The effects of pre-IPO corporate activity on newly-public firms' growth

Roberto Ragozzino [a, *], Kourosh Shafi [b], Dane P. Blevins [c]

[a] Haslam College of Business, University of Tennessee, 408 Stokely Management Center, Knoxville, TN 37996-0545, USA
[b] Warrington College of Business, Entrepreneurship and Innovation Center, 133 Bryan Hall, P.O. Box 117168, Gainesville, FL 32611-7168, USA
[c] University of North Carolina at Greensboro, P.O. Box 26170, Greensboro, NC 27402, USA

ARTICLE INFO

ABSTRACT

We investigate firms' pre-IPO corporate activity. We find that firms involved in extraordinary — i.e., beyond momentum — amounts of acquisitions, JVs, and alliances in the year leading up to their IPOs (1) are more likely to engage in post-IPO corporate activity; and (2) enter into their first post-IPO transaction twice as fast as other firms. Our results indicate that signaling via extraordinary corporate activity can have a significant effect on entrepreneurial firms' growth. The implications are discussed.

© 2017 Elsevier Ltd. All rights reserved.

Introduction

Undergoing an initial public offering (IPO) is simultaneously a highly sought-after objective and an extremely demanding proposition for entrepreneurial firms. On one hand, going public raises funds at a juncture in which capital is essential to the growth and survival of firms, and it also allows entrepreneurs to capitalize on their investment and diversify their risk. On the other hand, IPOs call for fees owed to lawyers, auditors, and investment banks, all of whom help prepare the organization for public ownership. Underwriters alone demand a variable fee that hovers around seven percent of the gross proceeds in United States' IPOs (Chen and Ritter, 2000), with the total cost of going public ranging from 5.7 to 17 percent of the gross proceeds depending on the size of the offering (Lee et al., 1996).

However, it is not only financial costs that firms face, but also *opportunity* costs. For example, senior management faces significant costs in the form of the amount of time spent on helping transition the firm from private to public. As an illustration, during the marketing stage of an IPO, investment banks encourage entrepreneurs to introduce their company to institutional investors via a series of on-location presentations, otherwise known as the "road show" (Jenkinson and Ljungqvist, 2001). The IPO road show is a demanding process that lasts multiple weeks, and requires that the firm clearly articulate its strategy with potential investors—with the outcome so crucial, that a firm may even be forced to withdraw its offering if potential investors come away from presentations unconvinced of the viability of its strategy (Busaba et al., 2001). Accordingly, the top management team must weigh the benefits against the costs of going public, all during a pivotal time when resources are constrained.

* Corresponding author.
E-mail addresses: rragozzino@utk.edu (R. Ragozzino), kourosh.shafi@warrington.ufl.edu (K. Shafi), dpblevin@uncg.edu (D.P. Blevins).

Given the significant investment in undergoing an IPO, it is plausible that firms preparing for an upcoming IPO would not want to initiate corporate activity above and beyond the pattern established in the preceding years leading up to the IPO. However, our data reveal that there is a considerable surge − well above momentum − in the number of corporate transactions entered into by firms in the period immediately preceding the IPO event. Therefore, it seems that some firms take extraordinary steps to increase their corporate activity as they near going public, which may be at odds with their need to allocate resources towards their ordinary corporate endeavors, as well as the IPO itself.

We argue that firms engaging in extraordinarily high levels of corporate activity prior to their IPO provide signals of their value to prospective partners (and also potential investors, which are outside the scope of our study), and therefore experience greater post-offering corporate growth as measured by their acquisitions, alliances, and equity joint ventures. We construct a sample of over one thousand U.S.-based newly-public firms over the years 1992−2008 and track their corporate growth activity before and after their IPO. Our results show that firms that escalate their acquisitions, equity joint ventures, and non-equity alliances prior to going public experience significantly higher corporate activity, and are more likely to engage in post-IPO deals than other firms. We also find that these firms enter into their first post-offering corporate deal twice as fast as their counterparts. These results withstand a host of robustness checks.

Substantial work has explored the effects of signaling on entrepreneurial firms' growth and competitiveness during the time of their IPOs. For example, affiliations with prominent institutional figures such as venture capitalists (VCs) and reputable investment banks affect an entrepreneurial firm's chances to be dual-tracked in M&A markets (Ragozzino and Reuer, 2007), or to form alliances after its IPO (Pollock and Gulati, 2007). Following in this work's footsteps, we do not use the IPO as a signal in and of itself, but rather as a central event to study a context where signals are used to decrease the adverse selection problem faced by prospective partners (and investors) of IPO firms, which often lack legitimacy and credibility as they transition from private to public (e.g., Certo, 2003; Gompers and Lerner, 2004; Graebner, 2009).

