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An investigation of the attention effects of venture capitalist backing on entrepreneurial firms

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ABSTRACT

In this paper, we predict that venture capital (VC) backed initial public offerings (IPOs) will attract more attention than non-VC-backed IPOs, as VCs offer important signals to investors searching for information about entrepreneurial firms. We use a measure developed by Google (i.e., Trends) to capture the spikes in investors' attention experienced by firms in the time period surrounding their IPOs. Our results demonstrate that firms backed by VCs enjoy a far greater spike in attention than their counterparts. Furthermore, we find that firms with more prominent VCs, a larger number of VCs, and VCs situated at farther geographic distances exhibit significantly greater spikes in investors' attention during the week of their IPO. Combined, the findings show a clear demarcation between entrepreneurial firms with or without VC backing, they bring to the fore new upshots stemming from the relationship between VCs and entrepreneurial firms, and they raise new potential questions on this relationship and beyond.

Introduction

Billions of dollars are deployed each year by the private sector to support start-up firms around the world. As an example, a recent report by the National Venture Capital Association (NVCA) indicates that the overall dollar volume of the venture capital (VC) industry in 2018 in the United States reached an all-time high of US$130.9 billion. The magnitude of this commitment provides a strong indication of the economic relevance of this industry, as well as of the value VCs may add to the entrepreneurial cycle, as shown by much of the extant research.[1] However, there remains substantial scope for investigations into *how* VCs create value for the entrepreneurial firms that they fund.

Besides providing capital, VCs bring their skills, experience, and social connections to entrepreneurial firms (Arikan and Capron, 2010; Leiblein and Reuer, 2004; Ozmel et al., 2013), while also offering a powerful signal on the value of the funded firm – given that a mere one percent of the firms screened by VCs actually receiving funding (Megginson and Weiss, 1991). With regard to the signaling effect of VCs in particular, a sizable body of work has brought evidence of its importance, arguing that the backing of VCs can simultaneously lower the hazards of adverse selection faced by prospective stakeholders (Carter and Manaster, 1990; Hsu, 2006; Nahata, 2008), reduce the costs of searching for partners for the entrepreneurial firms (Aoki, 2000; Burt, 1992; Gans et al., 2002; Lindsey, 2008), afford firms legitimacy (Petkova et al., 2013; Pollock et al., 2015; Stuart et al., 1999), and help entrepreneurial firms experience liquidity events (Hoehn-Weiss and Karim, 2014; Ragozzino and Blevins, 2016).

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[1] For discussions of exceptions see (Fischer and Pollock, 2004; Gompers, 1996; Lee and Wahal, 2004; Wasserman, 2003; Zacharakis and Meyer, 1998).

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Additional research in this stream has brought evidence of the "certification" role played by VCs (e.g., Colombo et al., 2019; Croce et al., 2013; Filatotchev and Bishop, 2002), thereby corroborating the theoretical notion that the presence of a VC in entrepreneurial firms can provide useful information signals to investors, and particularly so whilst these firms are going through the process of going public (e.g., Bruton et al., 2010; Gomulya et al., 2019; Ragozzino and Reuer, 2011; Shepherd and Zacharakis, 2001; Wang and Wan, 2013). In fact, although common wisdom dictates that reaching the IPO stage is a desirable outcome for entrepreneurial firms, IPOs are fraught with information hazards, as well (Da et al., 2011; Pollock and Rindova, 2003; Rock, 1986).[2] As such, it is argued that entrepreneurial firms need to provide signals of quality, such as being VC-backed, in order to gain legitimacy with potential investors.

This paper inserts itself in this stream of research and it examines whether signaling by VCs results in different spikes in investors' attention for VC- and non-VC-backed entrepreneurial firms at the time of their IPO debut. We draw from a data source developed by Google called Trends (henceforth GT), which tracks the searches for specific terms performed by internet users over time and space.[3] GT scores are especially valuable when studying a period of time in which a noteworthy event – such as an IPO – occurs, because one can observe whether said event results in spikes in the levels of public attention, relative to other time periods. For example, work in other fields of research has shown GT data can help explain a wide range of phenomena such as home and automotive sales, unemployment, tourism (Choi and Varian, 2012), and even influenza outbreaks (Ginsberg et al., 2009).

We investigate a sample of entrepreneurial firms during the two years surrounding their IPO and track the relative amounts of attention they received as per their GT scores. By design, we only sample on entrepreneurial firms that experience an IPO (which should help alleviate the self-selection concern that may arise when comparing VC- and non-VC-backed firms, see for instance Hsu, 2006). Generally, this concern is that it may be a mistake to attribute firm outcomes to the presence of VCs, because unobserved variables – such as variables directly measuring the quality of the firm – may not only explain these outcomes, but also the very presence of VCs in the firm. It is worthwhile to note that it is extremely difficult to obtain the variables above and that VCs offer a signal that should (at least partially) substitute for the paucity of information available on entrepreneurial firms.[4] Therefore, since we sample on firms that successfully completed their IPO, we are able to examine firms that have already accomplished significant milestones, and in turn, this allows us to drop from the sample of non-VC-backed firms the myriad of firms that were not even vaguely comparable to their VC-backed counterparts. Consequently, our study is designed to isolate the effects of VC backing from self-selection concerns and to offer as close of a comparison as possible.

Our analyses show that VC-backed firms experience significantly larger spikes in attention during the week of their IPOs than firms without VC-backing. For example, we find that at the median (mean), VC-backed firms enjoy an increase in attention in the week of their offering that is roughly 10.5 (11.7) percent greater than non-VC backed firms. Moreover, we find that firms with (1) more prominent VCs, (2) a larger number of VCs, and (3) VCs situated at farther geographic distances from entrepreneurial firms all attract significantly greater levels of attention during the week of their IPO. These results are statistically and economically significant and they withstand several robustness checks.

Overall, we aim to add two contributions to the existing literature. First, at the theoretical level, we contribute to research on VCs and signaling more generally (Gomulya et al., 2019; Gulati and Higgins, 2003; Lee and Wahal, 2004; Meglio et al., 2017; Pollock et al., 2015). Based on the growing interest in tying the signaling properties of VCs to the behavior and decision patterns of investors in entrepreneurial firms, this paper provides a new and complementary theoretical mechanism by which VCs help legitimize these firms. Second, this paper directly addresses recent calls on the need to understand both how and if signals are received (e.g., Connelly et al., 2011). The GT measure we adopt focuses on how the VC signals impact investors' *relative* search behavior, supporting the notion that investors *actively* search for signals about entrepreneurial firms in order to reduce their uncertainty (Da et al., 2011). Indeed, our empirical approach contrasts commonly used proxies for attention, such as counts of news headlines (e.g., Barber and Odean, 2008; Yuan, 2015) and advertising expenses (e.g., Chemmanur et al., 2011; Grullon et al., 2004; Lou, 2014) that *indirectly* proxy for the interest surrounding a firm. In this sense and given that other scientific domains have already made ample use of GT scores, we hope that our work can pave the way for future research in management that will consider this measure to advance the state-of-the-art knowledge in the field.

Theory and hypothesis development

Signaling theory

The theory of information economics and signaling finds its roots in the work of 2001 Nobel Prize winners Akerlof, Spence, and Stiglitz. Through their contributions, these economists have illustrated the problem of adverse selection, which arises when the parties in a given transaction hold asymmetric information about the item to be exchanged. The widely-known example used by Akerlof (1970) shows that in the market for used cars, when buyers cannot tell a good vehicle apart from a bad vehicle, their expected value always falls below sellers' asking price.[5] Unless good-quality sellers bear the cost of signaling, markets may not clear, or buyers

[2] A recent case in point is that of WeWork, which was to be floated at a value nearing $50 billion, but then withdrew its IPO as investors rapidly lost confidence in the firm (Platt and Edgecliffe-Johnson, 2020).

[3] We elaborate more on the measure in greater detail later in the paper.

[4] It is plain to see that if direct information on the quality of entrepreneurial firms were available, then the signal, and its inherent costs, would be redundant, as investors would face no information asymmetry problem.

[5] Note that this is true regardless of whether the seller is selling a good-quality car or a "lemon", because the latter will always ask the same price

may end up overpaying (e.g., Milgrom and Stokey, 1982). Therefore, signals – such as warranties and money-back guarantees, in the case of the used-car market – are costly but helpful conduits to lubricate markets and clear them of the inefficiencies of asymmetric information.

The ubiquity of adverse selection and the consequent usefulness of signals have been reported across many settings (see Riley, 2001 and Stiglitz, 2000 for reviews). As a few examples, labor (Spence, 1973), service firms (Nayyar, 1990), banking (Petersen and Rajan, 2002; Uzzi, 1999), exports (Shaver, 2011), top management teams and corporate boards (e.g., Certo, 2003; Cohen and Dean, 2005; Heil and Robertson, 1991), mergers and acquisitions (Ragozzino and Reuer, 2007), strategic alliances (Nicholson et al., 2005), IPOs (Pollock and Gulati, 2007) and venture capital (Brav and Gompers, 1997; Carter and Manaster, 1990; Stuart et al., 1999) have all been found to be fertile backdrops for the study of signaling theory. Below we review the literature on the signaling effects of VC backing of entrepreneurial firms.

The signaling effects of VC backing

The idea that VC backing provides an information signal to investors is well-established in the literature examining entrepreneurial firms (Lee et al., 2011). To begin with, VCs are extremely selective of their investments, typically funding only a small fraction of the prospects they screen (Megginson and Weiss, 1991). This selectivity is explained by the uncertainty surrounding new ventures and the increased likelihood of their demise in the earlier years of their existence. For example, according to the SBA of the United States, on average only 50 percent of new ventures survive their first 5 years of existence, and less than 30 percent of them are still alive after 10 years (Small Business Administration, 2012).

