Journal of Financial Economics 136 (2020) 407–443

Contents lists available at ScienceDirect

Journal of Financial Economics

journal homepage: www.elsevier.com/locate/jfec

Mutual fund investments in private firms ☆

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ARTICLE INFO

Article history:
Received 16 January 2018
Revised 14 March 2019
Accepted 30 April 2019
Available online 8 October 2019

JEL classification:
G23
G24
G32

Keywords:
Private firm
Mutual fund
IPO

ABSTRACT

Historically, a key advantage of being a public firm was broader access to capital, from a disperse group of shareholders. In recent years, such capital has increasingly become available to private firms as well. We document a dramatic increase over the past twenty years in the number of mutual funds participating in private markets and in the dollar value of these private firm investments. We evaluate several factors that potentially contribute to this trend: firms seeking extra capital to postpone public listing, mutual funds seeking higher risk-adjusted returns and initial public offering (IPO) allocations, and venture capitalists (VCs) seeking new investors to substantiate higher valuations. Results indicate that the first two factors play a significant role.

1. Introduction

While going public is without question a watershed event in the life of a firm, the lines between private and public listing status have become increasingly blurred in recent years. The number of publicly listed companies has decreased, and at the same time, private companies are increasingly raising funding from investors who traditionally focused only on public companies. These changing dynamics affect multiple parties: firms who are faced with potential changes in both sources of capital and costs of capital, regulators who are faced with policies that are largely based on a relatively strict line between public and private listing status, and investors who face changes in their investment opportunity set.

In this paper, we focus on one group of such investors – mutual funds. Mutual funds are recognized as one of the largest investors in public firms, but they have increasingly extended their investment portfolios into private firms. Across a sample of 14 mutual fund families, 149 funds held shares in venture-backed private firms, over the 1995–2016 period. This practice has become increasingly widespread: less than 14 funds invested in private companies each year through 2000, compared to over 90 unique funds in 2014 and 2015. The aggregate valuation of mutual funds' investments in private firms increased from $16 million in 1995 to over $8 billion in 2015.

These 149 mutual funds invested in 270 unique companies during 1995–2016, with 39% of venture-backed initial

☆ We thank Michael Ewens, Laura Field, Joel Houston, Jennifer Juergens, Ronald Masulis, Jay Ritter, Ting Xu, and seminar participants at Baruch College, Beihang University, Central University of Finance and Economics, Drexel University, Erasmus University, Hong Kong Polytechnic University, Peking University, Renmin University, University of Amsterdam, University of Buffalo, University of International Business and Economics, University of Queensland, University of New South Wales, University of South Florida, Washington State University, the Norwegian School of Economics 2017 Conference, the SFS Cavalcade, the NYU Conference on "The changing role of stock markets in capital formation," and the China International Conference in Finance 2017. We thank Matt Denes for generously sharing code that facilitated the collection of patent data, and we thank Ke Shen for sharing details related to mutual funds' reporting of IPO allocations. We also thank Crunchbase for providing research access.

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https://doi.org/10.1016/j.jfineco.2019.10.003
0304-405X/

public offerings (IPOs) in 2016 having received mutual fund financing prior to going public. Mutual fund investments are concentrated among companies at later stages of development, a pattern that is consistent with fund managers' liquidity concerns, with fund managers' expertise, and with later-stage firms' greater capital demands (which more likely exceed what venture capitalists (VCs) are willing to provide). There have been substantial investments in the largest private firms that are commonly referred to as unicorns, defined as companies with a valuation of $1 billion or more: the mutual funds in our sample invested $6 billion into 40 unicorn companies. However, unicorns represent only a fraction of mutual funds' total participation in the private firm space, as reflected by the fact that they also invested $4.5 billion into 230 non-unicorn companies.

We evaluate three factors that have potentially contributed to this trend. The first factor represents a demand-side effect. We posit that firms have become increasingly likely to seek extra capital to postpone public listing. Staying private longer enables companies to achieve a larger scale before going public, which Gao et al. (2013) suggest is particularly important in today's world of increased economies of scale. It also enables companies to postpone many of the costs associated with public listing, for example regulatory requirements, increased disclosures that may lessen competitive advantages, and pressure from investors for short-term results, as highlighted by Beyer et al. (2010) and Asker et al., 2015. Chernenko et al. (2018) conclude that mutual funds represent an attractive source of capital for these firms because they tend not to demand strong control rights. In addition, mutual funds do not have defined lives that require them to exit investments by a specified date.

The second factor represents a supply-side effect. We conjecture that mutual funds have become increasingly likely to supply capital to private firms as a source of higher potential returns, greater diversification, and increased IPO allocations. The decrease in the number of public firms has decreased mutual funds' investment opportunities, making it more difficult for them to differentiate their portfolios from those of other funds and to identify sources of positive abnormal returns. In addition, actively managed mutual funds face increasing competition from index funds and exchange traded funds (ETFs), which advertise the benefits of passive investing and offer lower management fees. Finally, investments in private firms have the potential to contribute toward greater share allocations when the firms go public. Perhaps not surprisingly, given the large one-day returns when IPO stocks start trading, prior literature finds that institutional investors engage in many forms of quid pro quo activities as ways to garner such allocations (see, e.g., Reuter, 2006; Ritter and Zhang, 2007; Goldstein et al., 2011; Nimalendran et al., 2007). In sum, actively managed funds may seek alternative investment opportunities as a source of competitive advantage.

The third factor similarly relates to the supply side, but it focuses on the perspective of VCs. We evaluate the possibility that VCs look to mutual funds as a source of "dumb money" that is willing to invest at particularly high valuations. VCs generally sit on the companies' boards, and they have sufficient control rights to influence companies' capital raising. Frictions arising from information asymmetry and conflicts of interest between potential investors and investors in previous rounds can incentivize VCs to seek overly high valuations in certain cases. VCs would encourage their portfolio companies to raise financing from mutual funds if these funds were willing to provide more capital in exchange for a lower percentage ownership (i.e., to invest at higher valuations).

These factors are not mutually exclusive, and our evidence suggests that several play a role. From the perspective of firms, i.e., the demand side, we find strong evidence that mutual fund financing enables firms to delay exit. The amount of capital provided by mutual funds is substantial. Among rounds in which mutual funds participated, the funds provide an average 38% of the total financing raised (median = 32%), over 2011–2016. Moreover, this capital is incremental to that provided by the VCs.[1] This should enable companies to stay private longer, and this is precisely what we find. To isolate the causal effects of mutual funds' investments in private firms, we use an instrument that captures relationships as conduits of information (see, e.g., Cohen et al., 2010; Engelberg et al., 2012). Specifically, we measure the evolution of the lead VC's mutual fund connections through its other portfolio firms, since the firm's first funding round. This captures both the strength of the lead VC's connections as well as the lead VC's openness to co-investing with mutual funds. Using this instrument, a wide array of instrumental variable regressions suggest that mutual fund financing enables companies to stay private longer.

We also find empirical support for the second posited factor: mutual funds are motivated to supply capital to these private firms as a source of positive abnormal returns. Similar to VCs, mutual funds' returns from these private firm investments come predominantly from those firms that exit via IPO. Over our sample period, mutual funds earned an average 4.8% per month across their investments that exit via IPO. IPO allocations provide a further source of returns, as fund families with pre-IPO investments have both a higher probability of receiving an IPO allocation (64% versus 21%) and a greater mean allocation size (4.7% versus 2.4% of shares offered).[2] Back-of-the-envelope calculations based on the probability of exit via IPO, the probability of exit via acquisition, and returns conditional on exit (including the higher allocations in cases of IPO) produce a wealth relative of 1.7–2.6 (i.e., mutual funds earn 1.7 to 2.6 times more in their private firm investments than in the equally weighted market index over analogous time periods). While these investments are likely riskier than their public market counterparts, this risk appears to be largely idiosyncratic. The correlation between the average mutual fund investment in a private firm and the equal-weighted index is an insignificant −4%, suggesting that these investments also provide meaningful diversification benefits.

[1] In some cases, mutual funds also provide liquidity to early shareholders in the firm, through the purchase of secondary shares.

[2] We find little evidence that mutual funds benefit along the more perverse dimension of strategically valuing these investments while the firms are still private.

We find little evidence in support of the third posited factor, that mutual fund investments represent dumb money that is used to support higher valuations. Because all investors in the same round generally receive the same terms, informed investors should be less likely to invest alongside dumb money. Yet we find that rounds with mutual fund investments are more likely to include higher quality VCs. In addition, an examination of round-level valuation changes provides no evidence that rounds with mutual fund participation are overpriced. Specifically, we find no evidence that future valuation changes are lower following rounds with mutual fund participation. Finally, we estimate market model and three-factor regressions of returns between each round and final exit following the methodology of Korteweg and Sørensen (2010). This approach similarly provides no evidence that rounds with mutual fund participation earn lower alphas.

We also consider the possibility that other sources of capital to private firms became less available, and mutual funds came in to fill the void. However, we find no evidence to support this scenario. Rather, both VC funding and other sources of capital to private firms, for example, private equity (PE) and corporate venture capital (CVC), also increased around the same time as mutual fund financing increased.

Our findings relate to several streams of literature. First, our finding that firms are increasingly employing mutual fund capital as a means to stay private longer is illuminating when viewed as part of the broader debate on the benefits and costs of being a public firm. A revealed preference argument suggests that firms perceive the net benefits of staying private longer to have increased. This conclusion is consistent with the fact that many of the factors that have traditionally motivated firms to publicly list are increasingly available to firms while they are still private: capital, liquidity, and a dispersed shareholder base. While Brau and Fawcett (2006), Brav (2009), and Gilje and Taillard (2016) provide evidence on these benefits of public listing, and Iliev (2010) and Asker et al., 2015 provide evidence on the costs of public listing, our evidence suggests that these benefits and costs are changing in systematic ways.

Second, and more broadly, our paper contributes to a growing literature showing changes in the IPO market. Gao et al. (2013) highlight an increased propensity of private firms to be acquired rather than go public, and Doidge et al. (2017) focus on changes in non-US firms' decisions regarding the market on which to list. Ewens and Farre-Mensa, 2019 conclude that increases in the supply of capital available to private firms has contributed to the lower number of US IPOs, where much of this increased supply is attributable to regulatory changes. Unlike us, their analysis focuses on capital coming from investors who typically focus within the private firm space, e.g., on PE and CVC, as well as the more traditional VC. In contrast to mutual funds, these entities have substantial experience with private firms, and PEs and VCs have a closed-end fund structure specifically geared to investments in illiquid firms. While CVCs do not have the closed-end fund structure, they also do not have the disadvantage of short-term liquidity pressures, as faced by mutual funds.[3] Intriguingly, despite mutual funds' apparent disadvantages, their participation in this market has grown from financing less than 10% of VC-backed IPOs in the late 1990s to 25% in 2014–2016. Our detailed data of mutual fund holdings allow us to examine their returns and other benefits from these investments. More similar to us, Chernenko et al. (2018) also examine mutual funds, but they focus on the corporate governance features of investments in unicorns. They conclude that the limited skill sets of mutual funds contribute to fewer governance rights in the underlying firms, and they conjecture that this may translate into fewer cash flow rights. We investigate more broadly the factors influencing the increasing trend of mutual fund investments, including both demand-side and supply-side factors. Moreover, our results highlight the positive aspects of these investments for mutual funds, for example the fact that they contribute toward higher abnormal returns and are associated with higher IPO allocations when the firms go public. In addition, we examine a much longer sample period and a broader set of private firms rather than just unicorns. In fact, our analysis highlights that the majority of companies with mutual fund investment are non-unicorns.

Third, by documenting mutual funds' increasing investments in private firms and the potential gains from such investments, we contribute to the debate about the investment opportunities of individual investors due to the declines in IPOs and in public firms, especially small firms. Investing in mutual funds gives individuals the opportunity to invest in some private firms. However, due to regulatory limits and funds' liquidity concerns, few mutual funds invest more than 2% of net asset value in private firms. As such, individual investors continue to have only limited exposure to this sector of the market. From a policy perspective, the benefits of protecting individual investors against a risky class of investments about which they may have little understanding must be weighed against the costs of limiting their access to an increasingly large portion of the market.

2. Data

This section describes the various sources of data used throughout the paper, including the sample of VC-backed private firms, data on mutual funds holdings in these firms, and data on patents granted to these firms.

2.1. Private firm sample

Our sample consists of VC-backed private firms, as listed in the Thomson Reuters Private Equity database (formerly known as VentureXpert), over the 1990–2016 period.[4] Our focus on venture-backed private companies is

[3] Moreover, CVCs are primarily motivated by strategic reasons rather than a search for high returns. See e.g., Masulis and Nahata (2009) and Ma (2019).

[4] We evaluate potential survivorship-bias-related issues in the Thomson Reuters data by comparing our dataset with a VentureXpert download from 2005 but find no evidence that such biases influence our results. Kaplan and Lerner (2016) conclude that no other database is clearly superior for the types of data we are using.

motivated by (1) many non-VC-backed companies have no definite plan for exit, meaning we would be unable to assess the effects of the mutual fund investment; (2) information on key investors is less available for non-VC-backed companies; and (3) many mutual fund managers focus on venture-backed firms.

We omit a small number of companies that received mutual fund financing before the first VC round, and we restrict the sample of VC-backed companies along several dimensions. Firms must be private and US based, and they must receive an investment from at least one fund with investment type "venture capital", thus excluding firms whose financing is solely real estate, mezzanine finance, or private equity. We require companies to be founded after 1980 and to have the first venture capital funding round in 1990 or later. Our final sample includes 28,516 VC-backed private firms. We obtain the industry of each firm, and for each financing round, we obtain the date, the dollar amount invested, and identity of investors. We use the SDC New Issues Database and the SDC Mergers and Acquisitions Database to determine whether each firm went public or was acquired. Several analyses focus on company outcomes, which we define as exiting via IPO, exiting via acquisition, or failure. Firms are classified as failed if they have not exited and have not received a funding round for at least four years prior to the end of the sample period.

Looking at Panel A of Table 1, column 1 shows the annual number of companies receiving VC financing for the

Table 1
Sample description.
The sample consists of 28,516 unique companies that received venture capital financing between 1990 and 2016. We exclude companies founded prior to 1980, companies that received their first round of VC financing prior to 1990, companies that received mutual fund investments before VC financing, and companies in the buyout/acquisition stage at the time of first financing round. Panel A categorizes companies by financing year. Column 1 shows the total number of companies each year receiving VC financing for the first time, and column 2 (3) shows the subset of these that subsequently exit via IPO or acquisition (receive mutual fund financing while still private). Column 4 shows the number of private VC-backed companies each year that receive mutual fund financing for the first time, and column 5 (6) shows the subset of these that subsequently exit via IPO (exit via acquisition). Panel B categorizes companies by exit year. Column 7 (8) shows the number of companies exiting via IPO (acquisition) each year, and column 9 (10) shows the subset of these that had received mutual fund financing prior to exit.

Panel A: # companies receiving their first financing from venture capital or mutual funds

Year of fin'g	From venture capital, each year			From mutual funds, each year		
	Total	# that subsequently		Total	# that subsequently	
		Exit	Receive MF fin'g		Exit via IPO	Exit via acquisition
	(1)	(2)	(3)	(4)	(5)	(6)
1990	302	118	2			
1991	228	103	2			
1992	353	167	5			
1993	311	153	4			
1994	387	203	3			
1995	731	316	9	4	0	2
1996	892	419	16	3	1	0
1997	1060	432	16	6	0	4
1998	1339	468	17	6	3	1
1999	1938	713	27	24	8	5
2000	2849	933	13	36	3	12
2001	1020	390	9	12	2	2
2002	709	317	4	2	0	1
2003	704	291	6	1	1	0
2004	885	352	9	6	2	3
2005	995	356	16	7	0	1
2006	1190	398	8	7	4	0
2007	1368	404	13	7	1	2
2008	1273	309	15	11	3	4
2009	784	196	12	2	2	0
2010	1010	244	9	5	4	0
2011	1330	209	18	12	9	1
2012	1327	170	11	15	6	2
2013	1491	133	13	18	7	2
2014	1443	64	10	36	15	3
2015	1456	21	2	46	12	4
2016	1141	4	1	4	0	0
Full sample						
1990–2016	28,516	7883	270	270	83	49
Partial samples						
1990–2010	20,328	7282	215	139	34	37
1995–2016	26,935	7139	254	270	83	49
1995–2010	18,747	6538	199	139	34	37

(*continued on next page*)

Table 1
(*continued*)

Panel B: # Exits each year

Year of exit	By VC-backed co's		By VC-backed co's with MF investments	
	Via IPO (7)	Via M&A (8)	Via IPO (9)	Via M&A (10)
1990	1	0		
1991	10	1		
1992	21	10		
1993	21	18		
1994	34	29		
1995	76	55		
1996	123	75		
1997	65	111	1	1
1998	58	141	1	2
1999	190	180	7	1
2000	150	295	4	4
2001	23	315	1	3
2002	15	281	0	1
2003	24	262	1	1
2004	56	322	2	5
2005	36	352	1	4
2006	39	378	0	3
2007	60	392	3	1
2008	5	343	0	2
2009	11	286	0	1
2010	35	461	1	2
2011	36	434	5	0
2012	41	415	5	2
2013	61	344	9	5
2014	89	431	17	1
2015	57	323	14	4
2016	28	264	11	6
Full sample				
1990–2016	1365	6518	83	49
Partial samples				
1990–2010	1053	4307	22	31
1995–2016	1278	6460	83	49
1995–2010	966	4249	22	31

first time each year, and column 2 shows the subset that subsequently exited via either IPO or acquisition. Columns 7 and 8, in Panel B, show the number of exits by exit year.

2.2. Mutual fund holdings

We manually collect data on mutual funds' holdings in private firms for the period 1995–2016. The Securities and Exchange Commission (SEC) requires mutual funds to disclose their complete portfolio holdings, with holdings in private firms listed as restricted securities (defined by the SEC as securities acquired in an unregistered, private sale from the issuing company or from an affiliate of the issuer). Standard data sources such as the CRSP mutual fund database and Thomson-Reuters Mutual Fund Holdings database do not include many private firm holdings. Thus, we collect data directly from EDGAR. Electronic filings are available from EDGAR starting around 1995, with mutual funds disclosing their portfolio holdings semiannually through 2004 and at a quarterly interval since 2005.[5] To ensure consistency across our entire sample period, we collect holdings data semiannually for all years, from Form N-30D for the period 1995–2004 and Form N-Q for the period 2005–2016. Appendix A provides an example.

Due to the extremely high costs of collecting data on every mutual fund, we collect data on a subset of funds. We seek to identify fund families that have the willingness and infrastructure to invest in private companies. To identify such a subset, we first identify all IPOs between 2006 and 2015, excluding real estate investment trusts (REITs), American depositary receipts (ADRs), banks, utilities, previous leveraged buyout (LBO) firms, and offerings with an offer price less than $5. We then search by IPO company name through the universe of mutual fund filings over this same period to determine which mutual funds owned any of these firms prior to the IPO. Filings are made at the central index key (CIK) level (where each CIK generally includes multiple funds). We identify 91 CIKs for which at least one mutual fund invests in a company prior to

[5] Starting from May 2004, the SEC requires mutual funds to file Form N–CSR ("Certified shareholder report") at the end of the second and fourth fiscal quarters and Form N–Q ("Quarterly schedule of portfolio holdings") at the end of the first and third fiscal quarters (Agarwal et al., 2015).

its IPO; in total, these CIKs include approximately 1500 funds.[6]

Across these 91 CIKs, 72 are associated with open-end funds in the Thomson-Reuters Mutual Fund Holdings database. Among these 72 CIKs, 68 CIKs are associated with fund families in decile 10 (largest), 3 with families in decile 9, and 1 with a family in decile 7 (where the deciles are based on the total assets of fund families listed in Thomson Reuters). In sum, larger fund families are substantially more likely to invest in private companies. Such families arguably have superior abilities and/or resources to evaluate this set of more informationally opaque companies.

