***	2.307***
	(0.0688)	(0.0879)	(0.135)	(0.151)	(0.0797)	(0.108)
SMB		-0.467**		-0.225		-0.522*
		(0.237)		(0.416)		(0.282)
HML		-0.0110		-0.135**		0.0533
		(0.0494)		(0.0639)		(0.0676)
Intercept	-0.119***	-0.101***	-0.189***	-0.136***	-0.0945***	-0.0954***
	(0.00476)	(0.0182)	(0.00966)	(0.0248)	(0.00547)	(0.0244)
Observations	11547	11547	3272	3272	8275	8275
R^2	0.111	0.113	0.106	0.113	0.123	0.125
Alpha (annual)	0.443		0.337		0.476	

Table 8: Inside rounds and "fund" outcomes

Notes: Table reports OLS regressions where the dependent variables are investment outcomes of non-inside rounds meaned within five-year intervals of VC firms' investment cycles. For each five-year interval from VC firm inception, a new "fund" is created. The dependent variable "# IPO" is the number of all non-inside rounds in each interval that had an IPO. The dependent variable "# good exits" is the number of all non-inside rounds in each interval that had an IPO or acquisition that returned at least 3X capital. The dependent variable "Mean exit value" is log of the average exit valuation for all exits in outside rounds in the five-year interval. The variable "Fraction inside rounds" is the fraction of investments made in that interval that where inside rounds. The "Second fund", "Third fund", etc. are dummy variables for each five-year interval, which we treat as funds. "Vintage year FE" are year fixed effects for the beginning of each five-year interval. Robust standard errors clustered at the VC firm reported in parentheses. * , **, *** represent significance at the 10%, 5% and 1% level respectively.

	Exit outcomes for outside rounds					
	Log # IPOs	Log # IPOs	Log # good exits	Log # good exits	Mean exit value	Mean exit value
	(1)	(2)	(3)	(4)	(5)	(6)
Fraction inside rounds	-0.723***	-0.567***	-0.927***	-0.818***	-2.612***	-1.717***
	(0.0283)	(0.0469)	(0.0309)	(0.0536)	(0.182)	(0.325)
Second fund	0.0103	-0.317***	0.0157	-0.542***	0.0726	-1.284*
	(0.0111)	(0.0750)	(0.0122)	(0.0817)	(0.0752)	(0.763)
Third fund	-0.0511***	-0.734***	-0.0444**	-1.174***	0.0179	-2.400
	(0.0154)	(0.142)	(0.0176)	(0.155)	(0.119)	(1.482)
Fourth fund	-0.0775***	-1.157***	-0.106***	-1.847***	-0.325*	-3.789*
	(0.0228)	(0.209)	(0.0259)	(0.229)	(0.188)	(2.186)
Fifth fund	-0.173***	-1.731***	-0.199***	-2.627***	0.262	-3.309
	(0.0393)	(0.281)	(0.0473)	(0.308)	(0.462)	(2.945)
Log # investments	0.303***	0.301***	0.429***	0.427***	0.794***	0.703***
	(0.00828)	(0.0123)	(0.00791)	(0.0121)	(0.0256)	(0.0665)
Constant	0.547***	0.162	0.562***	-0.0886	3.208***	2.350***
	(0.0255)	(0.0982)	(0.0229)	(0.105)	(0.106)	(0.855)
Observations	8496	8496	8496	8496	6754	6754
Num. VCs	5348	5348	5348	5348	4415	4415
R^2	0.471	0.449	0.589	0.560	0.176	0.130
VC firm FE	N	Y	N	Y	N	Y
Vintage year FE	Y	Y	Y	Y	Y	Y

Table 9: NPV under alternative recovery rates

Notes: Table reports the NPV calculation for various costs of capital and recovery rates using equation (4). Panels A and B report the NPV distribution for a recovery rate of 25 and 10% respectively. In each panel, we reported the summary of the NPV distribution for three cost of capital assumptions: 20, 15, and 10%. The NPVs are weighted by exit-rates from the full sample.