Given that VCs rely on both financial and reputation capital (Podolny, 1994; Pollock et al., 2015), it is crucial that they build a track record of consistently picking winners over time. They strive for this goal by carefully evaluating entrepreneurs' qualifications, experience, competence, and integrity (Bussgang, 2011; Ramsinghani, 2011), as well as by taking the necessary time to examine the entrepreneurial firms' capabilities and their potential to be disruptive in their respective markets (Gompers, 1995). Moreover, during due diligence, VCs are able to tap into the network of their peers and partners, which often allows them to obtain private information that may be hard to come by for most other prospective investors (Hochberg et al., 2007). In sum, thanks to the rigorous vetting process briefly outlined here, the backing of a VC provides a useful screening mechanism for other investors and it may inform them on the prospects of entrepreneurial firms (Hsu, 2004).

Despite the above, it is important to note that the signal inherent in VC backing is also manifestly imperfect. Technically speaking, an imperfect signal is one in which multiple states of nature are possible both when the signal is present and when it is absent (see Birchler and Butler, 2007 for a discussion). In contrast, a perfect signal – arguably a very rare occurrence – is one whose presence invariably leads to a precise state of nature. As an illustration, if VC backing were a perfect signal of the quality of the underlying firm, then all entrepreneurial firms featuring this signal would succeed, whereas all others would fail. This is clearly not the reality we witness. In fact, even though VC-backed entrepreneurial firms tend to outperform their counter-parts along several dimensions, as we have already discussed, VCs often invest in firms that end up falling short of expectations, too (Ghalbouni and Rouziès, 2010). Likewise, it is apparent that entrepreneurial firms without VC backing may, and do, experience successful outcomes. These arguments lead us to the conclusion that the signal of VC backing is evidently imperfect. However, the empirical evidence at hand also makes it plain to see that the signal is not void – a void signal is one that offers no more information to its recipients than the information they would hold, if the signal were not available.

To the extent that the VC-backing signal allows potential investors to form a more precise, albeit imperfect set of expectations with respect to which entrepreneurial firms will succeed, we expect that they will use the signal to weed out less promising investment opportunities and focus on the ones holding a greater expected value. In other words, VC-backed IPOs should garner increased awareness at the time of their IPO—since the signaling role of VCs helps imbue new ventures with legitimacy (Petkova et al., 2013; Pollock et al., 2008), while providing access to resources (Pollock and Gulati, 2007), both of which can ultimately help a new venture complete its IPO (Da et al., 2011). As such, the positive signal associated with entrepreneurial firms that have secured VC-backing should help these firms attract more attention relative to firms without VC-backing. Accordingly, the selection process resulting from the signal of VC-backing should benefit VC-backed firms over their counterparts during the pivotal time of their IPO debut. Therefore:

Hypothesis 1. *VC-backed firms will experience higher attention spikes during the week of their IPO debuts than non-VC-backed firms.*

VC prominence as a signal

Insofar as the presence of a VC can provide a screening mechanism for investors and help them to lower their search and due diligence costs, we argue that – *within* the group of VC-backed firms – those backed by more prominent VCs should also attract more attention during their IPO debut than firms backed by less prominent VCs. Prior work in the area has already shown that the selection process by which firms and VCs come together is not random (Lindsey, 2008). Rather, the best firms are often endorsed by more

(*footnote continued*)
as the former, not to reveal its identity to the buyer. Thus, buyers have no way to discern sellers and their expected value will result from the probabilistic average of buying either type of car.

prominent VCs (Lee et al., 2011), since this not only ensures short-term gains for VCs, but it also helps VCs to build reputation capital, upon which their chances for repeat business depend (Gompers, 1996).

There is evidence to support the proposition that the endorsement of a prominent VC will produce superior benefits for entrepreneurial firms. For example, Chang (2004) shows that when VCs have a track record of taking entrepreneurial firms public, their endorsement will significantly decrease the time to IPO of firms they fund thereafter. Nahata (2008) and Sorensen (2007) corroborate this finding, showing that, even after controlling for endogeneity, the likelihood of speedier and more successful exits of entrepreneurial firms increase with the prominence of their backing VCs. As a last illustration, Manigart et al. (2002) examine the survival rate of a sample of 565 firms from Belgium and find that being backed by reputable VCs is more important than receiving VC-backing in the first place. Accordingly, the evidence on the positive effects of VC prominence has mounted in recent years (for additional examples, see Gulati and Higgins, 2003; Hsu, 2006; Krishnan et al., 2011; Lee et al., 2011; Reuer et al., 2012), allowing us to conclude that being endorsed by a prominent VC provides a non-void signal of the quality of entrepreneurial firms. As previously noted, this means that the presence of the signal allows investors to form expectations that reflect the probability of realizing a state of nature or another in the future more accurately than investors could form without the signal.

While investors have significant amounts of information available to them via the internet, they must inevitably make decisions with respect to what information to seek and process at any given time, because both search and due diligence costs can bear significant costs in their economy (Park and Steensma, 2012). Moreover, the opportunity cost of making ill-informed decisions can ultimately lead to sub-optimal outcomes (Rosenbusch et al., 2013). Paralleling our arguments in the development of the previous hypothesis, to the extent that the VC prominence signal is not void, we expect that investors will use VCs as a signal to optimize their search and due diligence when screening for entrepreneurial firms' IPOs. As such, interest in new ventures associated with prominent VCs should be heightened.

Furthermore, there is at least one other reason why VC prominence should result in greater increases in investors' attention at the time of a new venture's IPO. Specifically, the web content providers, such as news sources, investment blogs and others are called upon to decide what information they should present "front-and-center" and what information they should relegate to more remote areas of their websites. In the same vein as investors, we assume that these providers will prioritize companies that hold better prospects, in order to increase their reputation as reliable sources with their audiences. Assuming such providers hold the same information as the rest of the investment community and can benefit from information signals to decide which companies to highlight, they too may draw from the VC prominence signal to sharpen their own selection process in their reporting of IPOs. In turn, this will lead investors to gain awareness of entrepreneurial firms backed by more prominent VCs, which will then cause them to search for additional information on these companies and result in greater attention spikes. Combined, the arguments above lead us to our second prediction:

Hypothesis 2. *Within the group of VC-backed firms, firms backed by prominent VCs will experience higher attention spikes during the week of their IPO debuts than other firms.*

Number of VCs invested in the new venture

Our next hypothesis predicts that the level of attention at a firms' IPO debut will be positively related to the number of VCs invested in an entrepreneurial firm. The foundational argument to motivate this prediction is that the effect of VC signaling will increase with every additional VC backing the entrepreneurial firm. We have already established that the presence of a VC functions as a signal of quality of the underlying firm (Gompers, 1996). We assume that (1) each VC makes an independent evaluation of a given investment opportunity, (2) the judgment of VCs is not perfect – i.e., VCs make errors on occasion, and (3) the occasional errors by VCs can be at least partially explained by their own oversights, rather than by systemic or exogenous shocks in the environment. Under these assumptions, the decision to invest in an entrepreneurial firm by additional VCs translates into an increasingly more precise signal for investors, because it reduces the variance stemming from VC-specific misevaluations. Even if we relax the assumption of independent evaluations above, the presence of two or more VCs should still improve on the precision of the signal available to investors, unless all VCs make identical decisions based on identical sets of considerations.

Accordingly, in conjunction with the logic developed in our previous hypotheses, to the extent that both content providers and investors face significant search and information gathering costs tied to the evaluation of prospective opportunities, they will – all else being equal – prioritize those opportunities for which the hazard of adverse selection is smaller (i.e., opportunities characterized by richer information signals). Thus, content providers are more likely to promote the dissemination of information tied to the IPOs of entrepreneurial firms backed by more, and not fewer VCs; especially during the week of the IPO debut when there may be multiple firms going public that are competing for investors' attention. Therefore, the attention paid by investors will also likely converge toward the search and scrutiny of higher expected-value investments. Combined, these considerations lead us to our third prediction:

Hypothesis 3. *Within the group of VC-backed firms, the number of VCs present in the entrepreneurial firm will be positively related to the attention spikes experienced by the firm during the week of its IPO debut.*

Geographic distance between entrepreneurial firms and VCs

The last hypothesis ties the geographic distance separating entrepreneurial firms from their lead VC. A sizable amount of work has already examined the effects of geographic distance in the VC industry. In general, it is widely accepted that VCs prefer proximate

investments, because proximity facilitates monitoring and control (Lerner, 1995). Likewise, the larger the distance separating VCs from funded firms, the greater the information asymmetry between the two and thus, the more costly the search and the evaluation of opportunities to be performed by VCs (Stuart and Sorenson, 2003). Consequently, VCs generally limit the geographic scope of their investments, in order to maximize their outcomes (Chen et al., 2010). Alternatively put, VCs will only fund distant entrepreneurial firms when all else is not equal – i.e., when these firms hold higher expected values than other, nearer firms. Therefore, when the lead VC in a firm is situated farther away from the entrepreneurial firm, the information one might extract is that the VC must have been willing to bear the additional costs of funding a geographically remote venture, in order to secure the higher gains expected from the investment. In other words, this could be an important signal that draws investor attention.

A second reason why distant VCs might impact investors' attention is that the knowledge held by investors tends to be geographically bound. For example, Coval and Moskowitz (1999) show that the information advantage inherent in proximity results in a large proportion of stocks of local companies held by investors. When an entrepreneurial firm is backed by nearby VCs, distant investors may not be informed about it, or they may face higher costs in order to obtain this information. In contrast, if a VC is situated at a distant location, investors at the same location may learn about the entrepreneurial firm indirectly by following the VC, rather than the entrepreneurial firm itself. Moreover, we expect that these investors, who may have not gained awareness of the entrepreneurial firm without the local VC's endorsement, will also draw from the signal stemming from the fact that the VC invested in a distant firm, despite the hazards of geographic distance (Chen et al., 2010). Together, these arguments lead us to conclude that the signal issued by geographically distant VCs will reach farther and be more precise than the signal issued by proximate VCs. In turn, this will lead to a higher level of spikes in investors' attention for the former, as follows:

Hypothesis 4. *Within the group of VC-backed firms, the geographic distance separating the lead VC from the entrepreneurial firm will be positively related to the attention spikes experienced by the firm during the week of its IPO debut.*

Methods

Sample and Google Trends scores

The core portion of the data comes from the Security Data Corporation database (henceforth SDC), which is the reference data source for research in this area. We first identified all IPOs of US-based firms in the manufacturing and service industries (i.e., SIC codes 20–39 and 70–89, respectively) during the years 2005–2012, and then matched these firms by their CUSIPs and names with the VentureXpert module of SDC, in order to determine which firms in our sample had secured VC funding prior to going public. We only included firms for which the identity of the VCs was disclosed in the data. Ultimately, we arrived at a starting sample of 553 IPOs, of which 325 were backed by VCs and 228 were not.