We collect mutual fund holdings for a representative subsample of these 72 CIKs. Consistent with the above-described distribution of CIKs, we select 12 fund families from decile 10 (Blackrock, Fidelity, Vanguard, etc.), 1 from decile nine (Wasatch), and 1 that is not in the Thomson-Reuters Mutual Fund Database (Great-West Funds). This provides a sample of 48 CIKs across 14 different fund families. We extract information on each fund's holdings of restricted securities using Python as well as extensive hand collection and verification. We distinguish equity holding from debt holding, and we collect company names, number of shares, valuations, acquisition dates, acquisition costs, and security types. Additional details on this process, as well as the full list of mutual fund families for which we collect data, are provided in Appendix A. Table 1 describes the time series of these investments.

We strive to match each mutual fund investment with investment rounds in the Thomson Reuters Private Equity database and in Crunchbase. Thomson Reuters's coverage is more comprehensive in terms of number of companies covered, but Crunchbase has the advantage of providing round series information (e.g., Series A, Series B, etc.). We define a mutual fund investment to be part of a funding round if the absolute value of the difference between the mutual fund's acquisition date (as reported in mutual fund filings) and the venture round date (as reported in either Thomson Reuters or Crunchbase) is less than 30 days.

2.3. Patent data

Most venture-backed firms in our sample are in technology-focused industries, where patenting tends to be important. Patent activity represents a strong metric of a firm's level of development, particularly given the paucity of financial information for private firms. Following Denes (2017), we use Python scripts to download and extract patent data from the United States Patent and Trademark Office. Further details are provided in Appendix A.

Each patent includes two dates: application date and grant date. As discussed by Lerner and Seru (2015), firms apply for patents soon after discoveries are made, suggesting application year is more relevant. However, we only observe those patent applications that are ultimately granted, creating a truncation problem if one simply counts the number of patents based on application year. Following Hall et al. (2001) and Bernstein (2015), among others, we correct this truncation bias by scaling each patent by the average number of patents of all VC-backed companies in the same year and industry, using the Thomson Reuters industry groupings (shown in Table 2).

3. Characteristics of mutual fund investments in private companies

This section provides evidence on the time-series patterns in mutual fund investments into private firms. In addition, we also examine cross-sectional differences in companies with versus without mutual fund investment.

3.1. Time trends

Figs. 1–3 provide evidence on the time-series evolution of mutual fund financing in private companies. Panel A of Fig. 1 highlights the dramatic increases in the number of mutual funds participating in these private markets. Between 1995 and 2000, less than 15 mutual funds had investments in private firms, compared to 96 in 2014. There is a particularly large jump in 2011, which coincided with the economic recovery following the financial crisis, suggesting increased demands for capital by companies, combined with a weak IPO market. After strong growth for many years, there has been a slight decrease in 2015 and 2016.

Panels B and C show that the number of private VC-backed companies held by mutual funds and the dollar value of funds' investments in these companies have also increased. The number of companies with mutual fund investment increased from 4 to 99 between 1995 and 2015, and the aggregate valuation of these investments increased from $16 million to over $8 billion. Perhaps surprisingly, 36 companies received mutual fund financing in 2000, only moderately lower than the peak of 46 companies in 2015. However, the average investment size was much smaller in 2000 (not tabulated), which contributes to the stronger upward trend in dollars invested shown in Panel C. Consistent with evidence in Panel A, there has been a slowdown in all these metrics in 2016.

Only a portion of these investments are into the largest private firms commonly referred to as unicorns, defined according to the Wall Street Journal (WSJ) Billion Dollar Startup Club database as VC-backed companies that are valued $1 billion or more.[7] Even in the later years of our sample period, when these large private companies were more prevalent, less than one-third of companies receiving mutual fund financing are unicorns, as shown in Panel B.

[6] One potential concern is that this approach will fail to identify funds that have invested in private firms but none of these firms have gone public. To assess the severity of this factor, we compare our list of mutual funds with those listed in the Wall Street Journal Startup Stock Tracker, which includes private firms held by mutual funds with valuations of $1 billion or more as of the end of 2016. Our algorithm captures all fund families included in this list.

[7] Unicorns are further required to have raised money in the past four years and to have at least one VC firm as an investor. The WSJ's measure is not time varying, and some of the firms classified as unicorns likely received mutual fund financing prior to reaching unicorn status.

Moreover, across the 119 mutual funds that invested in private firms between 2011 and 2016, 37 funds (31%) invested only in smaller firms, and 65 funds (55%) invested in both unicorns and smaller firms.

Panel A of Fig. 2 shows that the capital provided by mutual funds represents an increasing percentage of total financing in the funding rounds in which they participate. In the 1995–2005 period, mutual funds provided an average 22.1% (median 5.6%) of capital in funding rounds. This increased to an average 38.0% (median 32%) over the 2011–2016 period. Panel B shows that mutual funds concentrate in expansion and later stage companies, consistent with a greater expertise in such companies. Somewhat surprisingly, they have become increasingly likely to invest in earlier stage companies, with nearly 20% of capital invested going toward early stage companies in the 2011–2016 period. One factor potentially driving mutual funds to increasingly invest in early stages is a search for investments that are less correlated with public firms.

Fig. 3 highlights the extent to which the most successful venture-backed private companies have been increasingly likely to receive mutual fund financing. The sample is restricted to VC-backed firms that went public, and for each year, the bar graph depicts the number and percent of such firms that received mutual fund financing prior to the IPO. This percent ranges between 0% and 5% prior to 2010 and has increased substantially in recent years, to 24% in 2015 and 39% in 2016.

3.2. Types of private companies in which mutual funds invest

Descriptive statistics on our sample of 28,516 venture-backed companies are provided in Panel A of Table 2, where the first column focuses on the 270 companies that received mutual fund financing, and the second column focuses on companies that did not receive such investment. Because we are interested in the decision of mutual funds to invest in firms, we measure VC funding characteristics

Table 2
Descriptive statistics.
The sample in Panel A consists of 28,516 unique companies, as described in Table 1. The sample in Panel B consists of the 270 firms that received mutual fund financing while still private, categorized into unicorns (defined as having a valuation of $1 billion or more according to the WSJ Startup Club prior to the end of 2016) versus non-unicorns. First-round VC characteristics are calculated based on the average value of each variable across all VCs that provided funding in the first round. VC funding characteristics and patenting activity variables are measured at min (last financing round date, exit date, first MF financing date). Time to exit variables are calculated across the subset of companies that exit private status. In Panel A (Panel B), this is 7,883 companies (132 companies) that have exited via either IPO or acquisition by the end of the sample period. Means are shown for all variables, and variable definitions are in Appendix B.

Panel A: Full sample of VC-backed companies that received first VC round 1990–2016

	With mutual fund financing Obs. = 270	Without mutual fund financing Obs. = 28,246	Difference
First-round VC characteristics			
VC firm age	17.01	13.96	3.051***
# Co's invested by VC	40.96	32.29	8.675***
# Exits by VC	16.70	9.94	6.763***
VC funding characteristics			
Rounds received	4.46	3.12	1.340***
VC syndicate size	6.69	3.66	3.027***
Amount raised ($ mil)	97.40	21.96	75.430***
Amount raised at first round ($ mil)	10.57	5.02	5.545***
Patenting activity			
Patents applied	6.73	2.51	4.214***
Patents applied (scaled)	1.40	0.54	0.861***
At least one patent applied	0.53	0.28	0.248***
Industry			
Computer	0.44	0.51	−0.073**
Medical	0.06	0.10	−0.038**
Biotech	0.26	0.06	0.191***
Communication	0.12	0.11	0.010
OtherElect	0.04	0.05	−0.010
NonHighTech	0.09	0.17	−0.0848***
Geographical location			
CA	0.51	0.35	0.162***
MA	0.14	0.09	0.058***
NY	0.07	0.08	−0.010
TX	0.01	0.05	−0.045***
PA	0.01	0.05	−0.040***
Exit performance			
Dummy = 1 if exited	0.49	0.27	0.214***
Dummy = 1 if exited via IPO	0.31	0.05	0.262***
Dummy = 1 if exited via M&A	0.18	0.23	−0.047*
Time to exit from first financing round	6.54	4.89	1.645***
Time to IPO from first financing round	6.08	4.46	1.628***
Time to M&A from first financing round	7.31	4.98	2.327***

(*continued on next page*)

Table 2
(*continued*)

Panel B: Among companies with MF financing, a comparison of unicorns versus *non-unicorns*

	Obtained unicorn status by the end of 2016 Obs. = 40	Not obtained unicorn status by the end of 2016 Obs. = 230	Difference
First-round VC characteristics			
VC firm age	18.79	16.70	2.088
# Co's invested by VC	49.91	39.41	10.51*
# Exits by VC	21.61	15.85	5.755**
VC funding characteristics			
Rounds received	5.83	4.22	1.603***
VC syndicate size	7.70	6.51	1.191*
Amount raised ($ mil)	234.53	73.55	161.0***
Amount raised at first round ($ mil)	14.44	9.90	4.545
Patenting activity			
Patents applied	13.60	5.53	8.070***
Patents applied (scaled)	2.26	1.25	1.018*
At least one patent applied	0.68	0.50	0.171**
Industry			
Computer	0.83	0.37	0.451***
Medical	.	0.07	−0.0696*
Biotech	0.10	0.28	−0.183**
Communication	0.03	0.13	−0.110**
OtherElect	.	0.05	−0.048
NonHighTech	0.05	0.09	−0.041
Geographical location			
CA	0.78	0.47	0.305***
MA	0.08	0.16	−0.08
NY	0.08	0.07	0.010
TX	.	0.01	−0.009
PA	.	0.01	−0.013
Exit performance			
Dummy = 1 if exited	0.28	0.53	−0.251***
Dummy = 1 if exited via IPO	0.23	0.32	−0.097
Dummy = 1 if exited via M&A	0.05	0.20	−0.154**
Time to exit from first financing round	6.19	6.57	−0.374
Time to IPO from first financing round	6.75	6.00	0.751
Time to M&A from first financing round	3.68	7.46	−3.779

and a firm's patenting activity prior to the first mutual fund financing for the sample of 270 firms that received such financing, and as of the last VC round prior to exit (or the end of the sample period) for all other firms. This approach is based on the intuition that funds had the choice to invest in these other firms at each point in time (up to ultimate exit or to the last observed round) but never did.

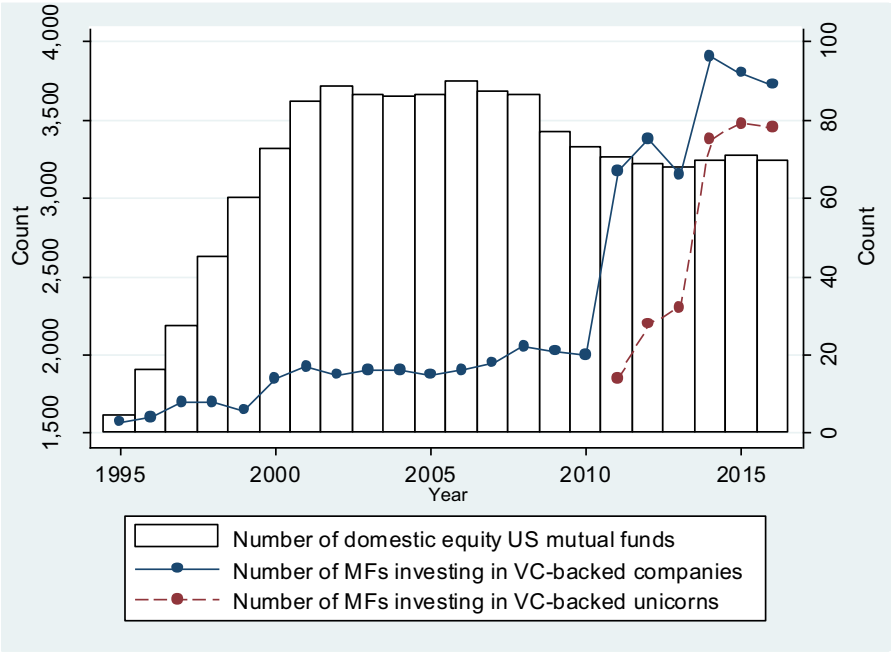
The first set of rows shows the characteristics of the VCs providing funding in the first round: VC firm age, the total number of companies in which the VC invested during the prior five years, and the number that had an IPO or were acquired in the prior five years. When there are multiple VCs in the first round, we take the average. These metrics are generally perceived to capture aspects of both VC and firm quality (see, e.g., Lerner, 1994; Hochberg et al., 2007; Nahata, 2008; Sørensen, 2007). All these measures indicate that firms ultimately funded by mutual funds are backed by higher quality VCs during the first round of financing. This is consistent with mutual funds relying on the certification of an intermediary when selecting private companies in which to invest.

The second set of rows indicates that mutual funds choose to invest in firms in which VCs have made greater commitments (i.e., firms that have had more financing rounds, firms with a larger number of VCs, and firms that have raised more funding).

The third set of rows shows measures of patenting activity. We find that companies with mutual fund financing have applied for significantly more patents (where the set of patents is restricted to those that are ultimately granted) than those without: 6.7 versus 2.5 in raw terms, and 1.4 versus 0.5 after adjusting for application year and industry. Looking at the fourth and fifth sets of rows, compared to the overall distribution of VC-backed private firms, there is a marked concentration of mutual fund-backed firms in the biotech industry, in California, and to some extent, in Massachusetts.

The sixth set of rows describes the firm outcomes. Those firms that receive mutual fund financing are significantly more likely to exit (49% versus 27%) and in particular to exit via an IPO (31% versus 5%). Interestingly, firms that receive mutual fund financing are less likely to exit via acquisition (18% versus 23%), a finding that likely reflects the fact that IPO exits are substantially more profitable than acquisitions. Finally, the firms that receive mutual fund financing also remain private significantly longer, measured as time to exit from first VC round: 6.54 years versus 4.89 years. This could be driven by differences in the types of firms that go public or by

Panel A: Number of mutual funds investing in private companies



Panel B: Number of private companies receiving mutual fund investments

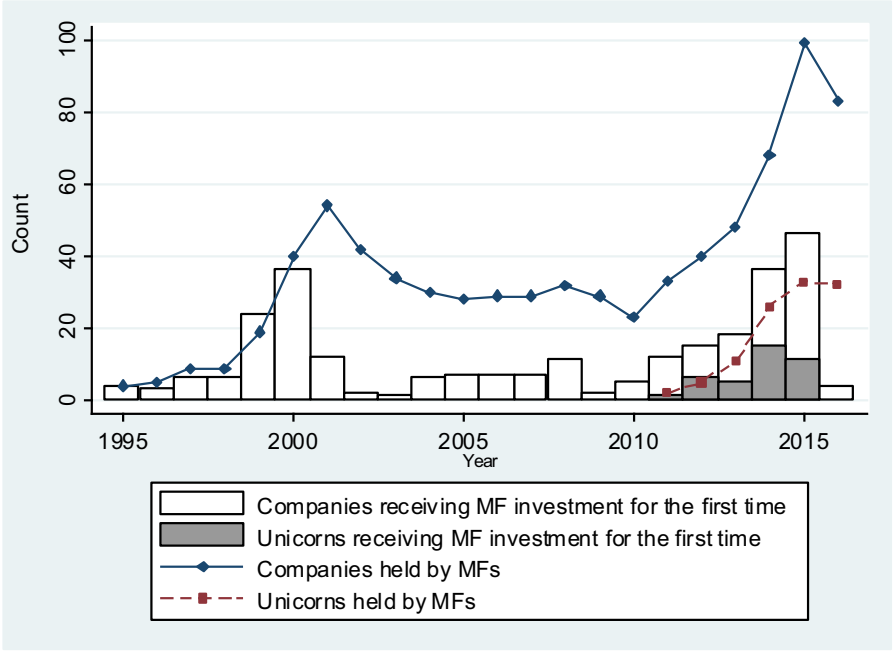


Fig. 1. Mutual fund investments in private companies.
Panel A shows the total number of domestic equity US mutual funds (Table 5, 2017 Investment Company Fact Book), the number of mutual funds that hold any private VC-backed companies, and the number of mutual funds that hold unicorns (where unicorns are defined following the WSJ Billion Dollar Startup Club database of privately held companies, valued at $1 billion or more, that have raised money in the past four years and have at least one venture-capital firm investor). Panel B shows the number of VC-backed companies receiving mutual fund investments for the first time as well as the total number of VC-backed companies held by mutual funds. It also shows these statistics for the subset of private VC-backed companies classified as unicorns. Panel C shows the inflow of new investments in VC-backed companies by mutual funds and cumulative valuations of VC-backed companies as well as the analogous statistics for the subset of these companies classified as unicorns. Mutual fund investments in VC-backed companies are based on mutual funds' restricted holdings extracted from EDGAR Form N-30D (1995–2005) and Form N-Q (2006–2016). Valuations and new investments are based on the last available reporting date in each fund-year, aggregated within each year.

Panel C: Amount invested in this space each year and cumulative valuation of these investments

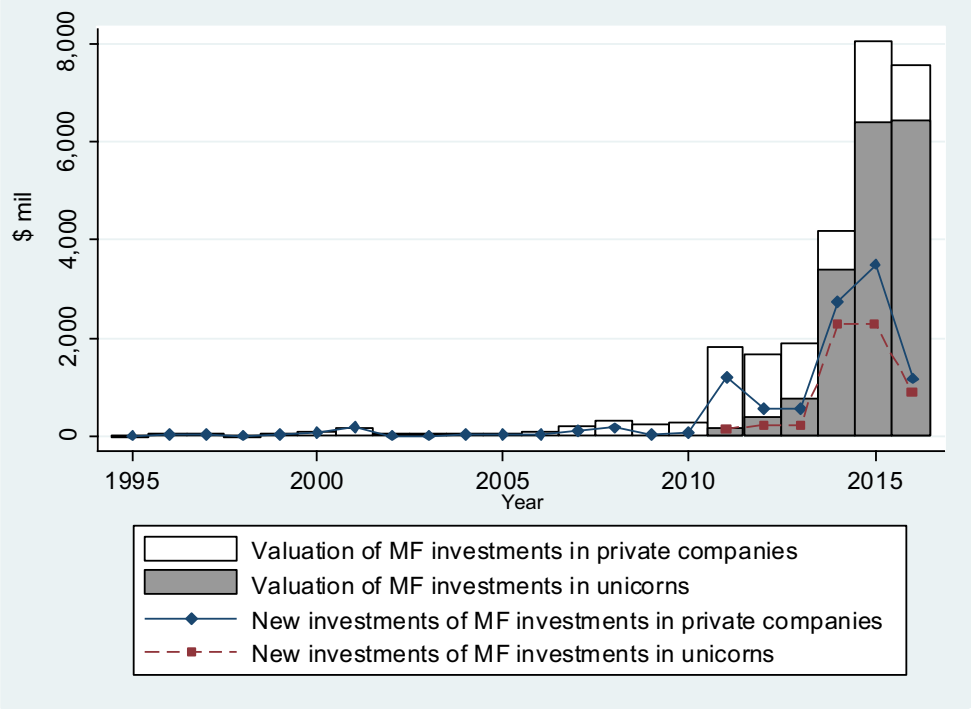


Fig. 1. Continued

the mutual fund financing enabling these firms to delay going public, an issue that we examine in detail later in the paper.