It is worth noting that we study the workings of signaling theory as a framework that goes above and beyond momentum theory (Amburgey and Miner, 1992; Haleblian et al., 2006). Specifically, momentum theory concerns itself with the effects of experiential learning as a predictor of future firms' actions, whereas our focus rests on the activity that lies outside of what predictable patterns firms have established over time. While we account for momentum in our investigation, we find that *extraordinary* activity plays a unique role that cannot be explained by experience. In this sense, our paper sheds light on how corporate growth strategies may be helpful in alleviating information asymmetry − which is the fundamental premise of signaling theory − and is especially salient in the context of entrepreneurial firms (Stuart et al., 1999). Accordingly, by bringing evidence of the importance of pre-IPO corporate growth activities, we contribute to the literature in corporate strategy and entrepreneurship (see Connelly et al., 2011 for a review), and show that signals issued during the pre-IPO window are consequential to the subsequent growth strategy of newly-public firms. The remainder of the paper is organized as follows: First, we lay the theoretical groundwork of signaling theory. Second, we build on the theory to develop our predictions, and then we detail our empirical design. Lastly, we present the results and discuss the implications of this work, as well as its voids and areas for future development.

Theoretical background

Information economics and signaling

The relevance of signaling theory has been discussed by scholars in economics and finance for quite some time. The theory finds its roots in the work of Akerlof (1970), Spence (1973) and Stiglitz (2002), who have received the Nobel Prize in economics for their contributions in this area. In his seminal paper, Akerlof describes the inefficiencies that arise in the market for used cars, when buyers do not hold the information needed to tell apart good-from bad-quality sellers. Under these circumstances, bad-quality sellers hold a natural incentive to misrepresent the value of their cars and for their parts, good-quality sellers cannot credibly convey the value of their cars, either. Spence (1973) uses the labor market to corroborate Akerlof's work and to underscore the importance of signaling. He argues that a job candidate can signal her value to a prospective employer by way of her educational achievements. In fact, although education may not speak directly to the candidate's capacity of performing the duties of a job, it may provide a signal of her quality, which reduces the risk of adverse selection and ultimately determines her wages.

One of the takeaways of Akerlof's and Spence's work is that without costly and observable signals − i.e., warranties on good-quality cars in the case of Akerlof's model and educational achievements in the case of Spence's model − attractive exchanges may not occur, or buyers may enter into non-value-adding exchanges, owing to adverse selection. Useful reviews of these powerful ideas can be found in Stiglitz (2002) and Connelly et al. (2011), and the significance of information economics and signaling theory has been echoed in a vast set of subsequent work (e.g., Garmaise and Moskowitz, 2004; Nicholson et al., 2005; Dewally and Ederington, 2006; Hsu, 2006). For instance, signaling opportunities have been associated with insider trading in R&D-intensive firms (Ahuja et al., 2005), firms' name changes (Lee, 2001), the appointment of new directors on boards (e.g, Certo, 2003), the characteristics of top management teams (Cohen and Dean, 2005), the choice of FDI in lieu of exports (Katayama and Miyagiwa, 2009), firms' foreign sales activity (Shaver, 2011) and many others.

While this work has explored several different contexts, its common premise has been that firms' investment opportunity sets might be constrained as a result of information asymmetries (Fazzari et al., 1988; Nayyar, 1990). Under these circumstances, signals can reduce the effects of adverse selection and allow firms to compete without the inefficiencies brought about by this problem. In the next section, we (1) describe the relevance of signaling theory for entrepreneurial firms; (2) review the literature that has discussed various signaling opportunities for entrepreneurial firms nearing an IPO, with an emphasis on how pre-IPO corporate activity can function as a signal; (3) develop our predictions, which relate a specific type of signal — i.e., the engagement in unusual pre-IPO corporate activity — to these firms' growth opportunities in the aftermaths of their IPOs.