The second part of our data collection effort consisted in the extraction of search data from GT. According to NetMarketShare, which is a California-based source of internet-based statistics part of the NetApplication group, between January 1st, 2010 and December 31st, 2014 Google accounted for roughly 70 to 86 percent of global desktop computer searches and for about 90–96 percent of searches performed on mobile and tablet devices (NetMarketShare, 2015). Thus, by using data from Google we are drawing from the lions-share of the search activity all over the world.

Starting from 2004, GT collects data on the *relative* number of searches performed by internet users over a set geographic space and period of time. For example, one may be interested in exploring the pattern of worldwide searches for presidential candidate Donald Trump following the televised August 6th, 2015 Republican debate. GT provides longitudinal data such that (1) for each period, the number of Google searches for Donald Trump is divided by the *total* number of Google searches for anything at all, and (2) the highest score in the period of reference is normalized to 100 and then all other scores are computed as a fraction of the highest score. In the case of Donald Trump, such a search would show that internet users' attention was highest on the day after the debate (i.e., score of 100 on August 7th), while it steadily faded in subsequent days.

Given our goal to gauge the amount of attention spikes for entrepreneurial firms surrounding their IPOs, we collected data on the searches for each of these firms over a total of 104 weeks before and after they went public. Thus, in all cases week 52 is the week during which the IPO actually took place. As an illustration, in Fig. 1 we provide a graph showing the distribution of GT scores for Tesla Motors around its June 29th, 2010 IPO. Predictably, the GT score of 100 occurs at the time of the offering, while most other data points lie well below that score (the spike in the 33rd week coincides with the announcement by Tesla that the company had filed to go public, which occurred on January 29th, 2010).

For the purpose of understanding the data and the ensuing analysis, it is imperative that we stress that the GT scores do not offer information on the volume of searches, per se. Rather, the scores show percentages of interest relative to the period with the highest amount of interest. For example, for comparative purposes, if two distributions reflecting searches for two separate terms appear to be identical, that does not necessarily mean that the number of searches performed for each term was the same. Likewise, if a distribution of GT scores lies mostly above another that does not mean that the former experienced more searches than the latter, either.

The correct way to interpret a longitudinal distribution of GT scores is to examine the relative change between the highest point in the distribution and all other points within a subject. As theoretical examples, if a distribution showed scores of 90 for all data points except for the 100-peak point, this would mean that the level of searches was even throughout the period of observation, notwithstanding search volumes. In contrast, if a distribution showed scores of 10 for all data points except for the 100-peak point, this would mean that the increase in attention at the peak for the latter was extremely significant. Throughout the analysis, it is important to keep this perspective in mind when examining and attempting to make sense of the results.

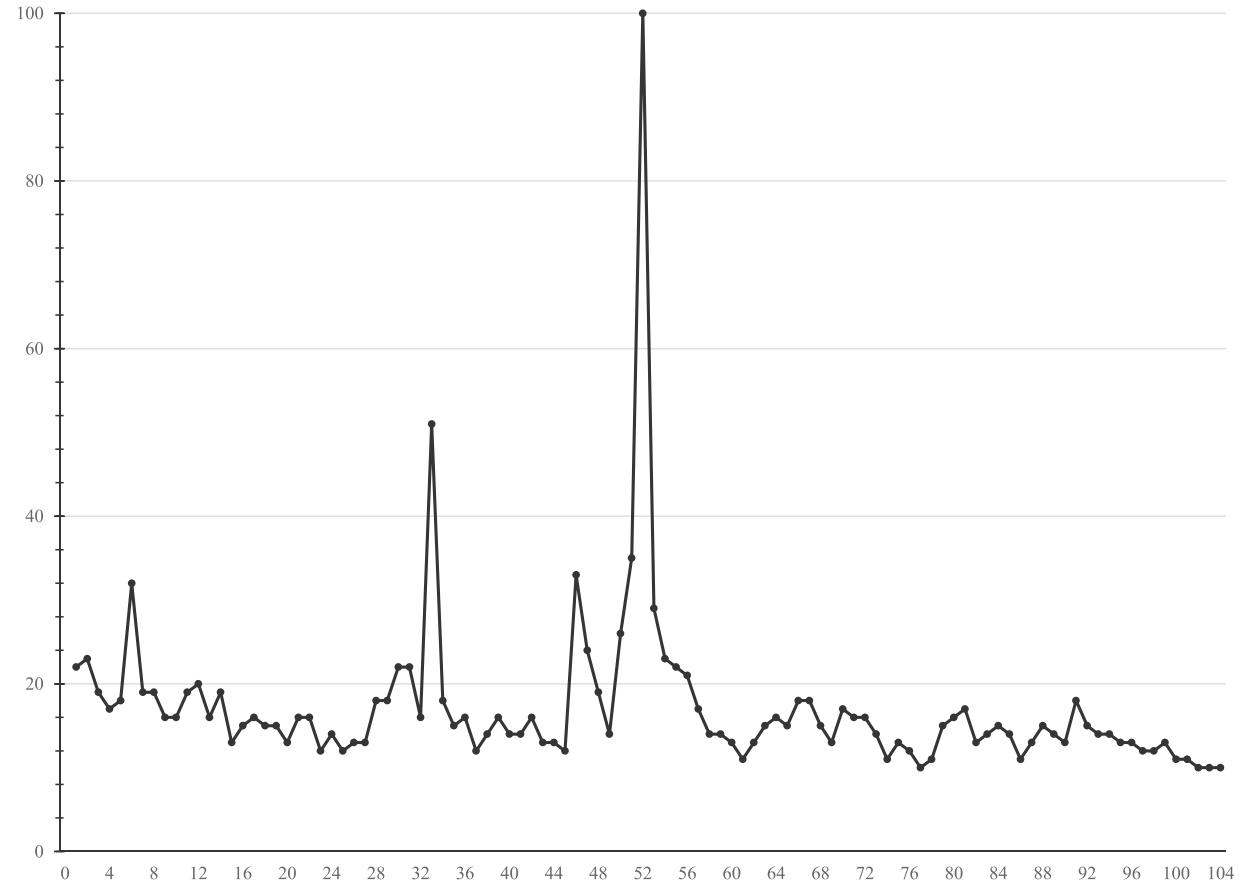

Fig. 1. Median weekly GT scores two years around the IPO – TESLA MOTORS (IPO week = 52).

Furthermore, in our paper we are not interested in whether the firms going public in our sample captured a smaller or larger chunk of overall internet searches. Rather, we are interested in whether *investors' attention* in a firm is greater when the firm makes its IPO debut, as opposed to during "normal" times away from the going public event. In other words, our interest is confined within the focal firm and over the two years surrounding its IPO. In sum, once the peak point during the 24 months comprising our data is established, the only relevant datapoints are the number of searches for the firm for each of these months and regardless of the total number of searches for anything else. Put differently, the number of searches in the two-year period we examine is normalized by Google. Finally, as a last methodological note, Google eliminates searches from the same IP over a short period of time and filters out searches with special characters and apostrophes. Additional details on the methodology applied by Google can be obtained at: https://support.google.com/trends/?hl=en&vid=1-635757513924762354-2176255889#topic=4365599.

The process of collecting GT scores resulted in the loss of some data, either because Google left out firms for which extremely low search volumes existed, or because GT scores were only available with a monthly frequency, rather than the desired weekly one. Based on our need to aggregate data and compare attention levels on an apple-to-apple basis, we only kept firms for which we could obtain weekly data, and this left us with 143 of the total 553 IPOs. In order to alleviate concerns with respect to biases in the selection process leading to our sample, we provide both graphical and statistical evidence of the representativeness of our data. Fig. 2 shows the distribution of entrepreneurial firms for which we were able to obtain GT scores, broken down by whether these firms were VC-backed or not. The dark area behind the histograms represents the overall IPO activity for the period, regardless of VC backing. It is plain to see that the two distributions follow a very close yearly pattern and a formal Kolmogorov-Smirnov test confirms this thesis (i.e., $p = 0.96$). Table 1A corroborates this point by providing comparative tests for the equality of our sample vis-à-vis the un-sampled IPOs comprising the population. With the exception of VC prominence (i.e., $p < 0.01$), none of the tests allow us to reject the null predicting equal samples. Interestingly, the fact that firms backed by VC with high prominence are also the ones most likely to be picked up by GT provides anecdotal evidence of the greater attention generated by prominent VCs, and we will discuss this point at greater length later.