Across the 270 firms with mutual fund financing, Panel B of Table 2 compares those classified as unicorns with all other firms. Consistent with Fig. 1, we see that the majority of firms in which mutual funds have invested, 85%, do not represent unicorns.[8] Perhaps not surprisingly, the unicorn firms are larger (measured as number of VC rounds, VC syndicate size, and amount raised) and at a later stage of development (measured by patenting activity). We also observe that the unicorns are less likely to have exited private status, though this is partly driven by time-period effects.

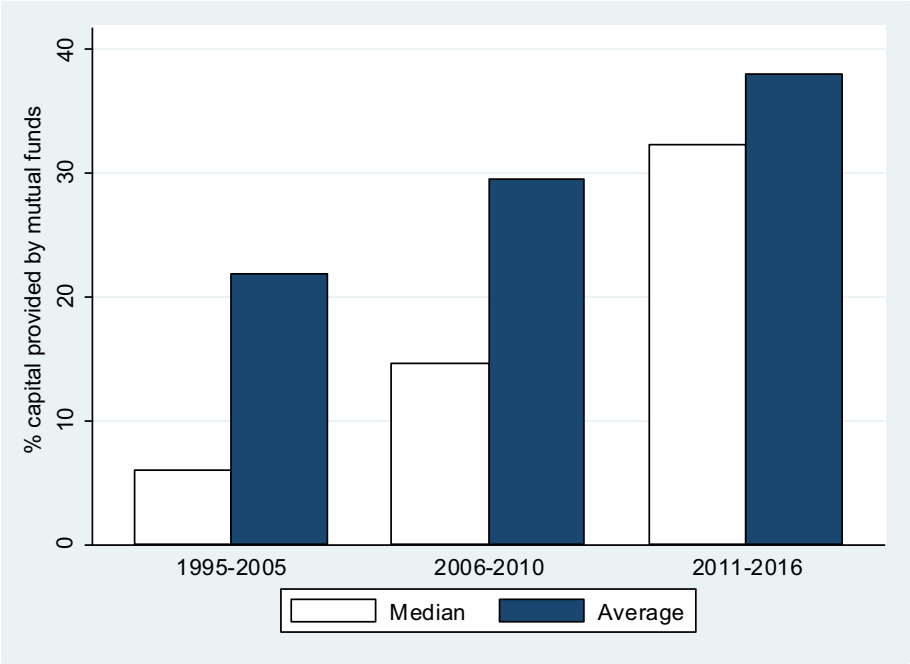
Table 3 examines the factors related to mutual fund financing in a regression framework. Each VC-backed private company represents one observation, and the dependent variable equals one if that company received mutual fund financing prior to either the end of the sample period or to exit. Column 1 includes the full sample of 28,516 private VC-backed companies, and columns 2–4 restrict the sample along various dimensions to limit the sample of firms to those on which mutual funds might more likely focus their attention. All specifications are ordinary least squares (OLS) and include stage (early, expansion, or later stage), state (of firm headquarters), industry, and first VC round year fixed effects. Explanatory variables are defined as in Table 2.

Results, which are similar to the univariate differences discussed above, suggest that mutual funds are more likely to invest in firms backed by high-reputation VCs and firms in more advanced developmental stages. Results are robust to limiting the regression sample to companies that received their first funding round over the 2005–2016 period (see Online Appendix Table A1), suggesting that mutual funds continue to invest in these same types of companies in more recent years.

Supplementary analyses of companies that were ex post successful, i.e., that went public via an IPO, suggest that companies in which mutual funds have invested are also characterized by high growth. For example, companies with mutual fund investment are 76% larger in terms of assets two years prior to the IPO ($33 versus $24 million) but 124% larger two years post-IPO. Much of this higher growth is coming from higher expenditures, but it is not accompanied by high profits. The combination of higher sales and expenditures, but lower gross margin, is consistent with these companies having insufficient internal cash flows to fund their growth and thus demanding more external capital. These results are shown in Online Appendix Fig. A1, and the statistical significance of these

[8] If we eliminate the early years during which there were no unicorns and restrict the sample to firms that received the first VC round in 1998 or later, a slightly lower 81% of firms with mutual fund financing represent non-unicorns. The total number of unicorns with mutual fund investments, 40, is comparable to data reported in the Wall Street Journal's Startup Stock Tracker, https://www.wsj.com/graphics/tech-startup-stocks-to-watch/. As of 2016, the WSJ Startup stock tracker reports 51 startups that are held by mutual funds and valued at $ 1 billion or more, including companies that are based outside US (e.g., Meituan–Dianping (China), Flipkart (India), and Spotify (Sweden), among others).

Panel A: Percentage of capital provided by mutual funds within each financing round



Panel B: Percentage of capital invested by mutual funds in each stage

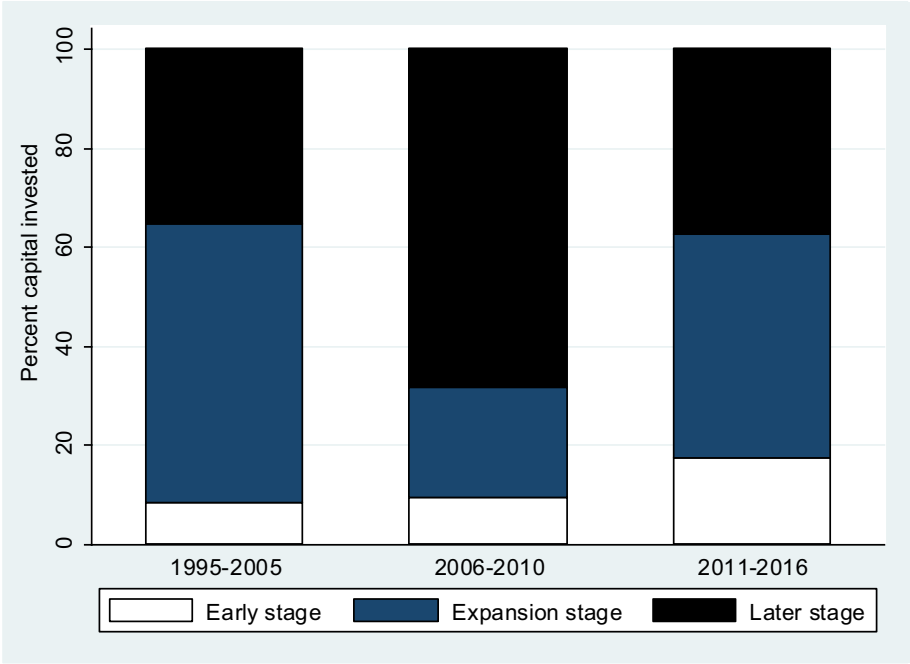


Fig. 2. The magnitude of mutual fund investments in private companies.
Panel A shows the percentage of capital provided by mutual funds within each financing round, conditional on financing rounds having at least one mutual fund as a participating investor. Among all 28,516 VC-backed companies that received first venture capital financing during 1990–2016, 270 companies received investment from at least one mutual fund. We match the 1,737 financing round dates of those 270 companies with the dates on which 149 funds acquired shares in these companies. We define a round as including mutual fund participation if the absolute value of the difference between the mutual fund's reported acquisition date and the Thomson Reuters's round date is less than 30 days. This matching process leaves us 234 funding rounds across 195 companies. Panel B shows the fraction of capital invested by mutual funds in each stage level. Acquisition costs are aggregated in each period and decomposed by stage level. The sample consists of 1,573 unique mutual-fund-company-security-type tuples (e.g., Fidelity Contrafund investing in Dropbox in Series C preferred stock). A company is classified as early stage if the company was at either seed or early stage (defined by Thomson Reuters Private Equity) when it received investment from mutual funds. Similarly, a company is classified as expansion stage (later stage) if the company was at expansion stage (later stage or buyout/acquisition stage) when it received investment from mutual funds. Data are based on mutual funds' restricted holdings extracted from EDGAR Form N-30D (1995–2005) and Form N-Q (2006–2016).

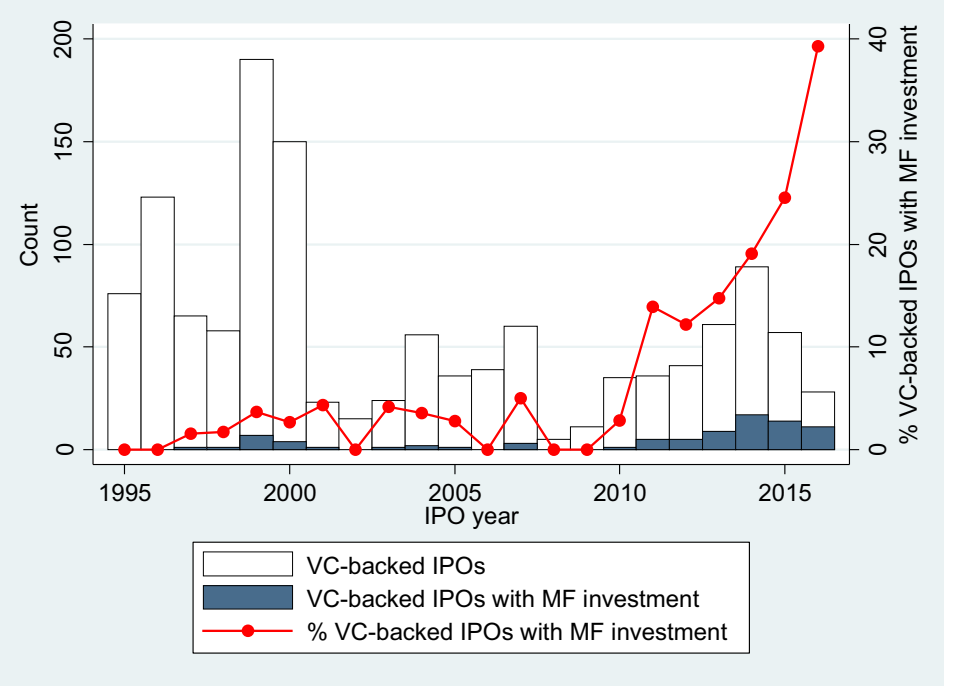


Fig. 3. Mutual fund investments in private companies that subsequently went public.
The sample consists of the subset of VC-backed companies, as defined in Table 1, that went public in an IPO between 1995 and 2016. This yields a total of 1,278 IPOs, of which 83 received mutual fund investments prior to the IPO. The bars show the number of VC-backed IPOs with (dark shaded) and without (lightly shaded) mutual fund investments prior to the IPO. The line shows the percent of VC-backed IPOs that received pre-IPO investments from mutual funds.

relations is confirmed in regressions, shown in Online Appendix Table A2.

Finally, Fig. 4 examines the extent to which mutual funds are more likely than other capital providers to focus on companies that plan to ultimately go public via an IPO. This would be consistent with funds' focus on companies at later stages of development, with high growth, and with large demands for capital, as noted above. It would also be consistent with funds seeking benefits such as higher allocations in an IPO, an issue we examine in Section 4.2. For each private company (as of 2016) that has mutual fund investment and is at a sufficient level of development to exit private status, we match to a company without mutual fund investment based on their Wikipedia pageview count, defined as the number of pageviews as of the first mutual fund financing date for mutual fund-backed companies and as of the last financing round date for all other companies.[9] We then search the company's Wikipedia webpage, the company's Crunchbase webpage, Google, and the Wall Street Journal from 2013 to 2016 for cases in which the CEO, other company executive, or related VC clearly mentions an IPO plan. Consistent with predictions, Panel A of Fig. 4 shows that a company insider discusses an IPO plan in 50% of companies with mutual fund financing, compared to in less than 10% of other companies. Inferences are similar if we restrict to instances in which the CEO mentions an IPO plan, as shown in Panel B.

4. Why have mutual funds' investments in private firms increased?

This section focuses on understanding the economic forces underlying the trends documented in the previous section. We consider the extent to which both demand-side and supply-side factors have contributed to the substantial increases in mutual funds' investments into private firms. First, on the demand-side, we consider the extent to which additional mutual fund capital enables companies stay private longer. Second, on the supply-side, we examine whether mutual funds have earned positive abnormal returns on these investments. Third, and also on the supply-side, we investigate whether VCs' might encourage mutual fund investment as a way to support inflated valuations. Finally, we also examine trends in other sources of capital to these private firms.

[9] Specifically, we restrict our sample (for both treatment firms and matching candidates) to companies that have received a financing round within the past four years, have received three or more financing rounds from four or more different VCs, and for whom the average first-round VC has funded nine companies over the past three years and has had at least 2.5 successful exits (where these cutoffs are based on the 25th percentile of these distributions, to exclude companies backed by low quality VCs). For companies without Wikipedia pageview counts, we randomly select a nonmutual fund backed company that similarly does not have Wikipedia pageviews.

Table 3
Determinants of mutual fund investments.
The sample consists of 28,516 unique companies, as described in Table 1. Each column shows an OLS regression, where the dependent variable equals one if the firm received mutual fund financing while private, and zero otherwise. The sample in column 1 equals the full sample of 28,516 private companies. In column 2, the sample is restricted to companies with a minimum of two rounds of venture capital financing. Column 3 adds the additional requirement that there are two or more VCs in the syndicate. Finally, column 4 adds the requirement that the amount of capital raised in the first financing round is above the median (compared to the set of first VC round financings in the same calendar year). Variable descriptions are provided in Appendix B. Robust *t*-statistics are reported in parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1% levels, respectively.

	(1) I(MF financing)	(2) I(MF financing)	(3) I(MF financing)	(4) I(MF financing)
First-round VC characteristics				
ln(VC firm age)	−0.001	−0.001	−0.001	−0.001
	(−0.835)	(−0.750)	(−0.767)	(−0.552)
ln(# Companies funded by VC)	−0.000	−0.000	−0.000	0.001
	(−0.101)	(−0.135)	(−0.400)	(0.612)
ln(# Exits by VC)	0.002***	0.003**	0.004**	0.002
	(2.847)	(2.286)	(2.422)	(0.669)
VC funding characteristics				
ln(Syndicate size)	0.010***	0.012***	0.014***	0.012***
	(6.609)	(5.659)	(5.205)	(3.141)
ln(Amount raised at first round)	0.003***	0.004***	0.004***	0.011***
	(3.613)	(2.995)	(2.789)	(3.567)
Time b/w 1st and 2nd round		−0.002***	−0.002***	−0.004***
		(−4.096)	(−3.826)	(−5.651)
Patenting activity				
ln(# Patents applied)	0.006***	0.007***	0.006***	0.007**
	(3.143)	(2.709)	(2.599)	(1.982)
Observations	28,516	18,087	16,624	9356
R-squared	0.018	0.019	0.019	0.023
Specification	OLS	OLS	OLS	OLS
First VC round	1990–2016	1990–2016	1990–2016	1990–2016
Co.s with MF investment	270	244	241	164
Stage-level FE	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
First VC round-year FE	Yes	Yes	Yes	Yes
Restriction	None	Min 2 VC rounds	Min 2 VC rounds + VC Syn >= 2	Min 2 VC rounds + VC Syn >= 2 + Amt raised above median

4.1. Firms' demands for capital: do mutual fund investments enable firms to stay private longer?

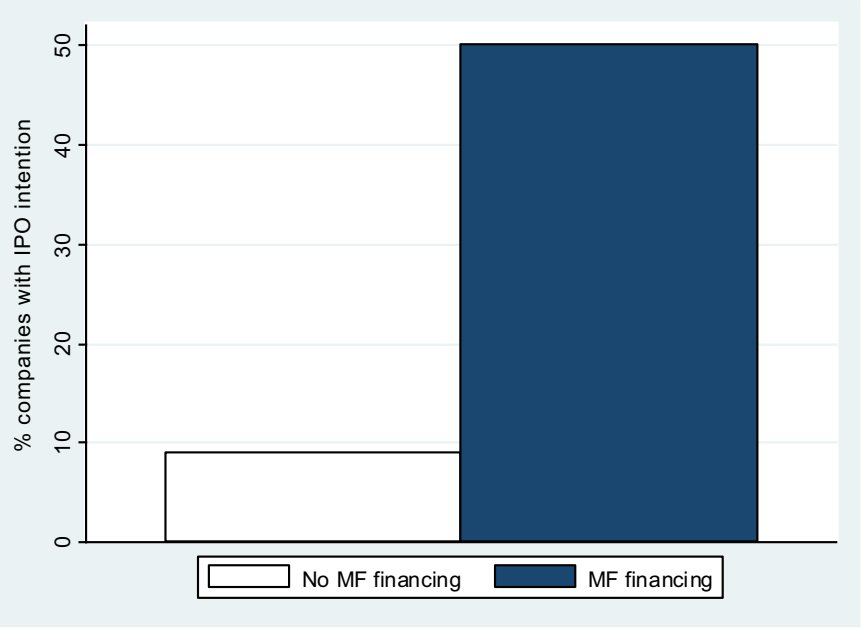
Public markets have changed in many ways over our sample period. Gao et al. (2013) argue that the economics of being an independent small firm have worsened; this potentially causes private firms to demand more capital, to enable them to stay private longer. Such dynamics likely necessitate sources of financing beyond the venture capital funding on which firms relied during their earlier years. VCs face multiple constraints, which limit their ability to fund private firms for extended periods of time. VC funds have lives of 10–12 years, and they seek to exit investments rather than invest more money in the later years of the fund. Also, there are limits on the percent of a fund they can invest in a single company (which can be binding for larger private firms with larger demands for capital) as well as limits on subsequent funds (by the same VC firm) investing in the same company. Because mutual funds do not have specific fund lives, they are likely to be more flexible regarding the timing of firms' exit.

4.1.1. Do mutual fund investments provide new capital or liquidity to existing shareholders?

To shed light on how mutual fund investments influence the underlying companies, we examine the ways in which they mitigate key constraints for private firms. We start by examining the extent to which these investments provide additional capital to the companies (i.e., primary shares) and liquidity to existing shareholders (i.e., secondary shares). Purchases of secondary shares enable existing shareholders to sell at least a portion of their holdings, thereby lessening one driver of public listing. However, the high growth trajectory of these companies arguably makes capital obtained through primary share investments particularly beneficial.