The importance of signaling for entrepreneurial firms

Entrepreneurial firms present severe information asymmetry problems vis-à-vis the host of prospective investors and stakeholders in their communities (Gompers and Lerner, 2004; Graebner, 2009). First, these firms' limited histories offer little information on their value and give rise to the well-known problem of the "liability of newness" (Stinchcombe, 1965). Second, the value of these firms is often tied to growth expectations and the qualities and vision of the entrepreneur, while assets in place tend to be a secondary part of the valuation concern (Barzel, 1987; Shane and Cable, 2002; Shane and Stuart, 2002). Lastly, entrepreneurs tend to hold overly-optimistic views of their own firms' potential (Cooper et al., 1988; Busenitz and Barney, 1997; Baron, 1998), as well as a natural incentive to exaggerate their prospects, due to the existence of asymmetric information between their firms and outsiders (Ravenscraft and Scherer, 1987). Together, these issues elevate valuation costs for prospective investors (Mitchell and Singh, 1992; Mody, 1993; Hagedoorn and Sadowski, 1999), decreasing the chances of deal making, and in turn, increasing the value of signals issued by entrepreneurial firms for the purpose of reducing the problem of adverse selection (Spence, 1973; Certo, 2003).

It is therefore no surprise that research has investigated for some time how entrepreneurs might be able to signal information about their firms, which would otherwise be difficult to observe for investors. For example, Backes-Gellner and Werner (2007) find that education records can be a useful signaling tool for entrepreneurs to attract talented staff as well as outside capital. As another illustration, Deutsch and Ross (2003) find that high-quality entrepreneurial firms are able to separate themselves from low-quality ones by appointing reputable directors to their boards, as the latter can help fill information voids regarding the firm's legitimacy and value (Pfeffer and Salancik, 1978). As a final example, a recent economics paper develops a formal theoretical model (and tests its main proposition) predicting that filing for patents not only allows entrepreneurial firms to appropriate value over their inventions, but it also plays an important signaling role used to reduce information asymmetries between the firm and external investors (Conti et al., 2013).

Signaling by IPO firms

There has been a growing amount of interest in studying the inter-connectedness of firms' IPOs and other corporate events. As an overarching argument, prior work has considered going-public as a major event which releases information that can trigger subsequent corporate activity for entrepreneurial firms. For example, early anecdotal evidence showed firms' IPOs increased their likelihood to become acquisition targets in the aftermaths of their offerings (Pagano and Panetta, 1998). Later studies formalized the connection between IPOs and M&A, showing that newly-public firms are often purchased in M&A markets after they file to go public (Field and Karpoff, 2002; Reuer and Ragozzino, 2008; Brau and Fawcett, 2006).

While the work above has considered IPOs as a signal of firms' quality — thereby dichotomizing newly-public and private firms — subsequent work has departed from this approach. Namely, the going public event was considered as a given (rather than as a signal), and the features of IPOs were examined as individual signals on the quality of firms going public. This research showed that the association with reputable underwriters as well as VCs during the time of an IPO can function as signals that increase both the strategic alliances, and acquisitions of newly-public firms (Pollock and Gulati, 2007; Ragozzino and Reuer, 2007). To the extent that these two institutional figures hold the expertise required to tell apart a high-from a low-quality firm, and insofar as they rely on reputational capital for repeat business — which keeps them from misrepresenting the value of their partners — then their endorsements are bona-fide signals of the quality of the entrepreneurial firm about to go public (Carter and Manaster, 1990; Megginson and Weiss, 1991; Podolny, 1994; Gulati and Higgins, 2003). Likewise, given the incentives held by underwriters and VCs outlined above and in the light of the high costs of associating with these figures (Chen and Ritter, 2000; Hsu, 2004), lower quality firms will not be able to replicate these signals and attract partners after their IPOs (Spence, 1973; Higgins and Gulati, 2003).

Pre-IPO corporate activity as a signal

Similar to the logic found in the above work, we consider firms that have undergone an IPO, and we investigate how entrepreneurial firms signal their value to a host of partners. We argue that by engaging in unusually high levels of corporate activity in the period immediately preceding their IPOs (e.g., alliances, JVs, acquisitions), such elevated activities signal the

firm's strategic intent. Specifically, we argue that extraordinary corporate activity above and beyond momentum should provide a signal of the firm's growth strategy following its IPO.