A second concern might surround the fact that the VC- and non-VC-backed firms in our final sample of 143 IPOs might differ along some unaccounted-for qualitative dimensions. If this were the case, our results might be the consequence of these differences, rather than of the attention variable measured by the GT scores. In order to address this concern, we have run several tests aimed at comparing several characteristics of the firms comprising the two subsamples, and we report these results in Table 1B. Specifically,

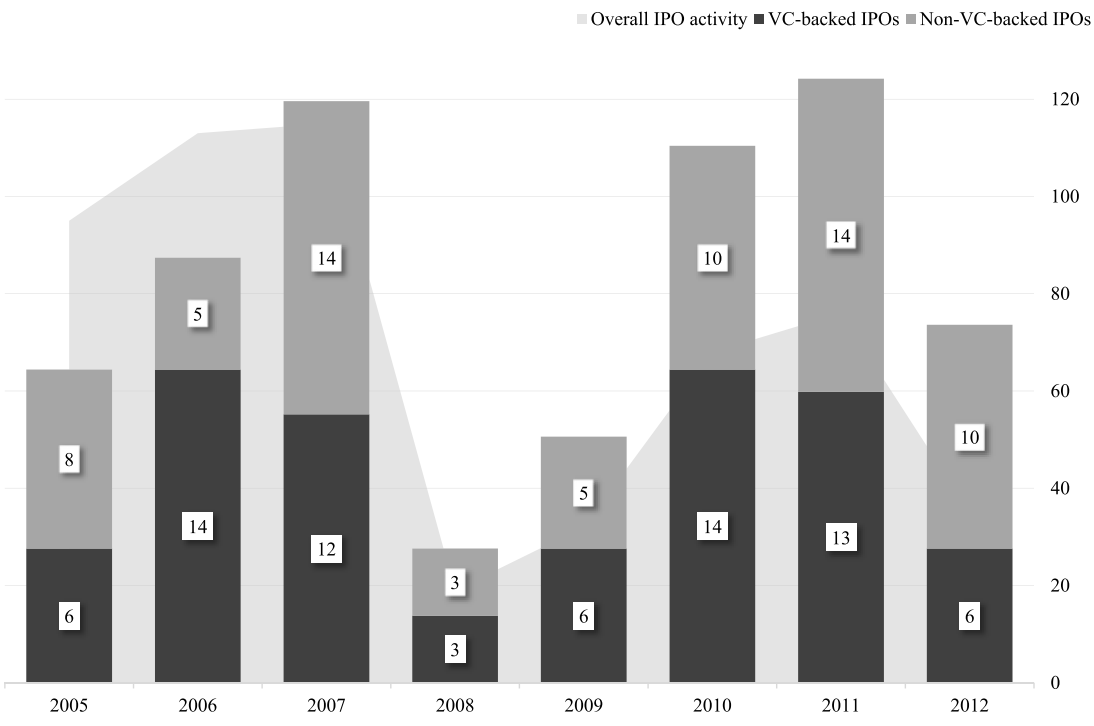

Fig. 2. Distribution of sampled VC-backed and non-VC-backed firms – Comparison with overall IPO activity.

Table 1A
Tests of key theoretical variables between the sample and the population [a].

	Independent variables	Sample	Population	Test [b]
VC backing	Mean	0.52	0.53	0.02
	SD	0.50	0.50	
	N	139	434	
Lead VC prominence	Mean	0.79	0.63	6.66**
	SD	0.41	0.48	
	N	72	228	
Number of VCs	Mean	7.81	7.20	0.78
	SD	5.90	5.72	
	N	72	228	
Geographic distance	Mean	1092	898	1.31
	SD	1040	958	
	N	58	181	

†p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001.

[a] The population comprises all US IPOs between 2005 and 2012 in manufacturing and service industries net of the sample firms appearing in the Sample column.

[b] The tests are χ^2 tests for discrete variables and *t*-tests for continuous variable.

we examine the underpricing and overall size of firms' IPOs, their geographic location, industry position and age. The table shows that none of the mean values of these variables are statistically different across the two groups of firms, with the sole exception of the *Firm in California* dummy, which shows very minor differences (i.e., $p < 0.10$). In sum, the evidence in Fig. 2 and in Tables 1A and 1B allows us to conclude that (1) the sample on which we run our analysis is a close representation of the population of all IPOs in the time period of reference, and (2) the VC-backed firms in our sample are extremely comparable to the non-VC-backed firms with respect to a host of characteristics that lie outside of whether or not they were backed by a VC.

Multivariate models dependent variable

While we set out to show the differences in attention spikes between VC- and non-VC-backed firms using several empirical approaches, it is worthwhile to explain the computation of the dependent variables adopted in the estimation of the multivariate

Table 1B
Differences between VC- and non-VC-backed firms in the final sample[a].

	Firm characteristic	VC-backed firms	~VC-backed firms	Test[b]
Underpricing	Mean	0.19	0.14	0.86
	SD	0.29	0.25	
	N	55	41	
IPO size ($ million)	Mean	119.52	80.03	1.18
	SD	242.78	126.26	
	N	74	69	
Firm in California	Mean	0.39	0.25	1.87†
	SD	0.49	0.43	
	N	74	69	
Firm in high-tech industry	Mean	0.55	0.43	1.43
	SD	0.50	0.50	
	N	74	69	
Firm age	Mean	16.97	18.75	0.62
	SD	24.41	18.15	
	N	73	68	

†p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001.
[a] The overall sample comprises a total of 143 IPOs, of which 74 were backed by a VC and 69 were not. Sample comparisons might entail smaller firm counts, as noted, depending on data availability.
[b] The tests are χ^2 tests for discrete variables and *t*-tests for continuous variable.

models. Specifically, we subtract the mean (median) of the GT scores experienced by the focal firm in the 103 weeks surrounding its IPO from the GT score observed in the very IPO week. Thus, we effectively capture the gap in investors' attention during "quiet" times, as opposed to during the week of the firm's initial public offering.

Other measures

VC backing. The main theoretical variable in our analysis is *VC backing*. As briefly mentioned previously, we match the entrepreneurial firms that go through an IPO in the period of reference against the Venture Xpert module of SDC, in order to determine whether these firms were backed by at least one VC when they went public. The IPO module of SDC also provides an indicator of this feature, although this information does not match exactly the information contained in Venture Xpert, and based on our need to obtain additional details on the firm/VC relationship, which are only available in Venture Xpert, we referred to the latter.

VC prominence. When narrowing our sample to VC-backed only firms, we attempted to separate several characteristics of the VC(s) involved in the entrepreneurial firm, in order to determine whether any of them led to a different level of investors' attention at IPO vis-à-vis the rest of the observation period. The first of such characteristics is *VC prominence*. We computed this variable following prior work (e.g., Gulati and Higgins, 2003; Stuart et al., 1999): We first counted the number of companies in which each VC listed in the Venture Xpert module invested, using five-year rolling windows. Subsequently, we assigned the role of lead VC in each entrepreneurial company to the VC that invested the largest dollar amount starting from the time of the first disbursement to the time of the last. Finally, we compared the total number of companies in which the lead VC invested with the overall distribution of all VCs and coded the *VC prominence* variable as one if the number of companies was above the median of the distribution, and zero otherwise. In subsequent analyses, we replace this measure with the total number of firms backed by lead VCs, as well as with the number of firms lead VC took public during the previous 5 years. We discuss these alternate approaches later in the document.

Number of VCs invested in the new venture. The second feature of the VC presence in entrepreneurial firm we track is *Number of VCs*. The variable is simply the total count of unique VC firms that funded the new venture, as reported by the Venture Xpert module of SDC. It is worthwhile to note that there is heterogeneity in the amounts provided by various VCs, as well as in the timing of their participation. Regardless, each VC is counted as one.

Geographic distance. The last VC characteristic we track is the geographic distance between the lead VC and the entrepreneurial firm. Following precedent (Coval and Moskowitz, 1999), we calculated G*eographic distance* by referring to their respective zip codes to determine their latitude and longitude coordinates. Then we used the great circle distance formula to compute the linear distance separating them, as follows:

$$\text{Geographic Distance} = r \times \arccos[\sin(\text{lat}_{\text{firm}}) \times \sin(\text{lat}_{\text{vc}}) + \cos(\text{lat}_{\text{firm}}) \times \cos(\text{lat}_{\text{vc}}) \times \cos(\text{lon}_{\text{vc}} - \text{lon}_{\text{firm}})] \quad (1)$$

Model controls. Besides the variables described above, in the multivariate models, we introduce a number of controls that might partially explain the difference in attention between the IPO week and the other weeks comprising our sample. Specifically, in order to determine the extent of the financial engagement of VCs in each entrepreneurial firm, we introduce *Equity invested by VC*. This

variable is calculated by dividing the total dollar amount invested by all the VCs that funded the entrepreneurial firm by the dollar amount representing the proceeds obtained through the firm's initial public offering. In turn, the proceeds are calculated as the IPO offer price multiplied by the shares sold on the day the company went public. Additionally, we include the following indicator variables: (1) *Firm high tech*, which takes a value of one if the firm operates in a high-technology industry and zero otherwise.[6] We include this variable because high-technology companies tend to have a broad appeal and visibility both with the VC and the investment communities. (2) *Firm age*, which is the number of years elapsed from the time of the firm inception to its IPO. Older firms may benefit from increased visibility and investors' attention, based on their longer histories and more established reputation. (3) *Firm in California*, which separates firms located in California from all others, because this state consistently features a disproportionately high concentration of VC-backed ventures (e.g., Gompers and Lerner, 2004). (4) *IPO major exchange*, which takes a value of one if the firm's IPO took place either on the New York Stock Exchange (NYSE) or NASDAQ, and zero otherwise. These two exchanges set significantly higher listing requirements than minor over-the-counter exchanges (e.g., Draho, 2004) in terms of size and financial health. Consequently, being listed on these exchanges should result in higher levels of attention by investors. (5) Lastly, to account for time variations across the period of observation, we introduce *Early period*, which is a dummy variable separating the years 2004–2008 (i.e., a value of one) from later IPOs (i.e., a value of zero). We discuss our results below.

Results

Besides comparing the sample with the population of IPOs, Table 1A offers some useful descriptive statistics. Moreover, Table 2 provides additional information and a correlation table for the all the variables examined. Roughly 52 percent or 74 of the sampled firms were backed by a VC, leaving us with 69 firms without this feature. Of the former, roughly 78 percent were backed by VCs with a 5-year investment count greater than the median deal count for all VCs. If we use more stringent cutoff points than the median, such as the 75th and the 90th percentile counts, the proportions of firms backed by a prominent lead VC drop to about 58 and 38 percent, respectively. Interestingly, the VC prominence variable does not seem to be correlated with either the total number of VCs, or the geographic distance separating the lead VC from the firm (i.e., all n.s.).