Multiple analyses indicate that most of these mutual fund investments represent primary shares. First, for each mutual fund investment in each firm, we calculate $\frac{\$: \text{Preferred shares invested}}{\$: \text{Total invested}}$ as a proxy for percent primary investment, as both Kaplan and Stromberg (2003) and conversations with VCs suggest that preferred stocks are almost always primary shares. Looking at Panel A of Fig. 5, this categorization indicates that in 66% of cases, the mutual funds receive almost entirely primary shares (fraction of preferred shares is greater than 90%), while only 13% of cases represent entirely secondary shares. Second, we match by date the mutual fund investments with the reported rounds in Thomson Reuters, under the premise that shares purchased in a round are likely to represent primary shares. We find that 70.4% of the 1,687 investments in our sample (where each of these 1,687 observations

Panel A: Plan to go public in an IPO, mentioned by any company insider



Panel B: Plan to go public in an IPO, mentioned by the CEO

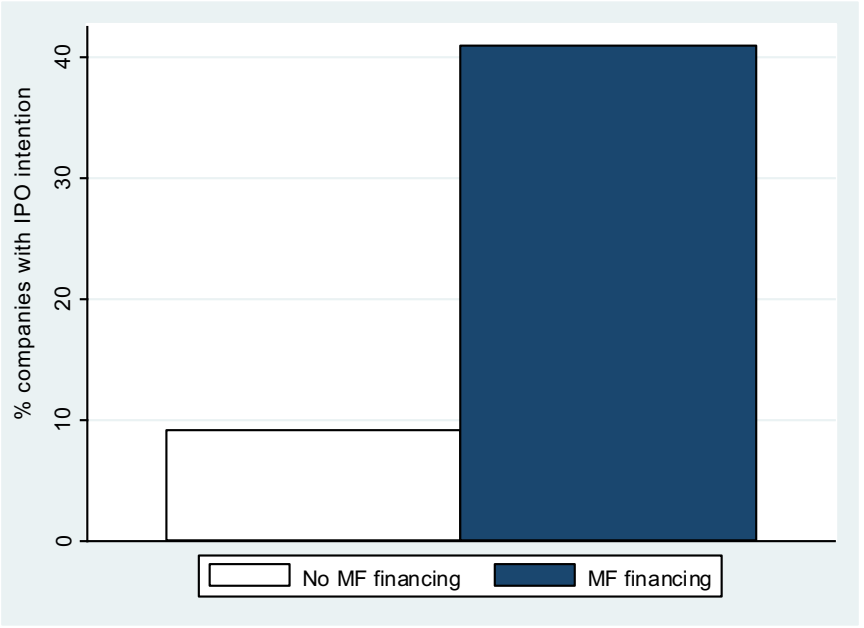
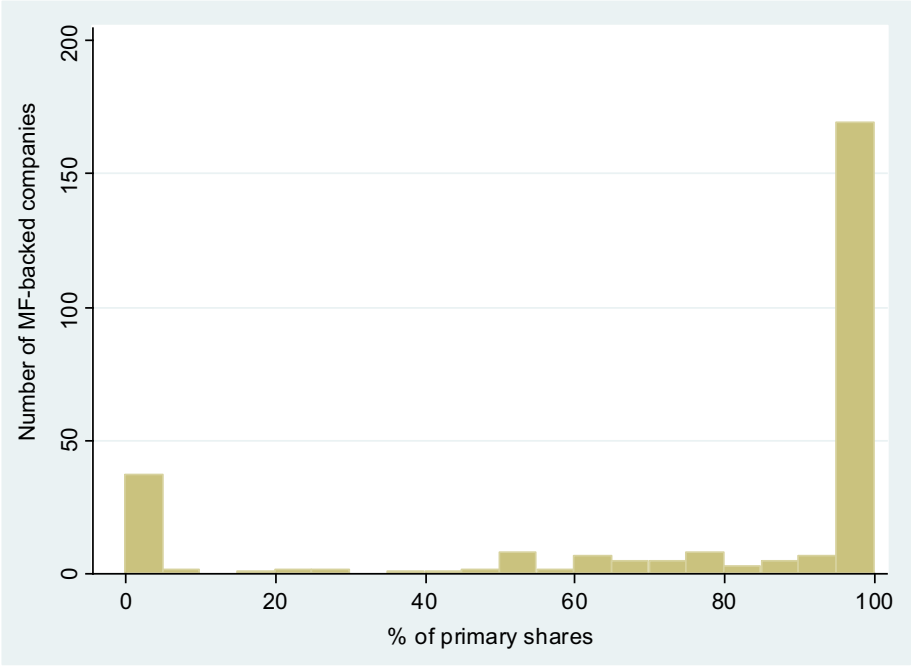


Fig. 4. Companies' stated intentions to go public in an IPO.
This figure examines companies' intentions to exit private status. The sample consists of VC-backed companies that received their first round of financing over the 2008–2016 period and who have not exited as of the end of 2016. Companies that do not receive follow-on financing for more than four years are defined as failure and excluded from the analysis. To limit the sample to companies that could feasibly go public, we require companies to receive at least 3 financing rounds, to be backed by at least 4 VCs, and for the average first-round VC to have funded at least 9 companies and to have at least 2.5 successful exits (via IPO or M&A) in the past 3 years. For each company that satisfies these restrictions and has mutual fund financing prior to the IPO, we retain all non-MF-backed companies with the same first financing round year, development stage, industry, and state. We then select the non-MF-backed company with the smallest difference in Wikipedia pageview count, where this count is measured at the first MF financing date for MF-backed companies and at the last financing round date for non-MF-backed companies. For MF-backed companies without a Wikipedia pageview count, we randomly a select a non-MF-backed company that similarly has no pageviews. Our final sample consists of 44 companies, 22 of which received mutual fund financing. We search the keywords "IPO" and "initial public offering" in each company's Wikipedia webpage, Crunchbase webpage, Google, and the Wall Street Journal. Panel A defines a company as intending to go public ("IPO intention") if the CEO, another company executive, or a related venture capitalist clearly mention an IPO intention at least once during the 2013–2016 period. Panel B is similar, but it focuses only on statements by the CEO.

Panel A: Distribution across private VC-backed firms: % MF investments that are primary shares



Panel B: Distribution of mutual fund financing date, relative to VC round date

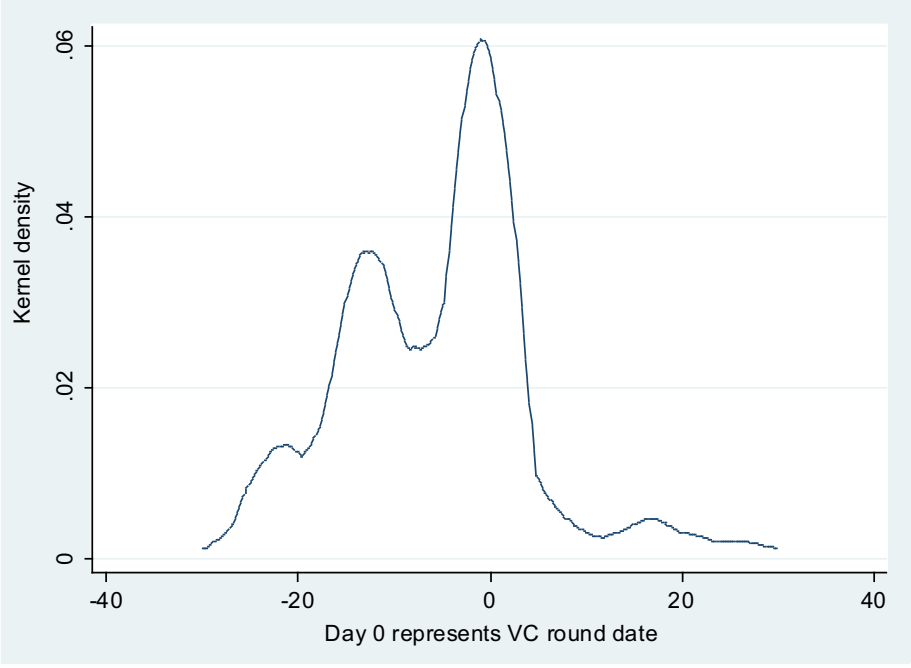


Fig. 5. Venture capital round versus secondary market transaction.
Panel A shows the distribution, across private VC-backed firms, of mutual funds' holdings by share type. From the initial sample of 270 VC-backed companies that receive mutual fund financing while private, we impose the additional filter that acquisition costs be nonmissing, resulting in 267 companies. Percent of primary shares equals (dollar amount of primary shares / total dollar amount invested by mutual fund in the company), where preferred stock is assumed to be primary shares and all other forms of investment (which are predominantly common stock) are assumed to represent secondary shares. In Panel B, mutual fund investments are matched with round dates in Thomson Reuters Private Equity if the absolute difference between mutual funds' acquisition date (Form N-30D and Form N-Q) and the Thomson Reuters round date is less than 30 days. Panel B shows the distribution of the difference between these dates, conditional on matching. The sample consists of 1,687 unique mutual fund-company-security-type tuples (e.g., Fidelity Contrafund investing in Dropbox in Series C preferred stock).

represents an investment by one mutual fund in one company at one date) are within 30 days of a VC round. Panel B of Fig. 5 shows that 70% of these cases are concentrated in the days preceding the round closing date, consistent with funds investing in the weeks leading up to this closing date. Google searches on a random sample of the remaining 29% of cases indicate that primary shares are issued in most (84%) cases. Finally, we also perform a similar match using Crunchbase data, which includes a smaller number of firms but has the advantage of including a series number (Series A, Series B, etc.), which enables a more precise match with mutual fund investments. Conclusions are similar under this approach. In aggregate, these alternative methods suggest that 80%–90% of mutual fund investments represent primary shares.

4.1.2. Do mutual fund investments represent incremental capital?

The effect of this new capital on the underlying companies depends on the extent to which it is incremental to investments that VCs would have otherwise made. Fig. 6 provides preliminary descriptive evidence suggesting that the mutual fund capital is incremental. We restrict the sample to the 1,151 funding rounds with nonmissing round amounts across the 195 unique companies that obtain mutual fund financing in at least one round, and we compare round size across the rounds with versus without mutual fund participation. We match the mutual fund investments to venture financing rounds using Thomson Reuters in Panel A (as this source provides the more comprehensive sample of venture financing rounds) and to Crunchbase in Panel B (as this source provides detail on the series). Across both panels, findings indicate that rounds with mutual fund participation are substantially larger than those without. For example, Panel B shows that among Series B financings, the median size of rounds with versus without mutual fund participation is $58 million versus $15 million.[10] Importantly, because the sample is restricted to companies that receive mutual fund financing at some point, this difference does not reflect a company-type effect.

Online Appendix Table A4 provides similar evidence within a regression framework, where we estimate OLS regressions of round size on mutual fund participation (either the natural log of round amount or a dummy to indicate mutual fund participation in the round), plus controls to capture company and VC characteristics and a broad set of fixed effects. Consistent with Fig. 6, we observe positive relations between mutual fund participation in the round and round size.

Table 4 provides more robust evidence on the extent to which mutual fund investments provide incremental capital to companies, within a regression framework that enables us to control both for other determinants of round size and for the endogeneity of mutual fund participation. The dependent variable is the natural log of the round amount, and the independent variable of interest is mutual fund participation in the round, measured either as the dollar amount raised from mutual funds in the round or as a dummy variable to indicate mutual fund participation. Controls include variables to capture VC quality and the firm's stage of development at the time of the round. We also include a measure of investor participation following Ewens et al. (2016)'s finding that rounds with no new investors tend to be smaller ("inside round"). These variables are all defined as of the time of each round, and fixed effects at the stage, state, industry, financing round year, and lead VC level are also included. Following Nahata (2008), lead VC represents the VC that participated in the first round and, conditional on such participation, made the largest total investment in the company across all funding rounds.

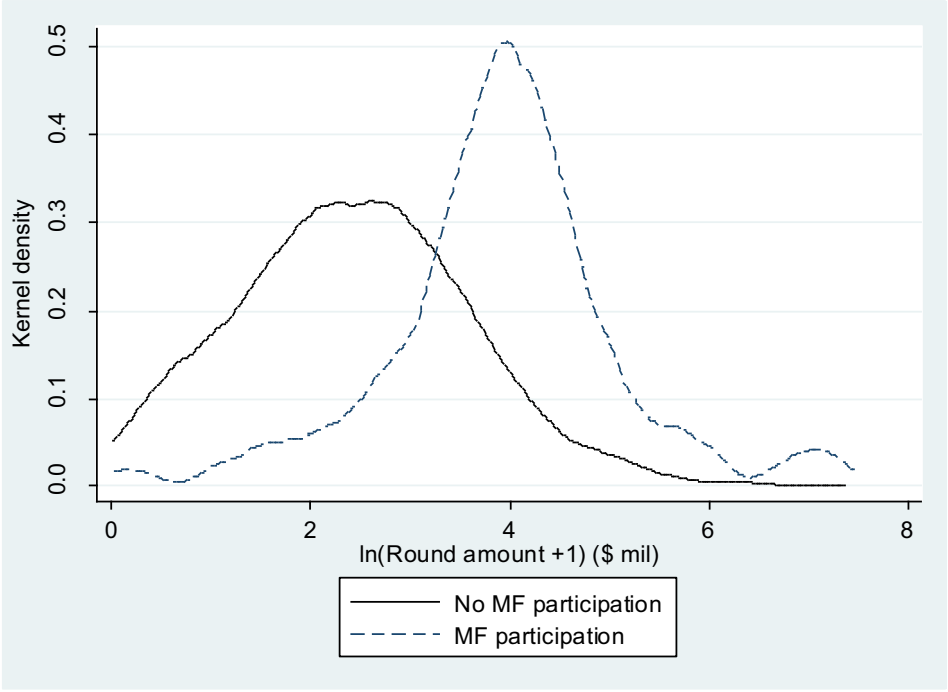
To control for the possibility that the rounds in which mutual funds participate are larger for reasons other than the mutual funds' participation per se, we use an instrumental variable (IV) approach. The most likely source of endogeneity in this context is correlated omitted variables (i.e., if the investment by the mutual fund is correlated with other factors that we do not observe and that cause round size to be larger). We require an instrument that is correlated with mutual funds' decision of whether to participate in a round (the relevance condition) but not correlated with other factors that affect the round amount (the exclusion condition). Based on both a broad academic literature on the value of connections and on conversations with mutual fund managers and venture capitalists, we focus on connections between mutual funds and the firm's lead VC.

To quantify the lead VC's connections with mutual funds, we do the following. For each company financing round (the observation level in regressions), we count the change in the lead VC's connections since the first round, where connections is defined as the number of the lead VC's portfolio companies that have obtained funding from a mutual fund. Thus, this measure varies as a function of the lead VC developing new connections with mutual funds through other companies in their portfolios. A VC that is increasingly enabling its companies to raise capital from mutual funds arguably has both increasingly strong connections to mutual funds and is increasingly open to the idea of investing alongside these nontraditional providers of capital. Fig. 7 provides an example. Facebook's lead VC was Accel partners, and at the time of Facebook's first funding, there were five companies in Accel's portfolio that had received funding from mutual funds. At the time of Facebook's round 2 and round 3 fundings, Accel had the same number of mutual fund connections, five, meaning the change in connections equals zero. At the time of Facebook's round 4 funding, Accel had seven companies in its portfolio that had received funding from mutual funds, meaning the change in connections equals two.

The relevance condition is supported by the substantial literature on the value of connections, for example, in decreasing information asymmetry and facilitating

[10] The larger values of rounds with mutual fund financings is not driven by such rounds representing the last round a company raises—only 55% of rounds with mutual fund participation represent the company's last round. Because relatively few companies have Series F, G, and beyond, we merge them into a single category.

Panel A: Round amounts, across with and without mutual fund participation



Panel B: Amount of capital raised in venture rounds

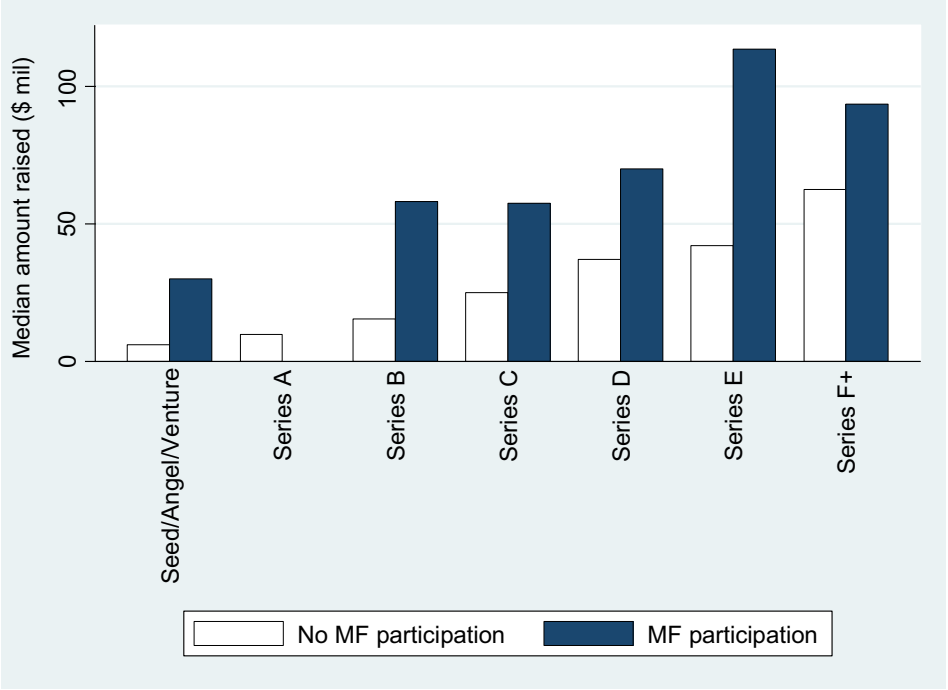


Fig. 6. Capital invested in private company funding rounds.
This figure compares round amounts across rounds with versus without mutual fund participation. In Panel A, from the initial sample of 270 VC-backed companies that receive mutual fund financing while private, we impose the additional filter that round amounts be nonmissing, resulting in 195 companies and a total of 1151 funding rounds where we can match Thomson Reuters round dates with mutual fund investments (based on the same procedure used in Fig. 5). Of these 1,151 rounds, 234 include mutual fund participation. Panel B repeats the similar exercise based on Crunchbase data. We first match the 270 companies in Thomson Reuters with companies in Crunchbase, resulting in 762 financing rounds across 184 companies, where we can match Crunchbase round dates with mutual fund investments (based again on same procedure used in Fig. 5) and where round amounts are nonmissing. Of the 762 rounds, 155 include mutual fund participation.