The notion that firms might partake in corporate activity for the purpose of pursuing objectives that are supplementary to the activity itself is not new. For example, Mitchell and Singh (1992) study the use of strategic alliances as a preamble to full entry in markets characterized by high levels of uncertainty. Stuart, Hoang and Hybels (1999) examine whether entrepreneurial firms affiliated with prominent alliance partners are able to borrow from their partners' reputation and experience more timely and successful IPOs than firms lacking these extended networks of relationships. Reuer and Ragozzino (2008) discuss the information revelation properties of alliances, arguing that inter-firm cooperative agreements can provide signals on the quality of partners, thereby reducing information asymmetries and facilitating future subsequent exchanges. Additional evidence on the signaling properties of preceding strategic alliances shows that firms receive substantially higher valuations from VCs, equity markets and M&A buyers when they have an established record of alliances than otherwise (Nicholson et al., 2005; Ozmel et al., 2013).

Aside from deploying alliances as signaling mechanisms, entrepreneurial firms might also be able to signal their value through their acquisition activity. Admittedly, most prior theoretical and empirical work has focused on the value of signals going to the sell-side of M&A (Fishman, 1989; Eckbo et al., 1990; Kohers and Ang, 2000; Datar et al., 2001; Field and Karpoff, 2002; Brau and Kohers, 2005). More precisely, this work is generally concerned with how high-quality sellers might be able to use signals to reduce the effects of adverse selection and attract buyers in M&A markets. In contrast, our interest lies with how firms might be able to signal their value to prospective alliance partners, joint ventures, and acquisition targets by engaging in acquisitions as buyers. With regard to the latter, we propose that a track record of acquisitions can create a powerful signaling mechanism for acquiring firms. To the extent that the sharing of knowledge and resources with alliance partners provides information signals on the quality of a firm, as we argued previously, the straight-out purchase of a partner's assets should conceivably offer the same or greater signaling effects for entrepreneurial firms. This is because on one hand acquisitions are more resource-intensive transactions than alliances and therefore they signal a greater commitment by firms. On the other hand, prior work has discussed how the willingness by a target to be taken over by a buyer is itself a signal of the quality of the latter (i.e., Hansen, 1987).

Hypotheses development

Likelihood and volume of Post-IPO activity

The arguments above demonstrate the importance of strategic alliances, joint ventures, and acquisitions as signals of firms' quality in general. However, our predictions surround the signaling value of *extraordinary* corporate activity at the time of entrepreneurial firms' IPOs. Two key assumptions posited by signaling theory are that signals must be both observable and costly (Spence, 1973). Moreover, the cost of signals will be higher when the information asymmetries are severe, or alternatively when the benefits of the signal are comparatively greater. As an illustration of this point, it may be useful to go back to Spence's labor market setting. To the extent that education can signal the quality of job candidates and determine their wages, better education will provide a stronger signal than education obtained from less reputable schools. Put differently, a degree from an Ivy League school will be costlier to obtain, but it will also likely offer more information to prospective employers than the same degree obtained from a community college. Moreover, this difference will be particularly relevant when job candidates have few or no other achievements by which to signal their value.

Similar to job applicants in Spence's model, resource-constrained entrepreneurial firms find themselves in need to convey their value via signaling, in order to assuage adverse selection risks for prospective investors (Jenkinson and Ljungqvist, 2001). Engaging in pre-IPO corporate activity requires the direct deployment of resources away from routine activities, as well as the IPO itself. Arguably, a certain amount of corporate activity (i.e., momentum) preceding firms' IPOs may be explained by the trajectory previously set by firms, based on their attempts to build capabilities, create portfolios of growth options (Reuer and Tong, 2010), inertia and even management's self-interested behavior (Boulton et al., 2010). We assume that this predictable activity will continue as the firm approaches the IPO, despite the resource requirements set by going public. We also posit that predictable activity such as this will hold little signaling value, because, once again, it is aligned with the course undertaken by firms over prior years.