Turning to the other variables, it is worthwhile to note a few additional points. First, the number of VCs ranges from as few as 1 to as many as 25, although both the mean and the median values hover around 7 VCs. The geographic distance variable indicates that our sample comprises transactions in which the VC and the firm resided in the same zip code on one extreme, and as far as 2700 miles apart on the other. The other descriptive statistics, however, show that the mean distance of 1080 miles is somewhat skewed by extreme values at the top of the distribution, as nearly 70 percent of observations show a distance of less than 1000 miles and the median distance is 745 miles.

We now focus our attention on the GT scores. The first hypothesis used the mere presence of a VC to a predicted higher level of investors' attention at the time of the focal firm's IPO. Given that we are working with longitudinal distribution of normalized values, as we have previously discussed, the core of our analysis surrounds the relative increase in searches for the focal firm effectuated by internet users in the week of its IPO. A useful perspective on this point is provided by Fig. 3, which shows the differences in the median GT scores at each of the 104 weeks surrounding the firms' initial public offering. The figure clearly indicates negative differences in favor of firms without VC backing at nearly every week, with the very notable exception of the IPO week itself. In order to offer additional visual evidence of the distinct patterns in investors' attention for VC- and non-VC-backed firms, we plot the distribution of GT scores for these two classes of firms separately in Fig. 4.

Once again, leaving aside week 52, which is the week of the focal firm's IPO, it is rather apparent that the VC-backed firms' data points lie below their counterparts in most weeks. Formal non-parametric tests apt at determining whether the two distributions shown in Fig. 4 were the same allowed us to reject the null very convincingly, as Kolmogorov-Smirnov and Kuiper two-sample tests yielded p-values smaller than 0.0001. Additional perspective can be gained by examining Table 3. In the top panel of this table, we wish to determine whether the differences between the GT scores across the distributions of VC- and non-VC-backed firms are significantly different across the 103 weeks around the firms' IPOs, with week 52 being excluded from this analysis for reasons we are about to explain.

Both parametric and non-parametric tests show that the null of no differences is strongly rejected (i.e., $p < 0.001$ for both the *t*-test and the Wilcoxon rank-tests). Additionally, the table shows that on average non-VC-backed firms feature significantly higher GT scores than their counterparts outside of the week of the IPO.[7]

At first glance, it may be easy to conclude that these differences provide support for more, and not less investors' attention for firms without VC backing. However, this conclusion would be misguided. It is worthwhile to remember that GT scores offer a *relative* measure of investors' attention. Thus, higher GT values outside of the IPO week will systematically result in a *smaller* spike in attention during the IPO week. In fact, conceivably this spike could even be negative, if the IPO week were not the week with the

[6] To determine whether the target was in a high-tech industry, we used AeA's 45 4-digit-level SIC codes in this category. AeA was the nation's largest high-tech trade association, and it represented over 3000 companies operating in the software, semiconductors, medical devices, computers, internet technology, advanced electronics, telecommunications systems and service industries. In 2008, the AeA merged with the Information Technology Association of America (ITAA) to form TechAmerica.

[7] Please note that we lose 6 observations in the multivariate model estimation. Thus, the total number of IPOs drops from 143 to 137 in Table 3. Moreover, all models use the full sample of 137 observations. Thus, models testing the relationship of a given VC characteristic with the dependent variable contrast firms featuring said characteristics against all others and regardless of VC-backing status.

Table 2
Descriptive statistics and correlation matrix[a].

Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10	11
1. Attention gap	33.32	31.11											
2. VC backing	0.52	0.50	0.20*										
3. Lead VC prominence	0.78	0.41	0.22**										
4. Number of VCs	7.72	5.86	0.20*										
5. Geographic distance[b]	1.08	1.03	0.11										
6. VC equity stake	26.52	76.24	0.23**										
7. Firm high tech	0.50	0.50	0.04	0.12	0.12	0.26**	0.04	0.15†					
8. Firm age	17.83	21.56	−0.15†	−0.15†	−0.11	−0.20*	−0.15†	−0.17*	−0.11				
9. Firm in California	0.32	0.47	0.10	0.10	0.06	0.23***	0.08	0.14	0.16†	−0.08			
10. IPO proceeds	195.46	366.58	0.11	0.10	−0.04	−0.06	0.05	0.01	−0.16†	0.20*	−0.02		
11. IPO major exchange	0.92	0.28	0.09	0.16†	0.15†	0.10	0.08	0.11	−0.00	0.07	−0.00	0.33***	
12. Early period	0.45	0.50	−0.13	0.04	0.02	−0.01	0.04	0.05	−0.06	0.12	−0.05	−0.09	−0.08

†p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001.

[a] The number of observations varies depending on the variable (N = 143 for all variables, except: N = 74 for Lead VC prominence, N = 60 for distance and N = 141 for Firm age.

[b] In thousands of miles.

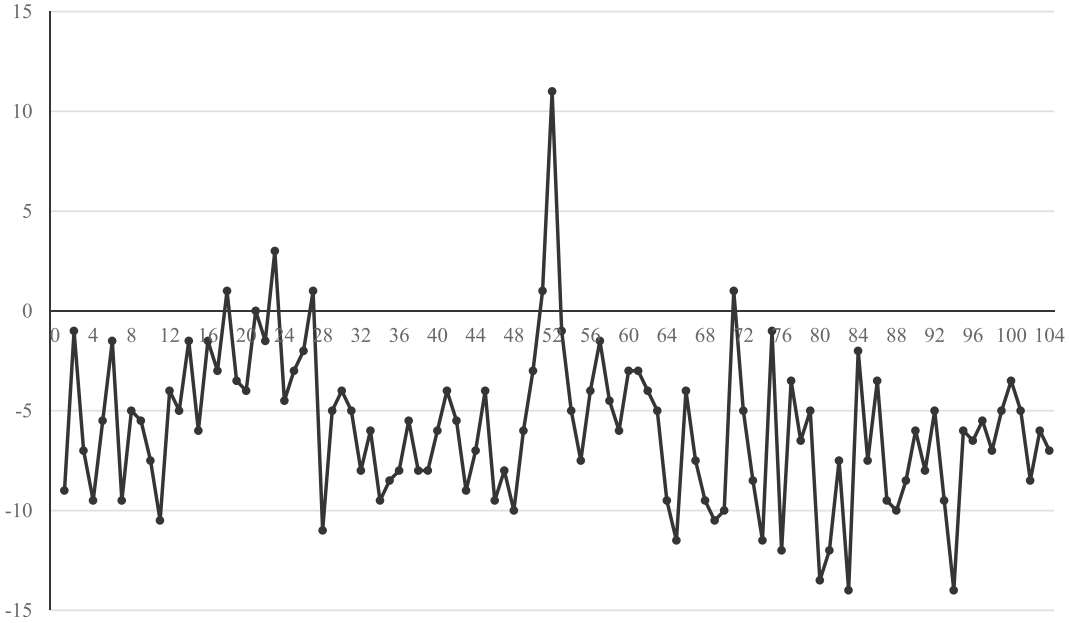

Fig. 3. Differences in median weekly GT scores two years around the IPO VC-backed minus non-VC-backed firms.
IPO week = 52. Kolmogorov-Smirnov and Kuiper two-sample tests for differences in distributions: p < 0.0001.

highest search count in the period of observation, and somehow the venture experienced high search counts throughout this period, but not so at its IPO. Conversely, lower GT values outside of the week of the IPO indicate a *higher* spike in attention during that week.

Two additional statistics help clarify this point. First, there is a positive difference in the median and mean investors' attention of 11 and 7.6 percent for VC-backed firms in the week of the IPO. Second, we compute the difference in the median and mean GT scores between the week of the IPO and all other 103 weeks of observations, for VC- and non-VC-backed firms. We then calculate the difference of the differences between the two types of firms and plot the results in Fig. 8. The first histogram shows that VC-backed firms experience 10.5 percent median and 11.7 mean higher increase in investors' attention than their counterparts. More to this point, when we estimate multivariate models using these differences as our dependent variables, we find that VC backing is positively and strongly associated with a bigger spike in attention at firms' IPOs, as per the first and fifth Tobit models estimated in Table 4 (i.e., p < 0.01).

Combined, the evidence above demonstrates the following: (1) the distributions of GT scores across VC- and non-VC-backed firms are by and large very different; (2) the nature of the difference is such that VC-backed firms feature significantly lower GT scores during the entire period of observation, not including the week of the IPO; (3) in the week of the IPO, the difference in GT scores reverses, showing a markedly positive difference in favor of VC-backed firms; (4) points 2–3 above indicate that VC-backed firms experience a far greater increase in investors' attention than their counterparts during the week when they go public; (5) the