Table 4
Do mutual fund investments increase total capital raised?
The sample consists of VC-backed companies as described in Table 1, with several additional criteria: the company has at least two rounds of VC financing (to enable definition of our instrument, the change in the lead VC's mutual fund connection), the lead VC serves in this role for at least two companies (to enable lead VC fixed effects), and the round amount is nonmissing. This leaves 15,651 unique companies with 45,757 financing rounds. We define a round as including mutual fund participation if |mutual fund reported acquisition date – Thomson Reuters round date| < 30 days. We use both the amount of capital raised from mutual funds and a dummy variable to measure mutual fund participation in financing rounds. The dependent variable is the natural log of round size. Columns 1 and 3 show first-stage regressions, and columns 2 and 4 show the associated 2SLS regressions. To construct the instrument, we first identify the lead VC for each company. Second, we count the number of companies funded by the lead VC that have received mutual fund investments, which we refer to as "connections." Our instrument, ln (Δ Lead VC's MF connections), equals $\ln(\text{Connections}_{\text{current round}} - \text{Connections}_{\text{first round}} + 1)$. All variables in log form represent the natural log of one plus the variable, and variables are calculated as of either the time of each round (firm characteristics) or the last quarter prior to the financing round (VC financing characteristics). Standard errors are clustered at the firm level. *t*-statistics are reported in parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

	First stage ln(Amt raised from MF)	*Second stage* ln(Round size)	*First stage* MF in round	*Second stage* ln(Round size)
ln(Amt raised from MF)		0.792**		
		(1.985)		
I(MF in round)				2.247**
				(1.978)
ln(Δlead VC's MF connections)	0.031***		0.011***	
	(6.425)		(6.687)	
ln(VC firm age)	0.014***	0.047***	0.004***	0.050***
	(3.953)	(3.736)	(3.348)	(4.131)
ln(# Co.s funded)	0.006**	–0.047***	0.002**	–0.046***
	(1.965)	(–4.151)	(2.075)	(–4.125)
ln(# Exits)	–0.010***	0.151***	–0.003***	0.149***
	(–3.809)	(13.526)	(–3.942)	(13.673)
Time since first round	–0.004***	–0.004	–0.001***	–0.004
	(–3.351)	(–1.051)	(–2.920)	(–1.201)
ln(Rounds received)	–0.000	–0.452***	0.000	–0.452***
	(–0.129)	(–29.509)	(0.060)	(–29.441)
ln(# Investors)	–0.012***	0.055***	–0.002	0.050***
	(–2.756)	(3.631)	(–1.434)	(3.405)
ln(Amount raised)	0.024***	0.358***	0.007***	0.361***
	(5.457)	(27.199)	(6.755)	(29.628)
ln(# Patents applied)	0.003	0.101***	0.003**	0.098***
	(1.002)	(9.398)	(2.000)	(8.831)
Inside round	–0.014***	–0.886***	–0.006***	–0.883***
	(–6.360)	(–85.437)	(–7.731)	(–79.572)
Observations	45,757	45,757	45,757	45,757
R-squared	0.059		0.059	
Stage-level FE	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Financing round year FE	Yes	Yes	Yes	Yes
Lead VC FE	Yes	Yes	Yes	Yes
First-stage *F*-stat	41.28		44.72	

information sharing (see, e.g., Cohen et al., 2010; Engelberg et al., 2012). The exclusion condition requires that the VC-mutual fund manager relationship not be directly related to changes in a company's characteristics in ways that would cause certain rounds to be larger than others. The fact that we focus on changes in the lead VC's mutual fund connections (defined over its other portfolio companies) after the company's first round of financing ensures we are not capturing anything directly related to the company. Moreover, we include lead VC fixed effects to capture any cross-sectional patterns across VCs, for example, the tendency of high-quality VCs to invest in larger firms that need more capital. Finally, the inclusion of financing round year fixed effects ensures that we are not merely capturing aggregate time-series trends.[11] We also include industry and stage-level fixed effects, as well as other controls.

Column 1 of Table 4 shows the first-stage regression where the dependent variable equals the dollar amount raised from mutual funds in the round, in log form. Our instrument, the change in the lead VC's mutual fund connections, is positive and significant as predicted in explaining the mutual fund investment, and the *F*-statistic from the first-stage regression is above 40, well over the critical value of 10. Looking at column 2 (the second stage regression), the coefficient on mutual fund investment is significantly positive, consistent with predictions. A $10 million investment (the median dollar amount) from mutual funds

[11] While we include both lead VC and year fixed effects, we do not have sufficient observations (in particular, sufficient firms with mutual fund investment) to include lead VC*year fixed effects. Thus, we cannot completely control for any interactions between VC investment waves and VC types (e.g., the tendencies of some VCs to invest in firms that will need substantial capital in the future).

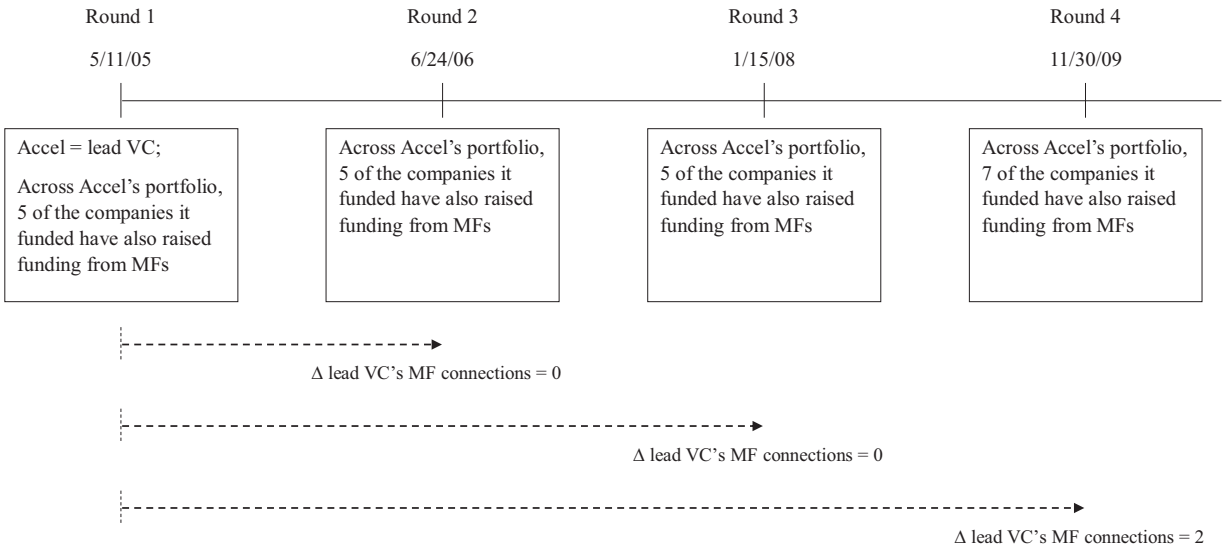


Fig. 7. An illustration of the instrument: changes in Accel Partners' connections with mutual funds.
This timeline shows the number of connections that Accel Partners has with mutual funds, at the time of each Facebook financing round (up to its fourth VC round). Accel Partners is Facebook's lead VC. The figure also shows the change in Accel Partners connections with mutual funds, relative to its initial funding of Facebook; this change is the instrument used in 2SLS analyses. Connections is defined as the number of lead VC firm's portfolio companies that have obtained funding from a mutual fund.

increases round size by 5.7 million dollars.[12] Columns 3 and 4 use a simpler measure of mutual fund participation, a dummy variable equal to one if a mutual fund invested in the round. Results similarly indicate that mutual fund investment significantly increases round size.[13]

4.1.3. Effects of mutual fund capital on time spent in private status

The finding that mutual funds provide incremental capital to these private firms, over and above that which venture capitalists would be willing to provide, suggests that these investments should enable the companies to stay private longer. The greater availability of capital mitigates one constraint that can otherwise push firms to go public before they are well positioned to manage the requirements of being a publicly traded firm (e.g., the added disclosures, regulatory requirements, and pressure from institutional investors). Fig. 8 provides suggestive evidence consistent with this intuition. Across both companies that went public in an IPO and companies that were acquired, the companies with mutual fund financing stayed private substantially longer.[14]

To more robustly test the prediction that mutual fund capital enables companies to stay private longer, Table 5 uses a data set of company-round-level observations, and we examine the extent to which mutual fund financing enables companies to stay private for an additional period of time after the round date. To control for endogeneity, we use the same instrument as defined above, the change in the number of the lead VC's mutual fund connections, with lead VC, financing year, stage, state, and industry fixed effects.[15] Independent variables are defined one quarter prior to each round, the independent variable of interest is whether the firm raised financing from a mutual fund during the round, and the dependent variable equals one if the firm is still private two years (columns 2 and 4 of Panel A) or three years (columns 3 and 5 of Panel A) later. The choice of two and three years is motivated by the fact that the average period between rounds is just less than two years (see, e.g., Tian, 2011) and the conjecture that the mutual fund financing effectively provides the private company with one additional funding cycle. Finally, we limit the sample to firms that will at some point exit, thereby ensuring that a company that is still private represents a

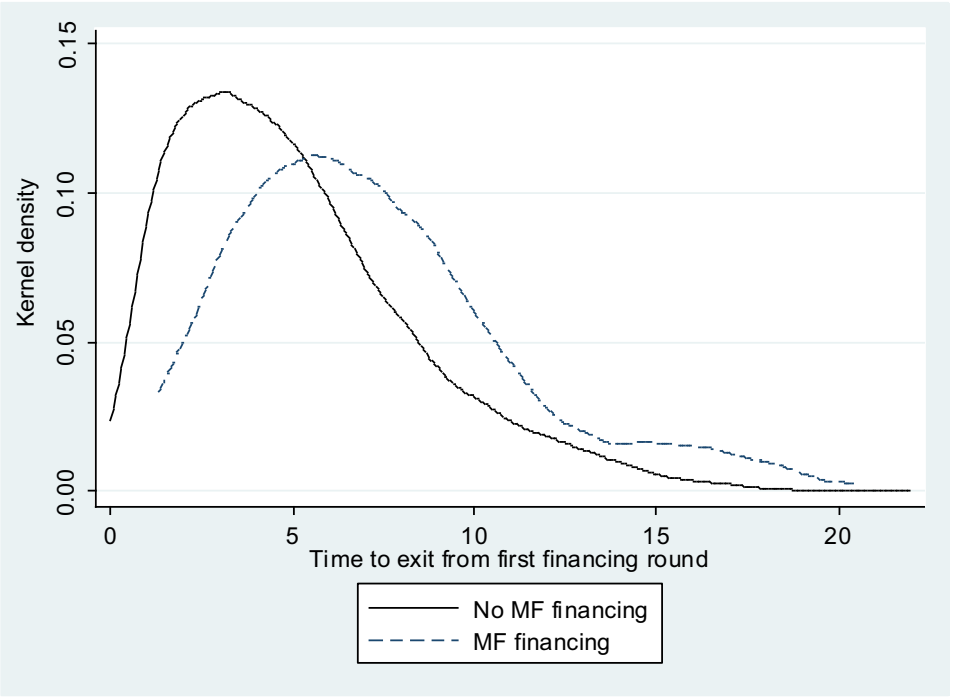
[12] The calculation of economic significance is as follows: $\ln(10+1)^{*}0.792 = 1.899$. $\exp(1.899) - 1 = 5.7$. As highlighted by Angrist and Pischke (2008), it is possible that local average treatment effects (LATE) cause economic significance estimates to be higher than average treatment effects (ATE). Our instrument is likely to capture cases in which the amount the company can raise is sensitive to its ability to overcome information asymmetries and credibly convey future prospects. Connections between mutual funds and VCs capture this decrease in information asymmetry, meaning the effects on round amounts will be greatest in exactly these cases.

[13] An alternative way to examine whether mutual fund financing provides incremental capital is to regress the amount of funding provided by VCs in the financing round on the amount of money provided by mutual funds. Consistent with mutual fund capital not substituting for VC capital, we find no evidence of a negative relation.

[14] OLS regressions similarly show a positive relation between mutual fund financing and time spent in private status (see Online Appendix Table A3). Mutual fund financing is also negatively related to failure and positively related to exit via IPO, similar to Aragon et al. (2018) findings for hedge funds. Finally, mutual fund financing may also influence the valuation of the company in the IPO, but we find no significant relation with initial returns. Huang et al. (2018) examine this issue in depth.

[15] As discussed above, employing the change in the lead VC's connections after the first round and including lead VC fixed effects ensures that we are not capturing cross-sectional patterns in VCs that might be related to firm quality.

Panel A: Time to exit from first financing round (kernel density plot)



Panel B: Time to exit from first VC round (grouped by first VC round year cohort)

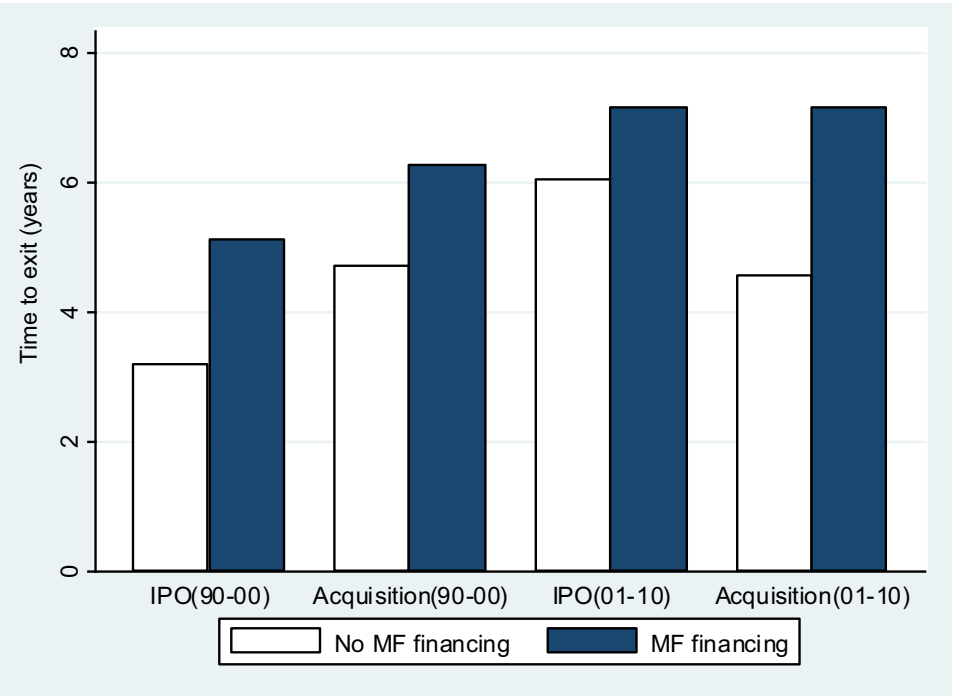


Fig. 8. Do companies receiving mutual fund investments stay private longer?
The sample consists of 7,282 unique companies that received their first VC financing in 1990–2010 and exited. Among this subset of companies that have exited, 111 companies received at least one investment from mutual funds. Panel A shows a kernel density plot of time to exit for companies with and without mutual fund financing. Panel B compares median time to exit from the first financing round, for firms with versus without mutual fund financing across all VC-backed companies that exit via either IPO or acquisition. The first and second (third and fourth) sets of bars show time to exit for companies that first received VC financing during 1990–2000 (2001–2010). All numbers represent medians.

company that is postponing exit rather than having joined the "living dead". We also require firms to have received at least two rounds of VC funding so that we can calculate our instrument.

Following prior analyses, we use two measures of mutual fund participation: the dollar amount raised from mutual funds in the round (Panel A) and a dummy for mutual fund participation in the round (Panel B). Looking first at Panel A, we report second stage regressions using both OLS (i.e., standard 2SLS specifications, shown in columns 2 and 3) and probit (i.e., IV probit specifications, shown in columns 4 and 5). OLS specifications are more robust to multiple fixed effects, but probit specifications (for which average marginal effects are reported in the table) have the advantage of better enabling inferences of economic significance when the dependent variable is binary. Results across Panels A and B indicate that mutual fund financing significantly increases the probabil-

Table 5
Do mutual fund investments enable firms to stay private longer—IV analysis.
The sample consists of the 6,073 VC-backed companies that received at least two rounds of VC funding and that have exited via either IPO or acquisition. We define a round as including mutual fund participation if |mutual fund reported acquisition date – Thomson Reuters round date| < 30 days. Independent variables are defined at the round level. In Panel A, the dependent variable equals one if a company does not exit via IPO or M&A over the subsequent two years (i.e., over the two years after the round) in columns 2 and 4, and the subsequent three years in columns 3 and 5. In Panel B, the dependent variable equals one if a company does not exit via IPO or M&A over the subsequent two years (i.e., over the two years after the round) in column 2, and the subsequent three years in column 3. We use both the amount of capital raised from mutual funds and a dummy variable to measure mutual fund participation in financing rounds. To construct the instrument, we first identify the lead VC for each company. Second, we count the number of companies funded by the lead VC that have received mutual fund investments, which we refer to as "connections." Our instrument, ln(Δ Lead VC's MF connections), equals $\ln(\text{Connections}_{\text{current round}} - \text{Connections}_{\text{first round}} + 1)$. All variables in log form represent the natural log of one plus the variable. Variables are calculated as of either the time of each round (firm characteristics) or the last quarter prior to the financing round (VC financing characteristics). Standard errors are clustered at the firm level. *t*-statistics are reported in parentheses in columns 1–3. *z*-statistics are reported in columns 4–5 in Panel A. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

Panel A: Investment amount as mutual fund investments

	First stage	Second stage OLS regressions		Second stage Probit regressions	
	ln(Amount raised from MF)	Active within 2 years	Active within 3 years	Active within 2 years	Active within 3 years
ln(Amount raised from MF)		0.832*	2.013**	0.887***	1.589***
		(1.918)	(2.440)	(2.775)	(4.379)
ln(Δlead VC's MF connections)	0.032***				
	(3.912)				
ln(VC firm age)	0.012**	–0.008	–0.015	–0.010	–0.012
	(2.551)	(–0.699)	(–1.066)	(–0.955)	(–1.241)
ln(# Companies funded)	0.001	–0.013	–0.015	–0.014	–0.011
	(0.153)	(–1.195)	(–1.069)	(–1.383)	(–1.002)
ln(# Exits)	–0.008**	0.015	0.017	0.015	0.012
	(–2.047)	(1.400)	(1.350)	(1.618)	(1.325)
Time since first round	–0.005**	0.007*	–0.001	0.006*	0.000
	(–2.422)	(1.873)	(–0.137)	(1.918)	(0.011)
ln(Rounds received)	0.004	–0.156***	–0.149***	–0.137***	–0.110***
	(0.895)	(–8.990)	(–7.181)	(–7.745)	(–5.222)
ln(# Investors)	–0.000	–0.013	–0.011	–0.011	–0.008
	(–0.073)	(–0.860)	(–0.561)	(–0.817)	(–0.598)
ln(Amount raised)	0.011***	–0.035***	–0.046***	–0.037***	–0.036***
	(3.963)	(–3.905)	(–4.373)	(–5.352)	(–5.301)
ln(# Patents applied)	0.004	0.031***	0.028*	0.027**	0.021
	(1.027)	(2.782)	(1.725)	(2.525)	(1.614)
Inside round	–0.017***	–0.050***	–0.021	–0.043***	–0.014
	(–5.112)	(–4.835)	(–1.522)	(–3.635)	(–1.160)
Observations	21,151	21,151	20,774	19,857	19,660
R-squared	0.071				
Specification	OLS	2SLS	2SLS	IV PROBIT	IV PROBIT
Stage-level FE	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Financing round year FE	Yes	Yes	Yes	Yes	Yes
Lead VC FE	Yes	Yes	Yes	Yes	Yes
First-stage *F*-stat	15.30				

(*continued on next page*)

Table 5
(*continued*)

Panel B: Financing round participation as mutual fund investments

	First stage	Second stage OLS regressions	
	I(MF in round)	Active within 2 years	Active within 3 years
I(MF in round)		2.260**	4.610***
		(1.967)	(2.578)
ln(Δlead VC's MF connections)	0.012***		
	(4.626)		
ln(VC firm age)	0.003**	−0.006	−0.011
	(2.120)	(−0.528)	(−0.863)
ln(# Companies funded)	0.000	−0.013	−0.017
	(0.168)	(−1.193)	(−1.237)
ln(# Exits)	−0.002	0.013	0.015
	(−1.489)	(1.223)	(1.219)
Time since first round	−0.002**	0.007*	−0.001
	(−2.374)	(1.776)	(−0.113)
ln(Rounds received)	0.002	−0.157***	−0.151***
	(1.105)	(−8.998)	(−7.355)
ln(# Investors)	0.002	−0.017	−0.020
	(0.881)	(−1.124)	(−1.034)
ln(Amount raised)	0.003***	−0.033***	−0.043***
	(3.631)	(−3.948)	(−4.444)
ln(# Patents applied)	0.004**	0.026**	0.021
	(2.080)	(2.120)	(1.163)
Inside round	−0.007***	−0.049***	−0.021
	(−5.828)	(−4.601)	(−1.568)
Observations	21,151	21,151	20,774
R-squared	0.069		
Specification	OLS	2SLS	2SLS
Stage-level FE	Yes	Yes	Yes
State FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Financing round year FE	Yes	Yes	Yes
Lead VC FE	Yes	Yes	Yes
First-stage *F*-stat	21.40		

ity that a firm stays private longer. Focusing on the probit regressions to infer economic significance, $10 million in mutual fund financing increases the probability of staying private for an additional two years by 36 percentage points.[16]

We note that these estimates are subject to three caveats. First, as discussed in footnote 12, local average treatment effects (LATE) potentially influence the magnitude of estimates. Second, probit specifications can be sensitive to multiple fixed effects, though this concern is mitigated by the similarity in results when we exclude any combination of stage, state, and industry fixed effects. (As discussed earlier, lead VC fixed effects are necessary to achieve identification.) Third, there are potential sample selection biases that arise from restricting the sample to firms that have successfully exited, raising the possibility that results are not generalizable. While we cannot completely dismiss this possibility, we note that conclusions are robust to many different specifications. For example, Panel B shows similar 2SLS specifications but uses a dummy variable to indicate mutual fund participation in the round. Results similarly show that greater mutual fund financing significantly increases the probability of staying private longer.[17]

For comparison, Online Appendix Table A4 reports the OLS analogs of these regressions. In each case, the analogous OLS coefficient is negative rather than positive, suggesting a negative selection effect (i.e., companies that receive mutual fund investment tend to exit more quickly). This is consistent with funds' tendencies to invest in later stage companies, and our controls not completely capturing this effect.