In contrast, elevated levels of pre-IPO corporate activity that lies outside of this expected course can function as a valuable signal for prospective corporate partners, because it calls for an extraordinary use of financial resources and managerial time, at a juncture in which neither are readily available. Therefore, we expect that those firms bearing the costs of undertaking unusually high levels of acquisitions, equity joint ventures, and non-equity alliances at such a taxing time, will be able to signal their value by initiating such corporate growth, and separate themselves from other firms that do not bear such costs. As a result, the search and valuation costs faced by prospective investors screening IPO markets for new opportunities will be lower for firms featuring extraordinarily high levels of pre-IPO corporate activity, and in turn this will lead to a greater volume of corporate transactions by these firms following their IPO debut:

Hypothesis 1. Firms with higher amounts of unusual pre-IPO corporate activity will engage in higher amounts of corporate activity after going public

Hypothesis 2. Firms with higher amounts of unusual pre-IPO corporate activity will show a higher likelihood of engaging in corporate activity after going public

Timing of Post-IPO activity

In addition to testing the signaling effects of unusually high levels of pre-IPO corporate activity on the likelihood and volume of post-IPO events, we are also interested in determining whether the speed of execution of the first deal will also be affected by this signal. As previously discussed, closely-held entrepreneurial firms face steep challenges in establishing their legitimacy and credibility in the marketplace, owing to their relative newness, smallness and lack of codified information on their value (Stinchcombe, 1965; Hannan and Freeman, 1989; Carter et al., 1994). In turn, these issues give rise to information asymmetry between entrepreneurial firms and outsiders, and research in the area has shown the difficulties experienced by entrepreneurial firms in obtaining financial and other resources as a result of asymmetric information (e.g., Shane and Cable, 2002; Shane and Stuart, 2002).

When firms finally go public, the IPO triggers important information cascades that inform investors on the value of newly-public firms. The mere reporting requirements of going public, along with the aggregate valuation of equity markets provide a host of new information by which to assess these firms (e.g., Hellwig, 1980; Holmstrom and Tirole, 1993). Furthermore, over time, these firms will become more visible and gradually establish their legitimacy in their competitive environments. Combined, these arguments may suggest that concerns surrounding the lack of information on entrepreneurial firms will dissipate once firms go public. However, newly public firms significantly underperform more established public firms (Ritter, 1991). In fact, most research in strategy and financial economics that has examined the effects of asymmetric information on firms' corporate activity has sampled on publicly-held companies, thereby inherently suggesting that adverse selection is still highly prominent after a firm goes public. Additionally, as previously discussed, recent work that has used firms' IPOs as a setting in which to study signaling has tied the presence of signals to events experienced after the firm went public. Indeed, information asymmetry for IPO firms remains high because these firms typically receive less coverage from analysts and the press than do larger and older public firms, and insiders often retain control (e.g., Zuckerman, 2000; Poulsen and Stegemoller, 2008).

Insofar as the uncertainty on the value of newly-public firms continues to linger after the IPO, early signals that speak to these firms' value will provide outside investors with information that can ease the uncertainty created by information asymmetry. By information economics logic, without signals, quality differences amongst newly-public firms will not be directly observable, as no firm will be able to make a credible claim about its value (Ravenscraft and Scherer, 1987). Therefore, prospective investors contemplating engagements with a newly-public firm will likely have to delay said engagements until the uncertainty surrounding the firm clears, and this process will inevitably require time, as the firm would gradually establish its legitimacy through its competitive actions. In contrast, if signals related to the value of the newly-public firm are available to prospective investors, it may not be necessary for the latter to wait until high-quality newly-public firms reveal themselves to the market. Thus, we propose that firms that signal their value through unusually high levels of pre-IPO corporate activity will be able to engage in acquisitions, non-equity alliances, and JVs faster than firms that do not signal such activity:

Hypothesis 3. The timing of the corporate activity after IPO increases with higher amounts of unusual pre-IPO corporate activity

Methods

Sample and data

The base sample for our analysis was drawn from the Securities Data Corporation (SDC). SDC is the premier data source for firms' corporate activities and its use in research areas from financial economics to strategy and entrepreneurship is extremely widespread (Hochberg et al., 2010; Li and Mahoney, 2011; Puri and Zarutskie, 2012; Shane and Stuart, 2002; Ozmel et al., 2013). We built our data starting from IPOs that took place in the United States in the manufacturing and service sectors (i.e., SIC codes 20-39 and 70-89, respectively) during the years 1992 through 2011. We then tracked the pre- and post-IPO activity of these firms, by computing the number of acquisitions, equity joint ventures, and non-equity strategic alliances they completed in the period ranging from four years prior to three years after the going-public event. Therefore, our full dataset spans the years 1988—2014. It should be noted that we consider all newly-public firms, regardless regardless of whether they engaged in any corporate activity in preceding years or not. The total number of IPOs comprising our sample is 2106.