	Panel A 25% recovery								
	Mean	sd	min	25th	50th	75th	90th	Max	% < 0
NPV ($r = 20\%$)	-5.19	56.48	-112.25	-13.85	-7.65	-4.03	-1.95	1227.11	.94
NPV ($r = 15\%$)	-4.27	61.30	-112.25	-13.53	-7.65	-3.96	-1.83	1273.76	.93
NPV ($r = 10\%$)	-3.00	68.80	-112.25	-13.48	-7.63	-3.90	-1.75	1324.35	.93

	Panel B 10% recovery								
	Mean	sd	min	25th	50th	75th	90th	Max	% < 0
NPV ($r = 20\%$)	-2.22	58.10	-111.35	-10.66	-6.09	-3.24	-1.52	1228.74	.93
NPV ($r = 15\%$)	-1.90	60.76	-111.35	-10.70	-6.21	-3.30	-1.56	1275.39	.93
NPV ($r = 10\%$)	-1.73	59.20	-111.35	-10.55	-6.15	-3.25	-1.51	1325.98	.92

Table 10: Differences in inside rounds: tests for agency and escalation of committment

Notes: Table reports regressions of an indicator for an inside round on a set of controls for insiders making follow-on investments. All models are VC firm effects and only include VC-investment pairs where the VC has already made at least one investment in the entrepreneurial firm. Column (1) introduces the variable "Fundraising" which is one if the VC investor made the investments within one year of the next fund closed. Column (2) includes the variable "No large exit" which is one VC has not had a 3X return or IPO in the last year. Column (3) has the dummy variable "Fund older than 5 yrs." which is one if the investment comes out of a fund that is more than five years old. Column (4) breaks out fund age into year dummies, where the excluded year is the fifth. "Year FE" and "Industry FE" are fixed effects for the firm's industry and current financing year FE. Robust standard errors clustered at the VC firm reported in parentheses. * , **, *** represent significance at the 10%, 5% and 1% level respectively.

	Inside round?			
	(1)	(2)	(3)	(4)
No recent large exit	0.0106**			
	(0.00451)			
After fundraising		0.0909***		
		(0.0237)		
Log fund age		-0.0273		
		(0.0217)		
Fund older than 5 yrs.			0.0702***	
			(0.00670)	
Fund 1 yr. old				-0.0830***
				(0.0103)
Fund 2 yr. old				-0.0660***
				(0.00977)
Fund 3 yr. old				-0.0504***
				(0.00961)
Fund 4 yr. old				-0.0210**
				(0.00964)
Fund 6 yr. old				0.0395***
				(0.0113)
Fund 7 yr. old				0.0483***
				(0.0129)
Fund 8 yr. old				0.0397***
				(0.0151)
Fund 9 yr. old				0.0544***
				(0.0177)
Fund 10 yr. old				0.0407**
				(0.0164)
Firm age (as of financing)	0.00336***	0.00127	0.00290***	0.00278***
	(0.000636)	(0.00429)	(0.000882)	(0.000883)
Constant	0.882***	0.475	0.803***	0.860***
	(0.246)	(0.607)	(0.296)	(0.296)
Observations	61507	1988	35759	35759
R^2	0.0428	0.0615	0.0487	0.0520
Number firms	8390	1270	6982	6982
Number VCs	2987	348	902	902
VC Firm FE	Y	Y	Y	Y
Industry	Y	Y	Y	Y
Year	Y	Y	Y	Y
Round # FE?	Y	Y	Y	Y

Table 11: Inside rounds and current contract features

Notes: The table reports the correlations between inside rounds and strong contract features. Contracts data from VC Experts was merged onto VentureSource financing when possible. Column (1) has a dependent variable equal to one if the financing had senior equity. Column (2) has a dependent variable equal to one if the contract has a liquidation preference greater than 1X. Column (3) has a dependent variable equal to 1 if the contract had participating preferred. Column (4) has a dependent variable equal to one of the contract had redemption rights. All variables are as defined in above tables. Robust standard errors clustered at the financing year reported in parentheses. * , **, *** represent significance at the 10%, 5% and 1% level respectively.

	Senior (1)	> 1X? (2)	Part. Pref.? (3)	Redemption? (4)
Full inside round	-0.0968	0.112	-0.0101	0.0948
	(0.0722)	(0.0986)	(0.0732)	(0.0722)
Log raised	-0.000348	-0.166***	-0.188***	-0.143***
	(0.0356)	(0.0504)	(0.0367)	(0.0356)
Years since last fin.	0.00750	-0.0498	-0.0154	-0.0420
	(0.0353)	(0.0468)	(0.0353)	(0.0362)
Observations	1906	1884	1910	1909
Pseudo-R^2	0.0665	0.0993	0.0587	0.0545
Num. firms	1392	1378	1389	1388
Mean dep. var	0.439	0.0987	0.590	0.447
Mean dep. var. | Inside	0.425	0.130	0.633	0.503
Founding Year	Y	Y	Y	Y
Industry FE ?	Y	Y	Y	Y
Round # FE?	Y	Y	Y	Y

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