[16] This represents the change in the probability of staying active when the mutual fund investment increases from $0 to $10 million, holding other variables at their mean values. The number of observations for probit regressions are slightly lower than those in OLS regressions because we need to drop observations that perfectly predict outcomes in probit models, for example, because of fixed effects.

[17] We do not include a probit model in Panel B because two discrete variables (mutual fund participation as the independent variable and staying private as the dependent variable) would require a bivariate probit (as opposed to the IV probit, which allows a continuous endogenous regressor). The number of financing rounds with mutual fund participation is not large enough to include necessary fixed effects in the bivariate probit model.

Table 6
Percent of mutual funds' investments that exited private status.
The sample consists of 149 funds that invested in 270 VC-backed companies over the 1995–2016 period. Within each fund, we calculate the fraction of investments that exited via IPO or M&A by the end of 2016. The table shows the rates for the 25th, 50th, and 75th percentile fund as well as the mean exit rate across all mutual funds. Observations are at the fund level.

	Quartile 1 fund	Median fund	Quartile 3 fund	Mean fund
MF investment dates 1995–2016, $n = 149$ funds				
% MF inv'ts that exited via IPO	0%	33.3%	66.6%	41.2%
% MF inv'ts that exited via M&A	0%	0%	10.7%	10.9%
MF investment dates 1995–2000, $n = 25$ funds				
% MF inv'ts that exited via IPO	0%	0%	25%	14.2%
% MF inv'ts that exited via M&A	0%	33.3%	50%	38.0%
MF investment dates 2001–2010, $n = 45$ funds				
% MF inv'ts that exited via IPO	0%	22.2%	100%	38.3%
% MF inv'ts that exited via M&A	0%	0%	25%	18.8%
MF investment dates 2011–2016, $n = 119$ funds				
% MF inv'ts that exited via IPO	20%	42.86%	77.8%	47.6%
% MF inv'ts that exited via M&A	0%	0%	0%	2.8%

In sum, results throughout this section indicate that mutual funds provide new capital to companies in the form of primary shares, and this capital is incremental to what VCs would have provided. Together, these factors suggest that the companies receiving this financing should be able to stay private longer, and this is precisely what the IV analysis shows. In aggregate, our findings provide support for a demand-side effect contributing to mutual fund investments in private firms.

4.2. Mutual funds' supply of capital: potential for higher returns, diversification, and IPO allocations

We conjecture that mutual funds' willingness to supply capital to private firms stems from a search for returns that are higher than or less closely correlated with those on their public market investments. We evaluate the success of this strategy during our sample period, an intriguing issue given that experience is found to be a key determinant of VCs' success with private firms and mutual fund managers have very little experience in this space. We also consider the possibility that investing in firms while they are still private contributes to higher allocations in the firm's IPO.

We begin by tabulating the percent of each fund's investments that exited via either IPO or acquisition across the 149 unique mutual funds that invested in VC-backed private firms. As shown in Table 6, over the entire sample period the average (median) mutual fund exited 41.2% (33.3%) of its investments via IPO. A more detailed examination provides some evidence that mutual funds have performed better over the more recent years. During the earlier 1995–2000 subperiod, both participation rate and frequency of successful exits were lower, with only 25 funds investing in private firms and the mean fund exiting just 14% of its investments via IPO, versus analogous rates of 119 funds and a 48% exit rate over the more recent 2011–2016 period. Interestingly, exits via acquisition have become less common, with the mean fund exiting just 2.8% of its investments through this channel during the recent subperiod. This decline contrasts with the overall trend of an increasing portion of VC-backed firms to exit via acquisition, as shown by Gao et al. (2013).

Table 7 looks in more detail at the fund investments that exited via IPO, as this is the most common form of exit. As pre-IPO investors, mutual funds can sell in the IPO, in which case such sales are included as secondary share sales in the prospectus, or hold through the lock-up period. As shown in Online Appendix Table A5, few mutual funds sell in the IPO, meaning that in most cases mutual funds hold through the lock-up expiration. Thus, we calculate returns over various intervals but focus our discussion on the period ending 180 days after the IPO, as this coincides with the typical lock-up expiration. Looking at Panel A of Table 7, row 1 shows that the average fund investment earned a raw return of 454%, where return equals $\frac{Closing\ price\ day\ 180 - Fund\ acquisition\ cost\ per\ share}{Fund\ Acquisition\ Cost\ per\ share}$. This equates to an average monthly return of 4.8%. Returns are higher over the subset of non-unicorns, 5.9% per month. These higher returns are consistent with these firms likely being smaller and riskier at the time of the funds' investments. As shown in the last column, returns on the equal-weighted market index measured over the same periods are only about 1% per month.

Panel B shows that in addition to providing high returns, these investments also provided substantial diversification relative to the publicly traded firms that represent the majority of mutual funds' portfolios. Across all mutual funds' private firm investments, the correlation between returns on the private firms and those on the equally weighted market index (measured over analogous periods) equals −0.04 (statistically insignificant). Consistent with the unicorns being larger and more similar on certain dimensions to publicly traded firms, the correlation is a higher 0.25 among this subset.

The possibility of receiving IPO allocations represents another potential benefit of investing in private firms. Because IPOs are underpriced by an average 15%, IPO

Table 7
Benefits to mutual funds, of their private firm investments that exited via IPO.
This table focuses on 83 private firms with mutual fund investment that subsequently went public in an IPO. Panel A shows the returns on mutual fund investments, with observations at the fund-company-security level (e.g., Fidelity Contrafund's investment in Dropbox Series A). Return is defined by $\frac{Price-Fund's\ acquisition\ cost\ per\ share}{Fund's\ acquisition\ cost\ per\ share}$, where price is either offer price or closing price on the IPO day, day 30, day 90, or day 180 after the IPO. Preferred stock is assumed to convert into common stock at the IPO. Warrants, convertible bonds/notes, and stock units are excluded. It also shows returns, over the acquisition date to day 180 period, on the equally weighted index. Panel B shows the Pearson correlation between the private firm investments and the equally weighted index over each of the Panel A time intervals, where ***, **, and * denote significance at the 1%, 5%, and 10% levels. Panel C shows the frequency with which mutual funds hold shares in IPO firms after the IPO, conditional on whether they invested prior to the IPO. The observation level is the company-family pair: 83 VC-backed companies that received mutual fund investment while they were private and subsequently went public × mutual fund families that invested in at least one firm pre-IPO over the 1995–2016 period. We limit the sample to fund-family pairs in which the firm went public after the family began investing in private firms. We obtain post-IPO fund holdings from the CRSP mutual fund database for the 2001–2016 period and from Thomson Reuters mutual fund database for 1995–2000 period. Post-IPO holdings equal shares held by the fund family at the first post-IPO mutual fund filing date as a fraction of firm shares outstanding. Panel D shows IPO allocations to mutual fund families, where the observation level is the company-family pair. We limit the sample to the pairs in which the family's affiliated investment banks served as a member of the IPO syndicate (as families are required in these cases to report IPO allocations). Across the 261 pairs, 14 are associated with pre-IPO investment (as shown in the first row) and 247 are not (as shown in the second row). The third row shows statistics for a matched sample of 28 IPOs without pre-IPO investment, where the matching is based on a propensity score approach as described in more detail in the body of the paper. Panel E shows the distribution across private firms held by mutual funds, of mutual funds' valuations, where the sample is restricted to funds that report value per share, holdings of preferred and common stock, and firms with more than one mutual fund investor reporting a valuation in the same month. Dispersion is calculated as $\frac{Highest\ valuation-Lowest\ valuation}{Lowest\ valuation}$ and is measured at each semiannual point for which we collect holdings from the underlying mutual fund filings.

Panel A: Mean monthly Returns, from the initial acquisition date

	Private firm inv'ts, from initial acquisition date to:					EW index, from initial acquisition date to
	Offer price	IPO closing price	30 days after IPO	90 days after IPO	180 days after IPO	180 days after IPO
MF returns on all private firm investments (539 obs.)						EW index
Raw returns	290.04%	529.85%	554.38%	605.94%	453.99%	28.72%
Mthly returns	10.35%	14.93%	10.89%	7.72%	4.78%	1.05%
MF returns on unicorns (137 obs.)						
Raw returns	44.68%	135.93%	98.68%	108.51%	66.38%	14.44%
Mthly returns	0.92%	4.34%	3.15%	2.37%	1.53%	0.70%
MF returns on non-unicorns (402 obs.)						
Raw returns	373.65%	664.10%	709.68%	775.46%	586.08%	33.59%
Mthly returns	13.57%	18.54%	13.53%	9.54%	5.89%	1.17%

Panel B: Correlation between MF investments in private firms and the EW market index

	Corr(returns to MF inv'ts in private firms, market indices) between initial acquisition date and				
	Offer price	IPO closing price	30 days after IPO	90 days after IPO	180 days after IPO
Correlation across all private firm inv'ts (539 obs.)	0.01	0.00	−0.00	−0.03	−0.04
Correlation across unicorns (137 obs.)	0.40***	0.44***	0.23***	0.50***	0.25***
Correlation across non-unicorns (402 obs.)	−0.02	−0.04	−0.04	−0.07	−0.08

Panel C: Distribution of post-IPO holdings

Percentile	P5	P25	P50	P75	P95	Obs.
Sample = mutual fund families that invest pre-IPO in at least 1 company * companies with pre-IPO investment						
With pre-IPO inv't	0%	0.87%	2.84%	5.31%	15.00%	93
Without pre-IPO inv't	0%	0.21%	0.28%	0.84%	4.93%	214

Panel D: IPO allocations

	Obs.	% IPO*Fund family pairs with IPO allocation	% IPO shares allocated (at family level, conditional on receiving an allocation) Mean	Median
With pre-IPO inv't	14	64.3%	4.7%	4.1%
Without pre-IPO inv't: full sample	247	17.0%	1.3%	0.3%
Without pre-IPO inv't: matched sample	28	21.4%	2.4%	3.0%

(*continued on next page*)

Table 7
(*continued*)

Panel E: Dispersion in funds' valuations of private firms

	Average [median] # entities holding firm				Dispersion in valuation across mutual funds				
	# Firms	# Firm-periods	# Funds	# Families	Q1	Median	Q3	90th pctl	95th pctl
Private firms held by >1 MF	137	768	6.44 [4.00]	2.15 [1.00]	0.00	0.00	0.12	0.79	1.38

allocations are coveted by investors. Reuter (2006), Ritter and Zhang (2007), Nimalendran et al. (2007), and Goldstein et al. (2011), among others, conclude that investors engage in various quid pro quo activities with investment banks to obtain higher IPO allocations. While a lack of publicly available allocation data on all sample firms presents an obvious challenge, we examine this issue in two ways. First, Panel C compares post-IPO fund holdings at the first available post-IPO mutual fund reporting date across a broad sample of IPOs, following Reuter (2006), Ritter and Zhang (2007), and Chemmanur et al. (2010) who have used this as a proxy for IPO allocations. Second, Panel D takes advantage of an institutional reporting requirement to obtain actual allocations across a subset of cases.

Looking first at Panel C of Table 7, fund families that invested in the firm prior to the IPO hold significantly more shares after the IPO. We focus on fund families that invested in at least one firm prior to its IPO, and we compare post-IPO holdings across those firms in which each family did versus did not invest pre-IPO.[18] Results show that the median (95th percentile) holding in firms with pre-IPO investment equals 2.84% (15.00%) of post-IPO shares, compared to a much lower 0.28% (4.93%) among firms without pre-IPO investment. We tabulate these statistics at the family level rather than the fund level, as underwriters typically allocate shares to families rather than to individual funds. Conclusions are similar at the fund level (not tabulated).

Panel D provides more direct evidence on allocations. Of the 14 fund families in our sample during 2010–2016, 3 are affiliated with an investment bank: Morgan Stanley, Allianz (affiliated with Morgan Stanley and JP Morgan), and Sun America/Seasons (affiliated with Goldman Sachs and JP Morgan). As discussed by Shen (2017), under SEC Rule 10F-(3), these funds must disclose on Form NSAR the allocations that they receive in any IPO in which the affiliated bank belongs to the IPO syndicate. Appendix A, Section A.6 shows an example. Exploiting this institutional detail, we collect actual IPO allocation data for these three fund families. We start with all VC-backed IPOs during 2010–2016 where one of these banks belonged to the IPO syndicate. Across this set of company-fund family pairs, there are 14 pairs in which the fund family invested prior to the IPO and 247 where they did not.[19] For each of these 14 cases, we use propensity score matching to select two control firms that are similar on other dimensions but for which these fund families did not invest prior to the IPO.[20]

Looking at Panel D, mutual fund families are substantially more likely to receive allocations when its affiliated mutual funds invested in the firm prior to the IPO. The fund family receives IPO allocations in 64% of the cases in which the family invested pre-IPO, compared to only 17% across the entire set of fund family-IPO pairs in which the family did not invest pre-IPO and 21% in the matched sample. Conditional on receiving an allocation, the percent of IPO shares allocated to these fund families is greater when one or more funds invested prior to the IPO. The mean (median) percent allocated is 4.7% (4.1%) in cases where affiliated mutual funds invested pre-IPO, compared to only 2.4% (3.0%) in the matched sample where there is no such investment.

Finally, we examine whether funds' private firm investments offer another, more strategic, benefit. Mutual funds must report valuations of these private firms on a regular basis, but the lack of public market prices raises the possibility that fund managers set valuations strategically, for example, for reasons pertaining to compensation contracts or fund-flow patterns.[21] We find that such instances are rare. As shown in Panel E, across a sample of 137 private firms with more than one mutual fund investor, the median dispersion in valuation, measured as $\frac{Highest\ valuation - Lowest\ valuation}{Lowest\ valuation}$, equals zero. It equals 12% at the 75th percentile and 79% at the 90th percentile. In sum, there is a small amount of disagreement in most cases but a large amount of disagreement within a relatively small subsample. The overall high level of agreement appears to reflect mutual funds' practice of revising valuations after the firm raises a new funding round, with other revaluations being relatively rare.

Table 8 provides back-of-the-envelope estimates of the total return to mutual funds. Based on findings in Tables 6 and 7, we categorize mutual fund investments into four groups: exited via IPO, exited via acquisition, defunct (firms that have not exited and have not raised

[18] We limit the sample to fund family-firm pairs in which the date of the firm's IPO occurred after the family began investing in private firms.

[19] We thank Ke Shen for providing institutional detail related to these allocations and for providing data for one bank-year whose filings were not machine readable.

[20] We estimate a probit model using IPO*fund family observations, where the dependent variable equals one if the fund family invested prior to the IPO and zero otherwise. Independent variables include variables from Table 3 (with the exception of fixed effects because of the small sample size).

[21] For example, a 2015 WSJ article highlights the varying valuations of Uber, with Blackrock valuing it at $40.03 per share, Hartford Financial Services at $35.67, and Fidelity Investments at $33.32. "Mutual funds flail at valuing hot startups like Uber," WSJ Oct 29, 2015. However, a contemporaneous paper by Agarwal et al. (2018) similarly finds that such instances are rare.

Table 8
Mutual funds' total returns to private firm investments, back-of-the envelope.
Panel A tabulates the number of mutual fund investments into private firms that experience each of three possible outcomes: exit via IPO, exit via M&A, or defunct. The observation is at the fund-company-security level (e.g., Fidelity Contrafund's investment in Dropbox Series A). The sample is limited to the 770 investments (out of a total of 871), with available data to determine the acquisition date and to calculate returns. For IPOs, investment duration for IPOs equals the number of months between the fund's acquisition date and day 180 after the IPO, and returns are calculated between the fund's acquisition cost and the closing price at the end of this period. Value-weighted returns are weighted by each fund's acquisition cost. Extra allocation is calculated as the average incremental allocation obtained times the money left on the table, as described in more detail in the text. For companies that exit via M&A, investment duration equals the number of months between when the mutual fund purchased shares and acquisition date, and returns are assumed to be 0%. For companies that go defunct, investment duration equals the number of months between when the mutual purchased shares and the last reporting date the firm appears in mutual fund filings, and returns are assumed to be −90%. The last row shows equally weighted and value-weighted returns across the 770 investments that have exited. Panel B shows wealth relatives, calculated for each mutual fund investment, as $\frac{Return\ on\ invt}{Return\ on\ EW\ index}$, where the returns are calculated over equivalent time intervals. For the representative case, shown in columns 1 and 2, companies that are still active (have not exited and are not classified as defunct) are assumed to, on average, experience the same outcomes as the observed cases (as tabulated in Panel A). For the conservative case, shown in Columns 3 and 4, companies that are still active are assumed to earn 0% returns. Columns 1 and 3 (2 and 4) show equal-weighted (value-weighted, weighting by fund's acquisition cost) wealth relatives. Wealth relatives are shown for the full sample as well as subsamples by unicorn versus non-unicorn status and by time period.