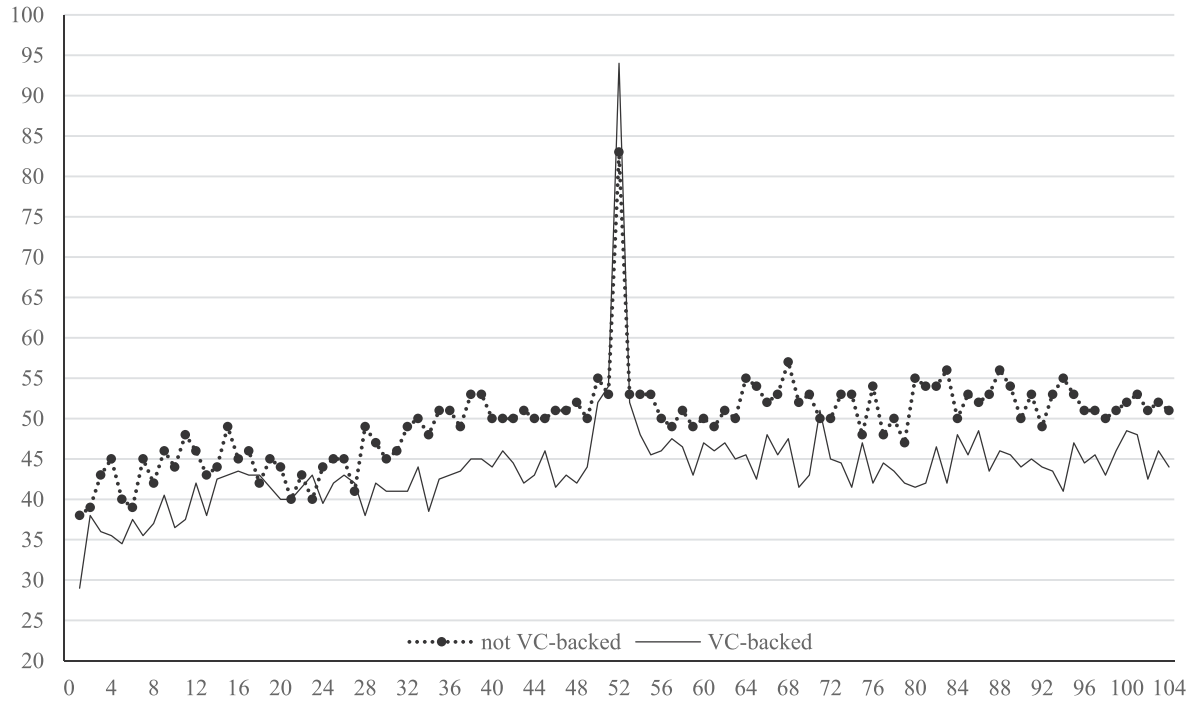

Fig. 4. Median weekly GT scores of VC- and non-VC-backed firms two years around the IPO.
IPO week = 52. Kolmogorov-Smirnov and Kuiper two-sample tests for differences in distributions: $p < 0.0001$.

multivariate analysis corroborate these points, after we control for a host of other factors. In sum, we find strong support for our first prediction. It is perhaps useful to note that we are in no way discussing absolute levels of attention and that therefore, although the relative GT scores of VC-backed firms are lower than the GT scores of non-VC-backed firms during most of the weeks of observation, this does not mean that the former received less attention, or fewer absolute searches. In fact, although we do not have the data to test this hunch, we strongly suspect that the reverse be true.

The second set of hypotheses centers only on firms with VC backing and it aims at testing whether specific differences in the firm/VC relationship might result in different levels of investors' attention spikes at IPO. Hypothesis 2 predicts that firms backed by a prominent lead VC will receive greater attention spikes than other firms. Paralleling the analytical approach laid out to examine H1, the graphical depiction of the distributions of these two categories of firm offered in Fig. 5 displays a rather clear pattern, such that firms backed by prominent VCs show far lower GT scores across the lions' share of the 103 weeks comprising our investigation. As before, both Kolmogorov-Smirnov and Kuiper two-sample tests for differences in distributions yielded p-values smaller than 0.0001. Moreover, the median and mean GT scores outside of the week of the IPO were 11 and 6.5 percent lower for these firms. In contrast, the positive differences in the week of the IPO amounted to roughly 18.5 and 3.3 percent for the median and the mean, respectively. Table 3 showcases the highly significant differences in GT scores across the no-IPO weeks between firms backed by prominent VCs and other firms (i.e., $p < 0.001$ for both the *t*-test and the Wilcoxon sign-rank test) and Fig. 8 shows a median 7.9 percent difference (9.9 percent mean) in the investors' attention spike between these firms. Lastly, the multivariate models indicate that prominent VCs are associated with greater spikes in investors' attention, whether we measure the outcome by comparing mean or median GT scores (i.e., both $p < 0.01$). Thus, we find strong support for our second hypothesis, as well.

It is worth noting that as a robustness check, we replaced the dichotomous VC prominence measure described above with a few other specifications. First, rather than using the median as a cutoff between prominent and non-prominent VCs, we split the sample based on the 90th percentile. Doing so reveals a significant change in the results. Namely, although there is still a visible spike in attention during the IPO debut week for firms backed by prominent VCs, the mean values throughout the entire period surrounding the IPOs are also significantly higher. In fact, comparison tests similar to the ones we report in Table 3 highlight the greater average GT scores experienced by firms backed by prominent VCs (i.e., $t = 13.05$, $p < 0.001$ and $Z = 11.92$, $p < 0.001$, respectively). In sum, the difference in the GT scores between the "quiet time" and the IPO week turns out to be statistically comparable across entrepreneurial ventures, regardless of the prominence of their lead VC.

As two alternate measures of VC prominence, we estimated two additional multivariate models resembling model 2 of Table 4, but with the VC prominence construct replaced by continuous variables reflecting either the total number of entrepreneurial firms backed by the lead VCs in the 5 years leading to the focal transaction, or alternatively the number of firms the lead VC took public during the same period. Both models revealed positive and significant coefficients, although at modest levels by conventional standards (i.e., $\beta = 0.17$, $p < 0.10$ and $\beta = 0.34$, $p < 0.01$, respectively). Thus, perhaps owing to the limited statistical power afforded to us by the small sample size of the data available for multivariate analyses, the findings on VC prominence appear to be

Table 3
Comparative tests of differences in GT mean and mean rank scores across key theoretical variables outside of firms' IPO week[a].

Independent variables	Yes	No	*t*-test	Wilcoxon rank-test
VC backed				
Mean	42.78	46.90	−9.37***	−10.11***
SD	26.32	26.90		
Firms	74	69		
Observations	7622	7107		
High VC prominence [b]				
Mean	41.37	47.90	−8.75***	−9.51***
SD	25.94	27.05		
Firms	58	16		
Observations	5974	1648		
High VC count [c]				
Mean	40.97	45.59	−7.37***	−7.86***
SD	25.23	27.71		
Firms	45	29		
Observations	4635	2987		
High VC distance [d]				
Mean	39.13	44.76	−9.14***	−9.05***
SD	25.04	26.79		
Firms	26	48		
Observations	2678	4944		

†p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001.
[a] The tests above exclude the IPO week (i.e., week 52).
[b] High prominence is assigned if the number of companies that the lead VC in the venture funded in the five years prior was above the median of all VCs.
[c] High VC count takes a value of one if the venture received funds by more VCs than the median VC-backed venture in the sample, and zero otherwise.
[d] High VC distance takes a value of one if the linear geographic distance between the venture and the lead VC was above the median and zero otherwise.

Table 4
Media attention gap between IPO week and 103 other weeks of observation by key theoretical variable – Multivariate models[a].

Independent Variables	Mean differences				Median differences			
	I	II	III	IV	V	VI	VII	VIII
Intercept	23.70* (9.27)	24.31** (9.14)	25.18** (9.27)	23.75*** (9.38)	23.29** (8.78)	23.87** (8.68)	24.70** (8.76)	23.36** (8.90)
VC backed	12.55** (4.83)				11.78** (4.57)			
High VC prominence		15.40** (4.78)				14.01** (4.54)		
VC count			13.78* (5.43)				13.69** (5.13)	
High VC distance				11.42† (6.06)				10.36† (5.74)
VC equity stake	0.06 (0.05)	0.05 (0.05)	0.08† (0.04)	0.08† (0.05)	0.06 (0.04)	0.05 (0.04)	0.08† (0.04)	0.07† (0.04)
Firm high tech	−5.52 (4.81)	−5.64 (4.75)	−7.03 (4.90)	−4.66 (4.85)	−5.05 (4.56)	−5.13 (4.51)	−6.60 (4.62)	−4.24 (4.60)
Firm age	−0.18 (0.12)	−0.17 (0.12)	−0.12 (0.12)	−0.15 (0.12)	−0.16 (0.11)	−0.15 (0.11)	−0.10 (0.11)	−0.13 (0.11)
Firm in California	10.22* (5.21)	11.09* (5.11)	9.13† (5.29)	11.17* (5.24)	10.61* (4.93)	11.45* (4.85)	9.44† (4.99)	11.52* (4.97)
IPO proceeds[b]	−4.69 (6.43)	−4.31 (6.34)	−6.50 (6.53)	−3.76 (6.49)	−4.29 (6.09)	−3.91 (6.02)	−6.15 (6.16)	−3.41 (6.16)
IPO major exchange	7.78 (8.85)	6.90 (8.73)	8.94 (8.80)	10.66 (8.84)	7.65 (8.38)	6.97 (8.30)	8.58 (8.31)	10.39 (8.37)
Early period	−8.21† (4.73)	−8.20† (4.67)	−8.32† (4.75)	−8.07† (4.80)	−8.99* (4.48)	−8.95* (4.43)	−9.16* (4.48)	−8.83† (4.55)
χ^2	43.66***	47.06***	43.36***	40.56***	44.97***	47.69***	45.43***	41.70**

†p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001.
[a] Standard errors appear in parentheses.
[b] The variable has been logged to remedy skewness, and the coefficient and standard error for this variable are multiplied by 1000. N = 137.