When we compared the characteristics of firms with any pre-IPO corporate activity against firms with no activity, we found that the two were different along many dimensions. For instance, active firms experienced more post-IPO transactions (i.e., 4.73 versus 3.14 deals), were backed by VCs more (i.e., 67.9 versus 46.3 percent), were endorsed by more reputable underwriters, listed on a major exchange such as NYSE or NASDQ, rather than on smaller exchanges, and were covered by more analysts after going public (all $p < 0.001$). Fig. 1 offers a graphical description of the distribution of the yearly total IPO counts and the percentages of these deals that featured pre-IPO corporate activity.
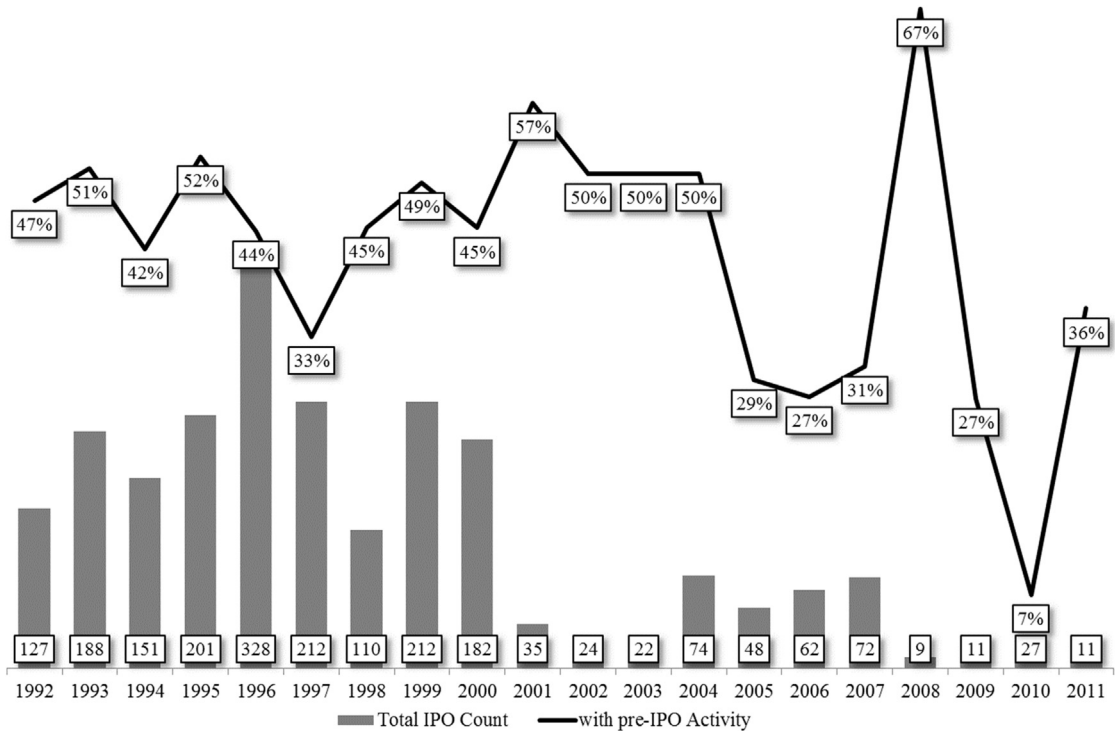
Fig. 1. Yearly distribution of firms with any pre-IPO Activity.

A longitudinal examination of the data reveals that 81.2 percent of the IPOs took place in the first 9 years of our sample and this number is similar when compared to the total IPO activity in the US (i.e., 81.9 percent). Likewise, a Kolmogorov-Smirnov two-sample test aimed at examining the similarities of the two distributions did not allow us to reject the null hypothesis (i.e., $p \approx 0.98$). Roughly 51.8 percent of the IPOs were in the manufacturing sector, while the remainder (i.e., 48.2 percent) was in the service sector. Again, these proportions closely resemble the split in the industrial distribution of population of IPOs in the same time window (i.e., 53.2 percent in manufacturing, and 46.8 in services).