Panel A: Returns by exit type, full sample

		Mutual fund investments in private firms			
		# inv'ts	Avg inv't duration (# mths)	EW returns	VW returns
Co's that exit via IPO	Returns	539	24.6	453.99%	275.51%
	Extra allocation	539	24.6	66.74%	3.82%
Co's that exit via M&A	Returns	122	39.8	0.00%	0.00%
Co's that are defunct	Returns	109	31.2	−90.00%	−90.00%
All Co's that have exit outcome:	Returns	770	28.0	351.77%	205.00%

Panel B: Wealth relatives vis-à-vis equally weighted index, over full sample, and subsamples

	Representative case "Still active" cases have similar outcomes to resolved cases		Conservative case "Still active" cases result in 0% returns	
	Wealth relative, EW	Wealth relative, VW	Wealth relative, EW	Wealth relative, VW
Full sample				
All firms	3.76	2.61	2.32	1.66
Unicorns	1.45	1.32	1.03	0.99
Non-unicorns	4.35	2.99	3.43	2.43
Subperiods, all firms				
1995–2000	1.01	0.92	1.01	0.92
2001–2010	1.21	1.02	1.15	0.98
2011–2016	5.13	3.37	2.59	1.78

financing for at least four years before the end of the sample period), and still actively private. For firms that exited via IPO, returns come both from price appreciation between share acquisition and lock-up expiration and from higher IPO allocations. Using statistics from Panel D of Table 7, we estimate the dollar value of the incremental allocation: "difference in the probability of receiving allocation (64.3% – 21.4%)" × "difference in the % shares allocated (4.1% – 3.0%)" × "money left on the table in the offering (proceeds raised × initial return)." As IPO allocation decisions are typically made at the fund family level, we distribute the dollar value of extra allocation to each fund within a family based on their pre-IPO investment amount and calculate the percent return between the dollar mutual fund investment and this value.

We calculate both equally weighted and value-weighted returns, where the weight is the dollar amount of the mutual fund's investment. For firms that exit via acquisition, we assume mutual funds earn 0%. This is likely a conservative estimate, when compared with the fact that 71% of the acquisitions in our sample have a deal value that exceeds total capital contributed and the average (median) gross multiple in these deals equals 12.6 (2.8).[22] Following Korteweg and Sørensen (2010) and Serrano and Ziedonis (2018), we assume a return of –90% for firms that go defunct, which allows for the fact that many companies have tangible assets or patents that they sell at the time of firm failure. Because mutual funds typically invest in later rounds, they have stronger liquidation preferences, enabling them to capture these returns. The number of investments in each of these categories, along with the average returns of each, is tabulated in Panel A of Table 8. Aggregated across all observed exits, mutual fund

[22] Gross multiple, defined as (deal value / total capital raised) – 1, is calculated across the 69% of deals with non-missing deal value in SDC. The extremely high average gross multiple is highly influenced by one outlier, without which the average multiple equals 5.6. Even for acquisitions with deal value, we would have to make assumptions regarding valuations of different share classes to estimate the actual returns of each fund. We opt for the more conservative approach of assuming 0% returns.

returns equal an estimated 205.0% on a value-weighted basis (351.8% on an equally weighted basis).

To enable a comparison of these returns with funds' likely investments in publicly traded companies, Panel B of Table 8 shows wealth relatives vis-à-vis the equally weighted index. This requires an assumption regarding the firms that are still private and not defunct (i.e., the truncated cases). We consider two alternative cases. The "representative case" assumes that these firms' exit outcomes are analogous to the non-truncated sample as reported in Panel A, while the "conservative case" assumes that funds earn 0% average returns across these firms. Wealth relatives range from 1.66 to 2.61 on a value-weighted basis and even higher on an equally weighted basis. These wealth relatives are higher among non-unicorns (2.43–2.99), which is consistent with the likely higher risk of these companies. Wealth relatives are also higher in the most recent subperiod. This may reflect either learning, as mutual fund managers have become more experienced in this space, or luck, as earlier subperiods were associated with large market corrections (i.e., the collapse of the internet bubble and the financial crisis).

In sum, results in Tables 6–8 highlight funds' strong performance in this sector—in terms of higher returns, greater diversification relative to public investments, and higher IPO allocations. This strong performance has likely contributed to their continued investments into private firms.

4.3. VCs' perspective: do VCs invite mutual fund investors to substantiate higher valuations?

A large literature debates the extent to which mutual fund managers are skilled, with the general consensus being that most mutual fund managers lack skill (see, e.g., Carhart, 1997; Fama and French, 2010). This raises the possibility that VCs view mutual fund managers as "dumb money", who are willing to invest at higher valuations than other more informed investors. While findings in the prior section regarding funds' returns provide some evidence against this explanation, we examine it more specifically in this section through three sets of analyses. First, we examine the other investors that participated in the same round as mutual funds. In general, all investors in a round receive the same terms. Thus, if mutual funds were investing at overly high valuations, it is likely that "smart money" would be less willing to participate in that round. Second, we examine the valuations of the rounds in which the mutual funds participated and, more pertinently, the returns following these rounds. Third, we estimate market model and three-factor regressions of mutual funds' returns on these investments.

We begin in Table 9 by examining the propensity of informed investors to participate in rounds that include mutual funds. We estimate regressions where the dependent variable is a measure of VC quality, calculated as an average across all VCs participating in the round, and the independent variable of interest is a dummy for mutual fund participation in the round. Contrary to the dumb money story, we find that rounds with mutual fund participation include VCs with significantly more experience (column 1, using VC age as a proxy for experience) and that are significantly higher quality (column 2, using number of the VC's portfolio firms that exited via IPO as a proxy for quality). We also find that total syndicate size is larger in rounds with VC participation (column 3), suggesting that potential VCs are more likely to invest alongside mutual funds.

Columns 4 and 5 present a more stringent test, we focus on high-quality VCs who have not invested in the firm in any prior round. We use two measures of high-quality VCs: top 30 according to Nahata (2008) (column 4) and being one of the top 10 VCs in terms of number of portfolio companies with an IPO over the prior five years (column 5). Neither measure provides any evidence that high-quality VCs are less likely to invest alongside mutual funds. Rather, coefficients are both positive, albeit insignificant at conventional levels. In sum, our results are more consistent with mutual funds only investing if more informed players are also investing at the same terms. This reliance on the certification of high-quality VCs has likely contributed to mutual funds' strong performance in the private firm space, as shown in the prior section.

Table 10 looks more directly at the relative valuations of rounds with versus without mutual fund participation, using two alternative approaches. Looking first at Panel A, for each round we estimate a pseudo market-to-book ratio (MB), equal to the post-round valuation from Thomson Reuters divided by the cumulative capital invested in the company up to that point. We define a round as including mutual fund participation if the absolute value of the difference between the mutual fund's reported acquisition date and Thomson Reuters's round date is less than 30 days. We estimate OLS regressions to assess the relation between mutual fund participation in a round and both the level of MB and the change in MB between the current and subsequent round. We estimate these regressions across all VC-backed private firms with available data (columns 1 and 3) as well as just the subset with mutual fund financing in at least one round (columns 2 and 4). Throughout we control for variables that potentially affect valuations, which are defined as of the time of each round (e.g., measures of VC quality (for the VCs that have provided funding to the firm) and firm quality). We also include stage-level, state, industry, financing round year, and lead VC fixed effects.

Results indicate that the rounds with mutual fund participation tend to occur at higher valuations (columns 1 and 2), but we find no evidence that these valuations are "overly" high, in the sense of being followed by lower subsequent valuation changes (columns 3 and 4). The coefficients on mutual fund participation in both columns 3 and 4 are insignificant at conventional levels. Results are robust both to controlling for mutual fund participation in round $t+1$ and to defining the dependent variable using post-money valuation instead of MB.

One potential concern regarding these results relates to the fact that many post-money valuations overstate fair value, as all previously issued shares are valued at the price of shares issued in the most recent round even though shares issued in the most recent round frequently

Table 9
Are mutual funds dumb money?
The sample includes rounds of VC-backed companies, from Thomson Reuters Private Equity database (formerly known as VentureXpert). All independent variables are calculated as of either the time of each round (firm characteristics) or the last quarter prior to the financing round (VC financing characteristics), with the exception of variables denoted t–1, which are calculated as of the prior round. Since we include VC financing characteristics from the previous round as control variables, the sample excludes the first VC round of each firm. The dependent variable is ln(VC firm age) in column 1, where age is defined as the number of years between the initiation of the VC's first fund and the current round; ln(# IPO exits) in column 2, defined as the number of the VC's portfolio companies that have gone public in an IPO within the past five years; ln(syndicate size) in column 3, defined as the VC syndicate size in the round; and number of new top VCs in columns 4 and 5, where new top VC represents a VC that is providing funding in this round and has not participated in any previous round. Top VC is defined as a top 30 VC from Nahata's (2008) ranking in column 4 and as a VC that ranks within the top 10 based on the number of companies taken public via IPO between year t-5 to year t-1 in column 5. The independent variable of interest, MF in round, equals one if one or more mutual funds invested in the round, and zero otherwise. We define a round as including mutual fund participation if the absolute value of the difference between the mutual fund's reported acquisition date and the Thomson Reuters's round date is less than 30 days. Throughout all panels, ln(variable) represents ln(variable + 1). Standard errors are clustered at the firm level. t-statistics are reported in parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

	(1) ln(VC firm age)	(2) ln(# IPO exits)	(3) ln(syndicate size)	(4) ln(# New top VCs, based on Nahata (2008)	(5) ln(# New top VCs based on IPOs)
I(MF in round)	0.097***	0.124***	0.227***	0.019	0.021
	(2.671)	(2.655)	(6.275)	(1.037)	(1.339)
Time since first round	0.048***	−0.011	−0.044***	0.005*	−0.003
	(6.713)	(−1.189)	(−7.361)	(1.918)	(−1.356)
ln(Rounds received)	0.080***	0.044***	0.080***	0.030***	0.017***
	(7.440)	(2.718)	(9.276)	(9.301)	(6.317)
ln(# Investors)	−0.053***	0.001	0.160***	−0.052***	−0.035***
	(−3.968)	(0.061)	(13.869)	(−8.557)	(−7.199)
ln(Amount raised)	0.004	0.008	0.013***	−0.008***	−0.002
	(0.579)	(0.950)	(2.632)	(−3.487)	(−1.011)
ln(# Patents applied)	−0.038***	−0.039**	0.037***	−0.008*	−0.015***
	(−2.815)	(−1.961)	(3.291)	(−1.739)	(−3.657)
Inside round	0.045***	0.058***	−0.394***	−0.060***	−0.040***
	(7.729)	(7.439)	(−86.986)	(−32.128)	(−26.611)
$\ln(\text{VC firm age})_{t-1}$	0.002	−0.021**	−0.004	0.003	0.002
	(0.253)	(−2.133)	(−0.671)	(1.067)	(0.975)
$\ln(\#\text{ Co.s funded by VC})_{t-1}$	−0.003	0.000	0.016***	−0.006***	−0.006***
	(−0.529)	(0.012)	(3.253)	(−3.127)	(−3.800)
$\ln(\#\text{ Exits by VC})_{t-1}$	0.026***	0.066***	−0.007	−0.015***	−0.015***
	(4.046)	(7.542)	(−1.456)	(−7.039)	(−8.647)
Observations	51,504	51,504	51,504	51,504	51,504
R-squared	0.665	0.765	0.615	0.360	0.309
Stage-level FE	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Lead VC FE	No	No	No	No	No
Financing round year FE	Yes	Yes	Yes	Yes	Yes

have more control rights, as shown by Gornall and Strebulaev, 2019. This will bias our results if rounds with mutual fund participation have systematically different valuation errors than other rounds. For example, returns subsequent to mutual fund participation will be biased upwards if this valuation error is particularly high at time $t++1$ or particularly low at time t. Using the Gornall and Strebulaev sample, we find no evidence in support of such biases.[23] In fact, we find that rounds subsequent to mutual fund participation have lower valuation errors, which would bias us in favor of finding support for the dumb money effect. Results are shown in Online Appendix Table A6.

Panel B of Table 10 provides an alternative metric of valuation changes, which has the advantage of controlling for risk. Following Cochrane (2005) and Korteweg and Sørensen (2010), we estimate alphas from VC-backed company investments, using factor-type models that account for the irregular intervals at which valuations are observed. The sample consists of financing rounds of companies that have exited via IPO or acquisition. The dependent variable (measured as of each round) equals the change in log value between the round post-money valuation and the exit value, net of the risk-free rate. We regress this on either the market factor (columns 1–3) or the three Fama–French factors (columns 4–6), where these factors are similarly measured in log return form. We estimate these regressions on the full sample of private companies that have exited (columns 1 and 4) and the subsets without (cols 2 and 5) and with (cols 3 and 6) mutual fund

[23] We thank Will Gornall and Ilya Strebulaev for sharing their data with us.

Table 10
Do mutual funds invest in overly high valuations?
In Panel A, the sample consists of VC-backed company rounds with nonmissing post-money valuations in the Thomson Reuters Private Equity database. The dependent variable in columns 1 and 2 is MB, defined as ln[MV(t) / BV(t)], where MV(t) equals the post-money valuation at the current financing round and BV(t) equals the cumulative capital invested in the company up through the current financing round. Columns 3 and 4 require a company to have a nonmissing post-money valuation for at least two consecutive financing rounds (otherwise, we cannot calculate the change), and the dependent variable is ΔMB_{t+1}. Independent variables are defined as of the time of each round, and robust t-statistics are reported in parentheses. *, **, and *** denote statistical significance at 10%, 5%, and 1% levels, respectively. In Panel B, the dataset consists of VC-backed company rounds with nonmissing post-money valuations in the Thomson Reuters Private Equity database, with the additional criteria that the company exits via either IPO or M&A. For IPO (M&A) exits, the dependent variable equals the change in log value between the round post-money valuation and offer price x shares at the IPO (deal value), net of the risk-free rate. In columns 3 and 6, the sample is restricted to financing rounds with mutual fund participation, which includes both (1) Thomson Reuters rounds in which the absolute value of the difference between the mutual fund's reported acquisition date and the Thomson Reuters' round date is less than 30 days, and (2) mutual fund financings for which reported acquisition dates fall outside this time range (if multiple mutual funds report investments on the same date at the same acquisition cost per share, then these are grouped together). In columns 1–3 independent variables include an intercept and the market return net of the risk-free rate. Columns 4–6 also include the SMB and HML factors from Fama and French (1993), which are obtained from Kenneth French's website. The monthly alpha, which represents a measure of abnormal performance, is recovered following Korteweg and Sørensen (2010).

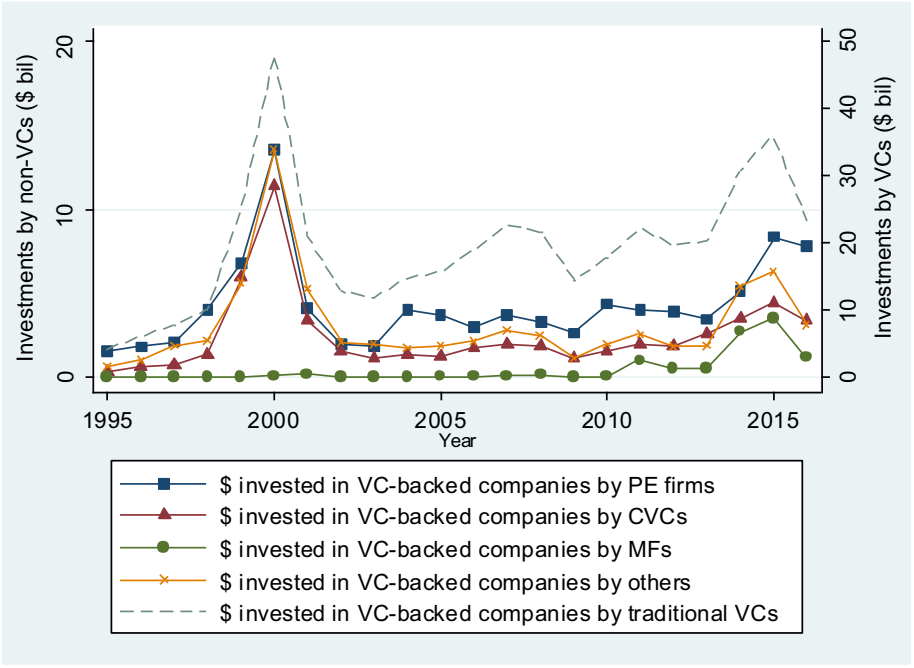
Panel A: Financing round valuations

	MB		ΔMB_{t+1}	
	All private co's	Private co's with MF invt	All Private co's	Private co's with MF invt
I(MF in round)	0.200***	0.125*	−0.101	0.246
	(3.743)	(1.940)	(−0.707)	(0.922)
ln(VC firm age)	−0.011	−0.050	−0.006	−0.129
	(−1.115)	(−1.069)	(−0.265)	(−0.684)
ln(# Companies funded)	−0.019	0.026	0.009	−0.342
	(−1.375)	(0.301)	(0.309)	(−0.968)
ln(# Exits)	−0.018	0.037	0.039	0.278
	(−1.572)	(0.534)	(1.623)	(1.182)
Time since first round	−0.021***	−0.037	0.002	0.036
	(−4.056)	(−1.289)	(0.167)	(0.352)
ln(Rounds received)	−0.072***	−0.200*	0.067*	0.030
	(−4.010)	(−1.712)	(1.728)	(0.064)
ln(# Investors)	−0.040***	−0.020	0.029	0.206
	(−2.934)	(−0.257)	(0.943)	(0.663)
ln(Amount raised)	−0.054***	0.014	−0.005	−0.194
	(−6.151)	(0.301)	(−0.262)	(−1.219)
ln(# Patents applied)	0.083***	0.220**	−0.038*	−0.121
	(7.179)	(2.473)	(−1.739)	(−0.790)
Inside round	−0.006	−0.040	−0.050**	0.198
	(−0.532)	(−0.601)	(−2.141)	(0.772)
Observations	13,488	337	5677	167
# unique companies	6986	133	3012	88
R-squared	0.375	0.807	0.184	0.441
Stage-level FE	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Financing round yr FE	Yes	Yes	Yes	Yes
Lead VC FE	Yes	Yes	Yes	Yes

Panel B: Factor regressions, using CAPM and 3-factor model

	All financing rounds	Rounds without MF participation	Rounds with MF participation	All financing rounds	Rounds without MF participation	Rounds with MF participation
Intercept	0.147***	0.148***	−0.026	0.241***	0.240***	0.029
	(11.902)	(11.919)	(−0.282)	(12.797)	(12.541)	(0.303)
RMRF	3.772***	3.820***	1.919***	2.801***	2.863***	1.411**
	(28.296)	(28.289)	(2.695)	(15.429)	(15.430)	(2.044)
SMB				1.499***	1.526***	1.639*
				(7.846)	(7.859)	(1.749)
HML				−2.753***	−2.730***	−2.779***
				(−15.979)	(−15.571)	(−3.620)
Alpha(monthly)	0.0771	0.0774	0.0820	0.0790	0.0793	0.152
Observations	5019	4933	86	5019	4933	86
R-squared	0.231	0.233	0.107	0.289	0.290	0.252

Panel A: Dollars invested by alternative investor types



Panel B: Number of VC-backed companies acquired by VC and PE firms

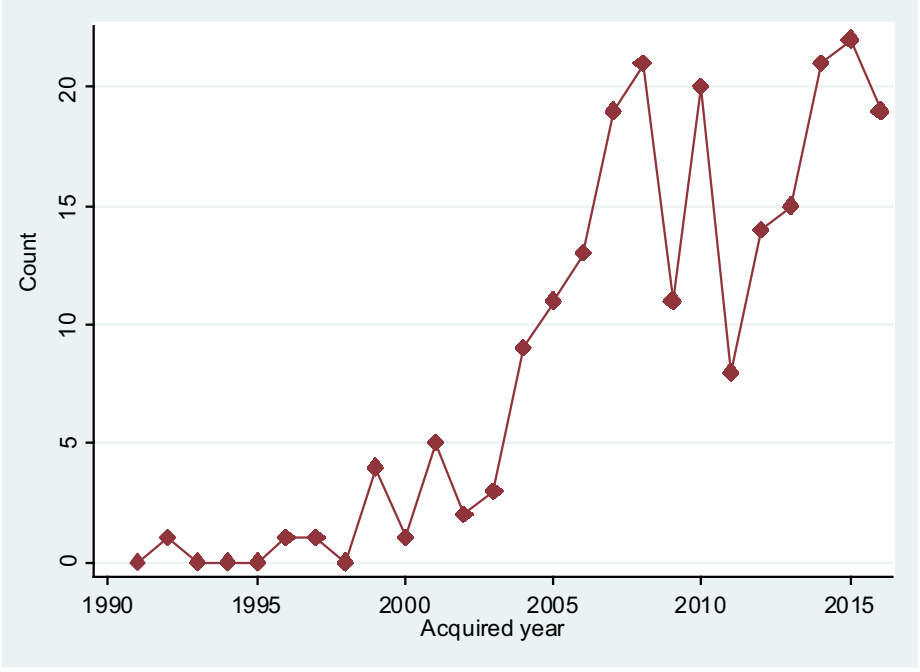


Fig. 9. Have other sources of capital dried up?
Panel A shows the dollar values of investments by three investor types: private equity firms (PE), corporate venture capitalists (CVC), and mutual funds (MF). Investors are classified as PE firms if the *firmtype* = "investment management firm" or "private equity firm" and *fundtype* = "buyout", "generalist private equity", "mezzanine", or "other private equity" in Thomson Reuters Private Equity database (formerly known as VentureXpert). Investors are classified as CVCs if *firmtype* = 'corporate PE/venture' in Thomson Reuters. Dollar amount calculations are based on the assumption that investors in a given financing round invest the same amount. Panel B shows the number of private VC-backed companies that are acquired each year by other venture capital or private equity firms. To identify the acquiror's identity, we name-match acquirer names with investor names in the Thomson Reuters Private Equity database. We define investor type = "VC/PE firm" if investors fall in (private equity firm, private equity advisor or fund of funds, incubator/development program, investment management firm).

investment. The monthly alpha is recovered following the approach of Korteweg and Sørensen (2010).