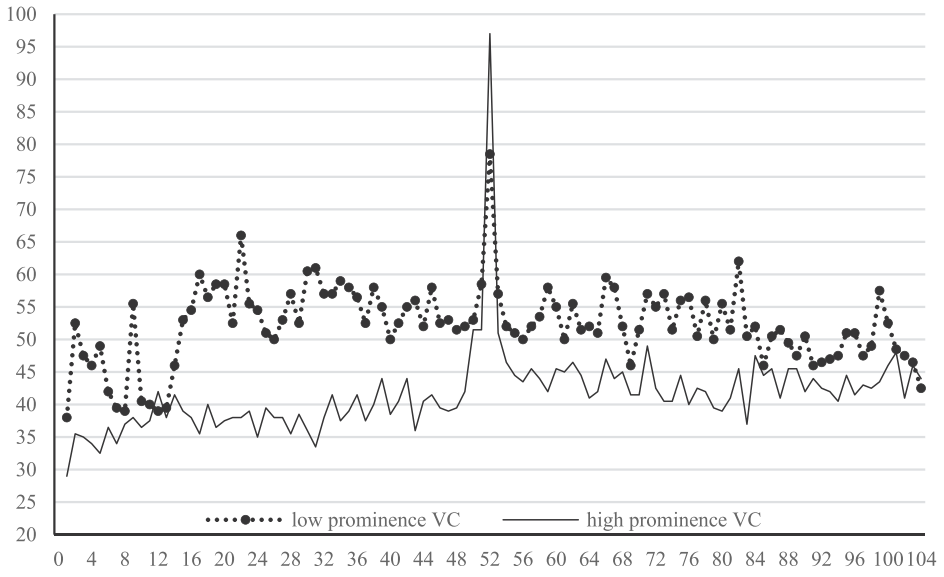

Fig. 5. Median weekly GT scores of firms by VC prominence two years around the IPO.
IPO week = 52. Kolmogorov-Smirnov and Kuiper two-sample tests for differences in distributions: $p < 0.0001$.

somewhat sensitive to the specification chosen to separate prominent VCs from other firms.

When we turn our attention to the other VC characteristics we examine, we find similar results to the ones reported above. Specifically, in the case of the VC count, Fig. 6 reveals that firms backed by more than the average value of 7.7 VCs feature smaller GT scores than their counterparts outside of the IPO week and that the two distributions are also very statistically significantly different (i.e., $p < 0.0001$). These results do not change if we replace the mean value with the median of 7 VCs. The differences in favor of low-VC count firms are also highly significant, as per Table 3 (i.e., $p < 0.001$ for all tests), and the median (mean) gap in the differences between the IPO week and the other weeks is of 8.8 (8.1) percentage points in favor of high-VC count firms, as per Fig. 8. As before, the multivariate analysis confirms the significantly different increases in investors' attention spikes at IPO for firms backed by more VCs. Columns 3 and 6 indicate that for each additional VC there is an average bump in attention of 13–15 percent ($p < 0.05$ and $p < 0.01$, for the mean and the median differences, respectively) (see Fig. 7).

The last hypothesis relates the geographic distance separating the lead VC from the firm to the investors' attention spike experienced by the latter during the week of their IPO. Again, we find support for this hypothesis. It is visually apparent that the

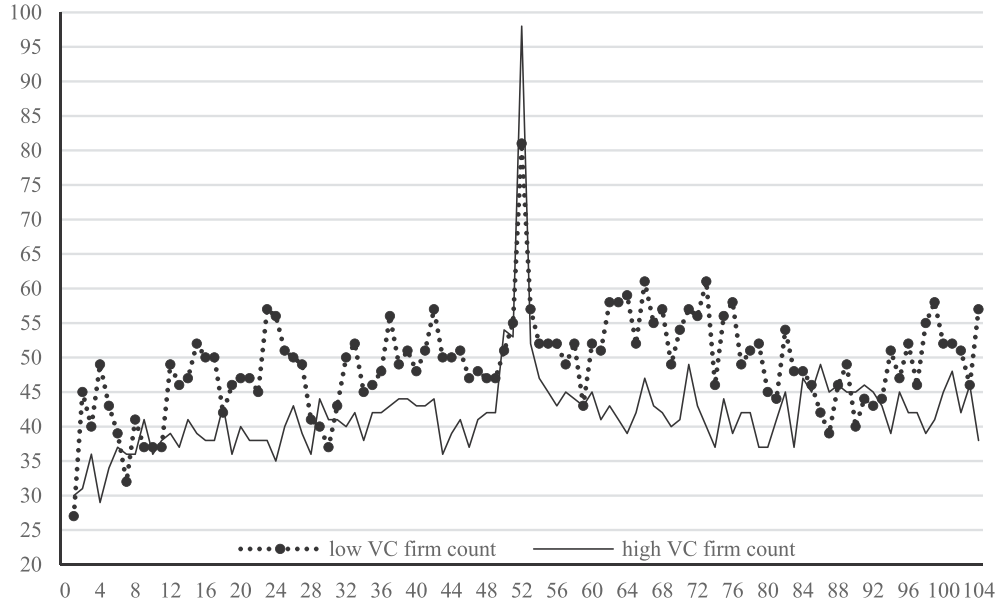

Fig. 6. Median weekly GT scores of firms by VC firm count two years around the IPO.
IPO week = 52. Kolmogorov-Smirnov and Kuiper two-sample tests for differences in distributions: $p < 0.0001$.

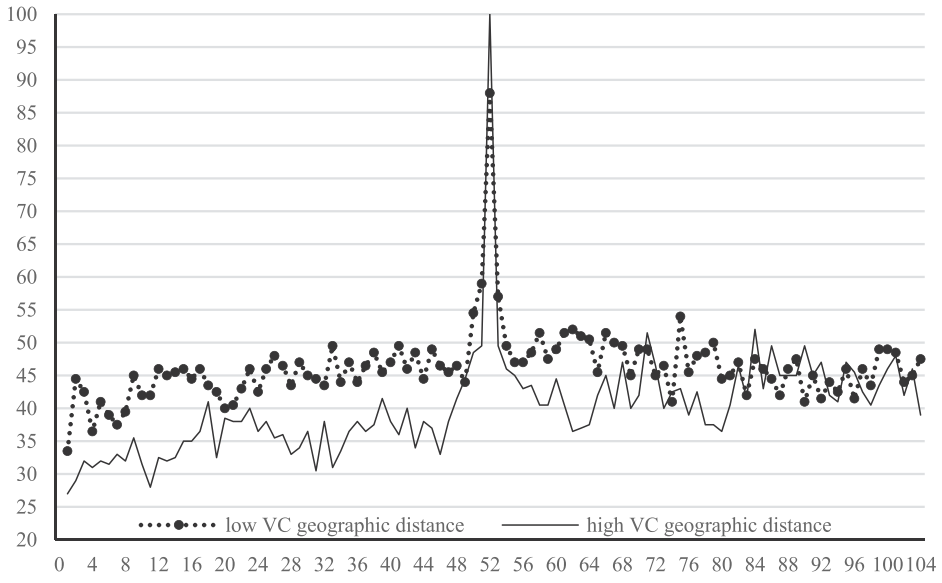

Fig. 7. Median weekly GT scores of firms by VC distance two years around the IPO.
IPO week = 52. Kolmogorov-Smirnov and Kuiper two-sample tests for differences in distributions: $p < 0.0001$.

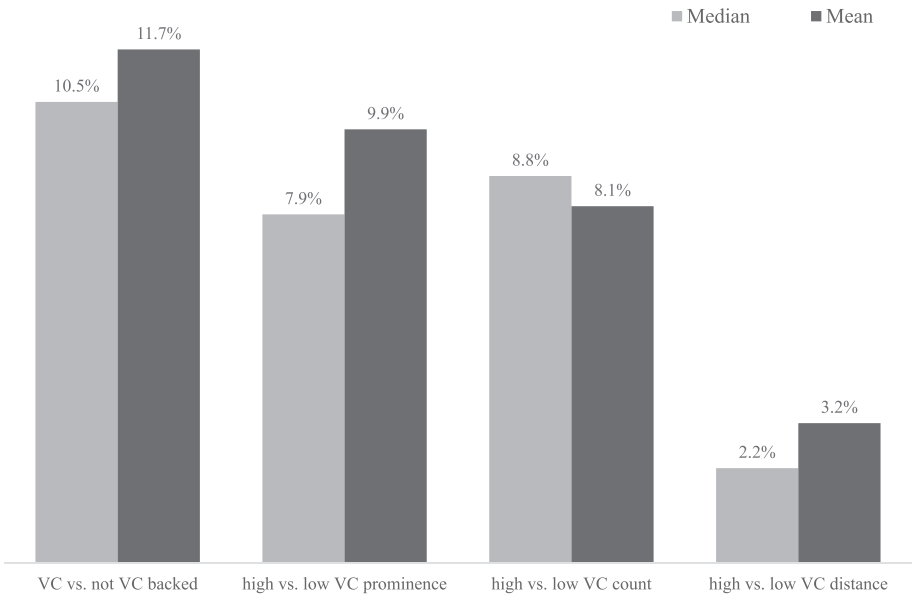

Fig. 8. Mean and median difference in differences between IPO week and 103 other weeks of observation by key theoretical variable.

distributions of GT scores between low and high distance differ and statistical tests corroborate this finding, as well ($p < 0.0001$ for all tests, as per Fig. 8). As before, examining the GT scores outside of the IPO week reveals that low distance firms showcase significantly higher scores (i.e., $p < 0.001$), which of course implies that the increase in investors' attention at IPO was far smaller for these firms, as previously reasoned. Moreover, the median (mean) gap in the differences between the IPO week and all other weeks is 2.2 (3.2) percent in favor of high-distance VC-backed firms. Although we also find support for our hypothesis from the multivariate estimation, the geographic distance variable is significant only at modest levels (i.e., $p < 0.10$ for both the mean and the median differences).

Discussion

A significant body of research shows that entrepreneurial firms benefit in important ways from their relationship with VCs. For example, VC-backed entrepreneurial firms have been associated with higher status (Pollock et al., 2014), greater legitimacy (Petkova et al., 2013), and increased interest (Pollock et al., 2008) relative to their non-VC-backed counterparts. Our findings both support and

contribute to this literature by showing that when entrepreneurial firms are backed by VCs and when VCs are prominent, high in count, and geographically distant—such firms experience higher spikes in attention during the week of their IPO debut. Furthermore, the statistical and economic effects of these differences are quite significant, and they highlight a new potential benefit associated with entrepreneurial firms and VCs. Accordingly, by using a novel (at least in management research) proxy for attention, our paper builds on the growing literature demonstrating the important role VCs play in the development of entrepreneurial firms.