Consistent with findings from other tests, we continue to find no support for the dumb money effect. Rather, the alpha from the mutual fund sample is actually greater than that from the non-mutual fund sample. The alpha from the subset of rounds with mutual fund participation equals 8.2% in the market model regression and 15.2% in the three-factor regression, compared to 7.7% and 7.9%, respectively, in the rounds without mutual fund participation.[24]

Insofar as these specifications control for risk, they mitigate concerns that prior findings are influenced by differences in risk across rounds with versus without mutual fund participation. We note that similar to Ewens et al. (2016), who adopt a similar approach, we lack a first-stage model that would account for selection issues, for example, the tendency of more successful companies to have more observed round valuations. To the extent that rounds with versus without mutual fund participation face similar selection problems, this will not bias inference. Alternatively, to the extent that a greater portion of companies with mutual fund investment are more successful, as prior findings suggest (Table 2), the returns in this subset are less likely to be upward biased. In other words, the selection bias, if anything, biases us against finding that returns following mutual fund investments are higher. An additional simplifying assumption is that we do not control for equity dilution across rounds (i.e., decreases in early round investors' ownership percentages due to the infusion of new capital). This would necessitate detail on the amount raised and post-money valuation of every round, which would substantially decrease sample size. This would only bias mutual fund round returns upward if these rounds had greater dilution effects, which seems unlikely given that mutual funds tend to invest in later rounds. In sum, any bias seems likely to push us toward finding support for the dumb money effect, but we lack the data to unambiguously prove this.

In aggregate, our findings provide no support for the dumb money effect. Our three empirical tests approach the dumb money conjecture from distinct vantage points: analyses of the investors that choose to invest alongside mutual funds, inter-round returns following mutual fund investments, and returns between round capital infusions and exit date valuations. The fact that they all point to the same conclusion is telling.

4.4. Other capital providers' perspective: have other sources of capital dried up?

Many sources of capital to private firms are cyclical, as shown, for example, by Kaplan and Schoar (2005). If certain types of capital have become less available over recent years, then this may have contributed to the increase in mutual fund financing. As noted by Ewens and Farre-Mensa, 2019, key regulatory changes cast doubt on this possibility. The National Securities Markets Improvement Act of 1996 made it easier for private firms to raise money by relaxing state-level rules known as blue sky laws, and it made it easier for VC and PE funds to raise larger funds by increasing the maximum number of investors in a fund. Consistent with these regulatory changes, Panel A of Fig. 9 shows that dollars invested by VCs, PEs, CVCs, and mutual funds have increased over our sample period. The large increase in investments by mutual funds occurred in 2011, which coincided or immediately followed similar increases by VCs in 2010 and 2011 and by PE firms in 2010.

An alternative possibility is that secondary market transactions were previously more likely among VC-backed firms. This phenomenon is relatively common in the private equity space, where one PE firm acquires a private firm from another PE firm. While somewhat rarer in venture capital, Panel B of Fig. 9 shows that this has also increased over time. In sum, we find no evidence that alternative sources of capital to private firms have dried up over our sample period, a conclusion that is similar to related literature.

5. Conclusion

Results in this paper demonstrate that the availability of capital to private firms in the form of investments by mutual funds has increased dramatically over the past 20 years. This trend is consistent with changes in the financial landscape over the sample period, which influence both the demand for and the supply of such capital. From the companies' perspective, investments by mutual funds enable them to stay private longer, which enables them to achieve a higher level of development before becoming subject to the regulatory demands, increased disclosure requirements, and pressure from institutional investors associated with being publicly traded. From the funds' perspectives, these investments have provided returns that are both higher than and virtually uncorrelated with public market index returns.

Within policy circles, there have been many questions regarding the dearth of IPOs. Without question, the increase in capital available to private firms has been a contributing factor. In earlier decades, demand for capital was a driving factor of public listing for many firms (see, e.g., Lowry, 2003), but this is less the case in more recent years. The greater availability of capital to private firms combined with nontrivial costs of being publicly traded means that the net benefits of public listing have decreased. If a vibrant IPO market is a policy objective, then regulators must consider both the ways in which the net benefits of being a public firm have changed and the ways regulations could be altered in the future to make public listing more attractive.

[24] Our monthly alpha estimate for the full sample is similar to that of Korteweg and Sørensen (2010), who report a range of 0.0681–0.0794 when selection bias is not corrected. The intercept in Panel B of Table 10 represents the coefficient on the square root of time to exit from each financing round; it does not represent a typical constant term in the OLS.

Appendix A. Data details

A.1. Additional details on obtaining mutual funds' holdings in private firms

The process of matching mutual funds' holdings of restricted securities to our sample of private, venture-backed firms involves many complications, beyond those described within the main body of the paper. The purpose of this appendix is to provide additional detail, which may be helpful to future researchers.

In addition to verifying that a mutual fund has an investment in a private company, we also need to determine if the investment represents equity. While mutual funds' investments in private startups are classified as restricted securities, not all restricted securities are investments in private companies. For example, PIPEs (private investment in public equity), newly public firms' shares before the lock-up expiration date, corporate bonds or notes with restricted conditions, investments in foreign countries, etc. are all classified under restricted securities. Using Python programming, we create a debt dummy = 1 if the filing contains wordings such as bond, note, term loan, tranche, etc. in the neighborhood of company name. In a similar way, we create an equity dummy = 1 if the filing contains wordings such as common, class A, class B, preferred, etc., in the neighborhood of company name. After creating these dummies, we manually check whether the investments are equity investments. Through this combination of Python and hand verification, we isolate equity investments.

In addition to matching fund holdings with firms on a semiannual basis, we also wish to track individual funds over time. This is complicated by several issues: multiple funds report their holdings within a single filing (i.e., the reported filing is based on the CIK level rather than the fund level) and funds can change their names. To overcome this problem, we use the EDGAR-assigned series number provided to each fund, as this series number remains the same even if the fund changes names.[25] For example, CIK 0000024238 corresponds to Fidelity Contrafund. There are four funds that report filings under this CIK: Fidelity Advisor New Insights Fund (S000006036), Fidelity Contrafund (S000006037), Fidelity Series Opportunistic Insights Fund (S000039220), and Fidelity Advisor Series Opportunistic Insights Fund (S000039221). The characters in parentheses represent series numbers. Because series numbers are provided beginning in 2006, we backfill series numbers for funds for the period 1995–2005. In cases where names are similar but not exact, we verify manually. This backfill is only possible if the same fund exists before and after 2005. If a fund only exists prior to 2005, we assign a pseudo series number.

A.2. An example: Fidelity Series Opportunistic Insights Fund, Sept 2015, form N–Q

Shown below is a screenshot from Fidelity Series Opportunistic Insights Fund's filing, for which the full filing can be found here: https://www.sec.gov/Archives/edgar/data/24238/000137949115001530/filing706.htm

[25] This is confirmed by David Marcinkus, the branch chief at the SEC as of August 2016.

Legend

(a) Non-income producing

(b) Security or a portion of the security is on loan at period end.

(c) Investment is owned by an entity that is treated as a corporation for U.S. tax purposes and is wholly-owned by the Fund.

(d) Restricted securities - Investment in securities not registered under the Securities Act of 1933 (excluding 144A issues). At the end of the period, the value of restricted securities (excluding 144A issues) amounted to $175,667,666 or 3.1% of net assets.

(e) Coupon rates for floating and adjustable rate securities reflect the rates in effect at period end.

(f) Affiliated fund that is generally available only to investment companies and other accounts managed by Fidelity Investments. The rate quoted is the annualized seven-day yield of the fund at period end. A complete unaudited listing of the fund's holdings as of its most recent quarter end is available upon request. In addition, each Fidelity Central Fund's financial statements are available on the SEC's website or upon request.

(g) Investment made with cash collateral received from securities on loan.

Additional information on each restricted holding is as follows:

Security	Acquisition Date	Acquisition Cost
23andMe, Inc. Series E	6/18/15	$444,005
Airbnb, Inc. Series D	4/16/14	$1,259,254
Airbnb, Inc. Series E	6/29/15	$1,299,970
Altiostar Networks, Inc. Series D	1/7/15	$1,800,006
ASAC II LP	10/10/13	$17,881,600
Blu Homes, Inc. Series A, 5.00%	6/10/13 - 12/30/14	$6,232,491
Blue Apron, Inc. Series D	5/18/15	$3,200,002
Cloudera, Inc. Series F	2/5/14	$1,019,782
Cloudflare, Inc. Series D	11/5/14 - 6/24/15	$1,533,709
Delphix Corp. Series D	7/10/15	$1,843,875
Dropbox, Inc. Series C	1/30/14	$7,540,008
Legend Pictures LLC	10/15/14 - 6/10/15	$11,580,173
Magic Leap, Inc. Series B, 8.00%	10/17/14	$19,369,901
Nutanix, Inc. Series E	8/26/14	$2,303,662
Oportun Finance Corp. Series H	2/6/15	$6,756,617
Pinterest, Inc. Series E, 8.00%	10/23/13	$7,538,571
Pinterest, Inc. Series F, 8.00%	5/15/14	$7,211,381
Pinterest, Inc. Series G, 8.00%	2/27/15	$2,651,490
Pure Storage, Inc. Series E	8/22/13	$642,037
Space Exploration Technologies Corp. Series G	1/20/15	$2,483,832
SurveyMonkey	12/15/14	$7,534,725
Twilio, Inc. Series E	4/24/15	$1,833,453
Uber Technologies, Inc. Series D, 8.00%	6/6/14	$4,110,027
WeWork Companies, Inc. Class A	6/23/15	$1,184,189
WeWork Companies, Inc. Series E	6/23/15	$10,657,799

A.3. A potential alternative approach

Our goal is to obtain mutual fund investments in private companies. Since SEC filings contain complete portfolio holdings and CRSP/Thomson Reuters provides portfolio holdings for public companies, one might consider the following strategy: join public holdings to complete portfolio holdings and take the unmatched residuals. Unfortunately, a number of facts make this simple strategy complicated and inefficient.

First, while CRSP or Thomson Reuters report data on fund level, mutual fund filings are based on the CIK level. For example, the CIK 319108 corresponds to BlackRock Series Fund, Inc., and there are eight individual funds under

this CIK as of 2015.[26] To map these eight funds with CRSP or Thomson Reuters, we need some type of fund identifier. However, there is no common identifier between fund in SEC filing and fund in CRSP/Thomson Reuters. This implies that we would have to name-match fund names in CRSP or Thomson Reuters with fund names in SEC filings. In addition, different funds use different names for the same company or security in their SEC filings. And of course, there is no company or security identifier in SEC filings. This implies that we would have to name-match every single security in Thomson to SEC filing.

A.4. Mutual fund families for which we collect data

- Allianz
- Anchor
- Blackrock
- Fidelity
- Great-West
- Hartford
- John Hancock
- Morgan Stanley
- Seligman
- Smallcap World
- Sun America Asset Management
- T. Rowe Price
- Vanguard
- Wasatch.

A.5. Patent data

Following Denes (2017), we use Python scripts to download and convert all patent files into a machine-readable format. We extract patent number, assignee name, assignee city, assignee state, application date, and grant date. We cross-check our patent data with previous literature and confirm that the numbers are consistent. For example, Hall et al. (2001) show that there are approximately 70,000 applied patents in 1985 (Fig. 1 in Hall et al., 2001). In our sample, the number is 78,643. Also, they show that there are approximately 90,000 granted patents in 1990 (Fig. 2 in Hall et al., 2001), and we have 99,275 granted patents in this year.

Because there is no common identifier between the patent data and Thomson Reuters, we name-match the two databases. We first normalize patent assignee names by removing punctuations and legal suffixes and then implement the cosine similarity algorithm developed by Denes (2017) to name-match patent assignee names with VC-backed companies in Thomson Reuters. The algorithm gives us the matching quality with a scale of 0–1. We match patents with Thomson Reuters if one of the following criteria is met: (1) match quality is higher than 0.9 or (2) match quality is higher than 0.8 conditional on having the same city. The matching gives us 260,494 patents matched to 11,101 VC-backed companies in our Thomson Reuters sample.

A.6. IPO Allocation disclosures

Mutual funds that are affiliated with an investment bank are considered to be affiliated mutual funds under SEC Rule 10F-(3). These funds are required to disclose the allocations that they receive in any IPO in which the affiliated investment bank was a member of the syndicate (Shen, 2017). Specifically, these disclosures are found in Form NSARs, under Item 770. Shown below is a screenshot from Morgan Stanley Institutional Fund Trust's filing, for which the full filing can be found here: https://www.sec.gov/Archives/edgar/data/741375/000123683515000098/77O.Mid.Cap.Growth.txt

[26] The list of eight funds are Blackrock Balanced Capital Portfolio, Blackrock Large Cap Core Portfolio, Blackrock Total Return Portfolio, Blackrock Global Allocation Portfolio, Blackrock Capital Appreciation Portfolio, Blackrock High Yield Portfolio, Blackrock US Government Bond Portfolio, and Blackrock Money Market Portfolio.

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<FILENAME>77O.Mid.Cap.Growth.txt
<DESCRIPTION>MID CAP GROWTH RULE 10F-3
<TEXT>
Morgan Stanley Institutional Fund Trust - Mid Cap Growth Portfolio
Item 77O- Transactions effected pursuant to Rule 10f-3

Securities Purchased: Lendingclub Corp.
Purchase/Trade Date: 12/11/2015
Offering Price of Shares: $15.000
Total Amount of Offering: $58,000,000
Amount Purchased by Fund: 1,081,454 shares
Percentage of Offering Purchased by Fund: 1.865
Percentage of Fund's Total Assets: 0.23
Brokers: Morgan Stanley, Goldman Sachs & Co., Credit Suisse, Citigroup, Allen & Company LLC, Stifel, BMO Capital Markets, William Blair, Wells Fargo Securities
Purchased from: Goldman Sachs
Firm Commitment Underwriting: YES
Issuer has over three years of continuous operations*: YES
Percent of offering purchased by Fund and all other accounts advised by the adviser is less than 25%: YES
The underwriting commission, spread and profit is reasonable and fair compared to the underwritings of similar securities: YES
* Muni issuers must also have an investment grade rating from at least one NRSRO; or if less than three years of continuous operations, must have one of the three highest rating categories from at least one NRSRO.

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Appendix B. Variable descriptions

This appendix provides names and descriptions for variables used throughout the paper.

Variables	Definition
Characteristics of VC(s) providing funding	
VC firm age	VC's firm age in years since its founding year.
# Companies funded	Number of portfolio companies in which the VC invested within the past five years.
# Rounds invested	Number of financing rounds participated within past five years.
# Exits by VC	Number of unique portfolio companies that received financing from the VC and exited via either IPO or M&A, within the past five years.
Characteristics of firm	
I(MF financing)	Equals one if company received investment from mutual funds before exit.
Time b/w 1st and 2nd VC rounds	Duration between the first VC round and the second VC round. This variable is measured for companies with at least 2 VC financing rounds.
# Patents applied	# patents for which the firm applied as of a given date, conditional on patent being granted by the end of 2016. Descriptive statistics include values of this variable on a raw basis and on an industry-year adjusted basis. Industry and year-adjusted measures are used in all regressions.
Relation between firm and VC(s)	
Rounds received	Total number of VC financing rounds a company received before exit, or the first mutual fund investment, or the end of the sample period, whichever comes first.
VC syndicate size	Total number of VCs that invested in a company before it receives a mutual fund investment or as of the last financing round before the end of the sample period.
Amount raised ($ mil)	Total dollar amount a company raised in VC financing rounds before it receives a mutual fund investment or as of the last financing round before the end of the sample period.
Exit Performance	
I(=1 if exited)	Equals one if company exits via either IPO or acquisition before 12/31/2016.
I(=1 if exited via IPO)	Equals one if company exits via IPO before 12/31/2016.
I(=1 if exited via M&A)	Equals one if company exits via M&A before 12/31/2016.
Time to exit	(Exit date – first-round VC financing date) / 365, where exit date is either IPO date or acquisition date.
Fixed effects (Dummy Variables)	
First VC round year	The year when a portfolio company received its first-round VC financing.
Stage level	Stage level has 3 categories: early stage, expansion stage, and later stage.
State	Company location has 6 categories: CA, MA, NY, TX, PA, and other.
Industry	Industry has 6 categories: computer, medical, biotech, communication, other electronics, and non-high tech.
Lead VC	The lead VC is defined as the VC that participated in the first round and, conditional on such participation, invested the greatest total amount in the company.

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