Our paper's main contribution is that it is better able to capture the effect of the VC backing signal on the signal recipients' search behavior and it shows that there are substantial differences in the attention garnered by entrepreneurial firms during the week of their IPO debut. Importantly, this approach helps corroborate past findings that show the positive signaling role VCs play in both developing entrepreneurial firms and providing them visibility (Lee et al., 2011; Petkova et al., 2013; Pollock et al., 2008). While this work is informative and has contributed to our understanding of how VCs can help benefit entrepreneurial firms, most of the extant literature focuses on outcomes experienced by firms that issue a signal about their quality (Hsu, 2004). For example, this work has implicitly assumed that once a signal is issued, prospective investors will systematically receive, process and act upon it. However, this assumption may not always hold, as there is bound to be heterogeneity in the way signals reach their targets, and consequently, whether the targets respond to signals. We account for this possibility and offer a fresh approach that helps measure the effects of signals with greater precision than before. In doing so, we shed some light on the impact these signals have on the attention of prospective investors who may be looking for ways to reduce the hazard of adverse selection facing them. To this end, our paper opens the door to several new questions both within the theoretical and empirical contexts we explore and beyond.

Perhaps the most immediate questions stemming from our paper concern both the antecedents and the implications of an increased amount of attention for entrepreneurial firms experiencing an IPO. Regarding the latter, as we have discussed, a great deal of work has motivated the reasons why the backing of a VC offers a signal to investors needing to acquire information on an entrepreneurial firm. While we certainly “buy” into this logic as a package, we fall short of isolating the individual properties of VCs and then associating them directly with the attention spike outcome we report. In other words, it would be interesting to determine which aspects of the VC presence provide the most useful information to investors and under what conditions. In our view, this sort of investigation would be very useful in the future.

Turning to the implications of the increased investors' attention experienced by VC backed entrepreneurial ventures, a number of projects would prove fruitful. As an illustration, it would be interesting to study the short-run effects of higher investors' attention vis-à-vis IPOs' underpricing, subscription volumes, analyst coverage, etc. Alternatively, taking a longer-term perspective, one might explore whether the differential attention received by VC-backed entrepreneurial firms leads to unique corporate events well after these firms go public. For instance, it is possible that the spike in attention generated through the association with a VC might be directly associated with a higher probability of forming strategic alliances with prominent partners, or of being swept up in an acquisition after the firm's IPO. In the same spirit, questions could be raised with respect to the various aspects of VC backing that we study, such that the effects of geographic distance on attention might lead to alliances with more distant partners, for instance. These sorts of investigations and others could help us to arrive at a better understanding of the meaning of having VCs as partners in entrepreneurial firms.

Another potentially interesting question stemming from our work pertains to the possibility that the large spike in attention-levels we report for VC-backed IPOs may be the upshot of window-dressing by VCs. Put differently, the impression management tactics of VCs afford a ripe area for future research interested in understanding VCs and their behaviors. For instance, a stream of research has shown that managers may engage in activities that can influence investors' impressions, and potentially mask managers’ true motives (e.g., Devers et al., 2013; Gamache et al., 2019; Graffin et al., 2016). Surely, recent work has found evidence of this behavior in related areas of corporate strategy. For instance, Gamache et al. (2019) find that CEOs may engage in acquisitions based on their own self-interest (e.g., timing of their stock options), rather than with the purpose of maximizing firm value. Similarly, it stands to bear that VCs may be “grandstanding” on behalf of the firms in which they invest. In turn, this casts doubts on the actual value VCs may be able to add to entrepreneurial firms.

While the need to protect their reputation capital may counteract VCs' incentives to act in self-interest (e.g., Gomulya et al., 2019; Jain and Kini, 1995), there are certainly arguments and anecdotal evidence to the contrary. For example, recent work has examined whether opportunistic motives might lead VCs to embellish the prospects of their funded firms for the purpose of maximizing their returns upon exit (Gomulya et al., 2019). As another illustration, in the aforementioned case of WeWork's failed IPO, it is believed that immediately prior to the IPO withdrawal VCs were rushing to unload their ownership in the firm (Platt and Edgecliffe-Johnson, 2020). Given the tension that exists between the signaling properties of VCs and their aggressive pursuit of high returns, there is a rather obvious need for future research to enhance our understanding of this relationship. In our estimation, the introduction of impression management theory (e.g., Devers et al., 2013; Gamache et al., 2019; Graffin et al., 2016) in this context may be especially worthwhile.

Outside of the realm of the VC backing, it is easy to envision research that leverages on the GT scores to examine how other milestones in the lives of entrepreneurial firms might create spikes in investors' attention and generate new opportunities for growth. For instance, the issuance of a new patent, the approval of a promising new drug by the Federal Drug Administration, the appointment of a visible executive on the board, the announcement of a new product, the formation of a strategic alliance with a prominent new partner, etc. might generate abnormal patterns in investors' attention and in turn, they might bring about economic consequences for the underlying firms. We envision the study of these topics as a potentially promising way forward, particularly as they pertain to firms adopting business-to-consumer models, because conceivably the performance of these firms is more susceptible to fluctuations in investors’ attention.

Furthermore, although our work uses the IPO as a pivotal event for entrepreneurial firms, it is apparent that most firms never

reach the IPO stage. Conceivably, future work could examine the effects of attention earlier in the lives of entrepreneurial firms, perhaps when VCs first invests in the venture. For example, prior research has reported the positive network effects created by VCs (e.g., Ozmel et al., 2013) and one could imagine that a VC's decision to fund a venture could trigger the attention of other VCs, which might in turn ultimately be a catalyst for a new VC to join. Similarly, prospective alliance partners may appear as a function of the possible increase in attention generated by the funding of a VC.

Finally, this paper can also be inserted in the broader discourse examining the relevance of information and availability cascades (Banerjee, 1992; Bikhchandani et al., 1998; Pollock et al., 2008; Welch, 1992) and how they contribute to the dissemination of information and the consequent actions undertaken by economic actors. Scholars in these areas of research have argued that private information and individual preferences are often replaced by dominant and socially verified information (Kuran and Sunstein, 1999), which in turn leads to imitation and herding behavior. Although these topics are generally found in behavioral economics, social psychology and political science –and therefore, they lie outside of the scope of our work – our paper might provide a useful starting point for future work in these areas.

For instance, to the extent that an investor elects to search for firms with VC-backing as they near their IPOs, as opposed to searching for firms without this feature, it would seem that this choice would be the outcome of a qualitative and discriminating cognitive process at the individual level. However, it is also plausible that the searches performed by investors are themselves the result of prior media-driven and social pressures applied through other channels. As an illustration, VCs might purposefully skew investors' general perception of the quality of the firms they take public, thereby driving the large increases in attention we report. Based upon the powerful repercussions triggered by search data patterns on business and society, either scenario presents fascinating facets that make this venue of research attractive in our view.

Limitations

As with most empirical work, we have had to rely on available data and make difficult decisions based on a number of issues. Although we hope that the compromises we have made still make this investigation worthwhile, it is important to note some of the limitations associated with them. First, as previously covered, we do not know the volume of *absolute* searches surrounding each company in our sample. Although our comparative analyses are not affected by this shortcoming, we are unable to provide any insights on whether VC- and non-VC-backed firms experience different levels of attention, overall. This means that even though the former experience greater *spikes* in attention during the week when they go public, they might be less followed than the latter, in raw search counts. If true, this possibility might place our findings under a less compelling light. In our defense, we suspect that VC-backed firms will be conceivably at least as visible as non-VC backed ones, and this question is arguably peripheral to our investigation. However, it is relevant in the economy of the broader research topic and we cannot address it here.

A second limitation of this work is that we are unable to discern whether the individuals performing searches on the sampled firms are in fact investors – as we claim – or casual internet users with little or no interest in the underlying firm's IPO. We believe that anyone matching the description of the casual internet user will hold a propensity to search for the company at any time during the period of observation and independent of whether the company is in its IPO week or not. Thus, given the relative nature of the GT scores, this category of investor might increase the total volume of searches throughout the observation period – but would not generate any systemic spike in attention during the IPO week. In contrast, we expect actual investors to be more likely to search for a company during the week of its IPO trading debut – a pivotal time in the life for a company during which information is especially salient for equity investors – than during quieter times in the year prior to or following the IPO debut. In sum, we ascribe to "noise" the GT scores that are generated by anyone other than individuals with the potential interest in investing in the firms we investigate. Nonetheless, we are unable to identify either category of searchers, so this point must be noted as a weakness in our work.

Moreover, regarding the concern that GT scores may not reflect the attention level of investors, it is equally true that other conventionally used measures of attention, such as media mentions, also cannot track whether the presence of articles on the company in the media translates into individuals perusing said articles. This last connection can only be assumed by prior work and it therefore represents a limitation of at least equal importance to the one we highlight here. In fact, while the GT scores track *active* searches by individuals – i.e., each search is counted only if an individual types the name of the company and hits "enter" on the Google search engine – media mention measures have no way to determine whether anyone at all paid any actual attention to the news and they are therefore passive. Clearly, it is unlikely that anyone would search for a company on Google and then ignore the results stemming from the search. In this sense, we consider the GT scores a far better metric to gauge attention.

Conclusion

This paper shows how different signals surrounding the relationship between VCs and entrepreneurial firms directly affect the level of attention received by the latter. While our goal is merely to show the statistically and economically significant effects of these signals on attention, our work perhaps raises more questions than it answers. Indeed, the use of search data such as GT scores has found fertile grounds in a host of other scientific areas and the evidence is overwhelmingly pointing at the usefulness of this approach for the purposes of understanding and predicting a broad range of phenomena. By introducing GT to the study of entrepreneurial firms and VCs, we hope to inspire scholars in management to continue to pave the way that leads to a better understanding of our key questions and relationships within the context of signaling and entrepreneurship, but also far beyond these confines.

CRediT authorship contribution statement

Roberto Ragozzino: Conceptualization, Writing - original draft, Methodology, Data curation. **Dane P. Blevins:** Conceptualization, Writing - review & editing, Data curation.

Appendix A. Supplementary data

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