Variables and measurement

Dependent variables

In this study we use several dependent variables to test the effects of unusually high levels of pre-IPO corporate activity by newly-public firms. First, *Total post-IPO activity* is the count of all acquisitions, equity joint ventures, and non-equity alliances entered into by the focal firm in the three years following the IPO event. We subsequently computed three separate variables for each of the three types of activities, in order to explore whether the unusual pre-IPO activity of our firms offers differing explanatory power for the formation of acquisitions, equity joint ventures, and non-equity alliances. Given our interest to investigate the likelihood of and timing to the first post-IPO transaction, we also constructed *Post-IPO activity*, which assumes a value of one if an event was experienced in the three years following the IPO and zero otherwise, as well as *Days to first post-IPO activity*, which measures the days that elapsed from the IPO to the first corporate event. As before, we separated these last two constructs into three separate variables based upon the type of corporate event entered into by the focal firm.

Theoretical variable

The theoretical variable in our model is *Unusual pre-IPO activity*. Our goal was to track the amount of corporate activity entered into by the focal firm in the year leading up to the IPO that was beyond momentum, or the expected amount based on the firm's activity in the three previous years. We use a 12-month pre-IPO window because firms typically begin to plan their IPO about one year before filing (Pollock and Rindova, 2003). We computed this variable by first estimating the following negative binomial regression:

$$(1) \text{ IPO year corporate activity} = \beta_0 + \beta_1 \text{Firm assets} + \beta_2 \text{Firm ROA} + \beta_3 \text{Firm age} + \beta_4 \text{Firm VC backed}$$
$$+ \beta_5 \text{IB reputation} + \beta_6 \text{Firm industry} + \beta_7 \text{Firm prior corporate activity}$$
$$+ \beta_8 \text{M\&A volume} + \beta_9 \text{JV volume} + \beta_{10} \text{Alliance volume} + \varepsilon.$$

Following an approach which has been adopted extensively in prior work (Das et al., 2006; Hsieh et al., 2011; Shen et al., 2014; Mudambi and Swift, 2014; Castellucci and Ertug, 2010), we then used the deviance residual as our theoretical variable. We report the results from this estimation in Table 1 for clarity of exposition.

Table 1
Negative binomial regressions for the estimation of hot period corporate Activity.[a]

Independent variables	DV = Pre IPO activity (I)	Pre IPO M&A (II)	Pre IPO JVs (III)	Pre IPO Alliances (IV)
Intercept	−2.90[***] (0.30)	−4.84[***] (0.51)	−6.40[***] (1.07)	−2.92[***] (0.40)
Total overall activity in quiet period	0.23[***] (0.03)			
Total M&A activity in quiet period		0.43[***] (0.09)		
Total JV activity in quiet period			0.93[*] (0.40)	
Total alliance activity in quiet period				0.39[***] (0.04)
Firm size[b]	0.13[***] (0.02)	0.30[***] (0.05)	0.18[*] (0.07)	0.03 (0.03)
Firm ROA	−0.34[***] (0.08)	−0.30[*] (0.15)	−0.26 (0.24)	−0.33[**] (0.09)
Firm age	−0.00 (0.00)	0.00 (0.00)	−0.01 (0.01)	−0.02[**] (0.01)
Firm high tech	0.22[*] (0.09)	0.23 (0.15)	0.05 (0.30)	0.32[**] (0.11)
VC backed	0.77[***] (0.10)	0.40[*] (0.16)	0.37 (0.32)	1.14[***] (0.13)
IB reputation	0.04[*] (0.02)	0.06 (0.04)	0.09 (0.08)	0.02 (0.03)
M&A volume (10^{-2})	−0.00 (0.00)	0.00[†] (0.00)	0.01 (0.01)	−0.01[***] (0.00)
JV volume (10^{-2})	0.03[*] (0.01)	−0.02 (0.02)	0.05 (0.04)	0.03[*] (0.01)
Alliance volume (10^{-2})	0.01[*] (0.00)	0.01 (0.01)	−0.00 (0.01)	0.02[**] (0.01)
χ^2	285.68[***]	833.81[***]	154.20[***]	1125.85[***]

N = 2271. [a] Standard errors appear in parentheses. [†] $p < 0.10$, [*] $p < 0.05$, [**] $p < 0.01$, [***] $p < 0.001$. [b] This variable was logged for the model estimation to remedy skewness.

Individual negative binomial regressions were also estimated separately for acquisitions, equity joint ventures, and non-equity alliances, in order to arrive at the deviance residuals of each type of transaction and estimate separate models in subsequent models. In additional robustness checks we also computed this variable using different methods and we will discuss these steps later in the document.

Control variables
The first control variable in the model is *Predicted pre-IPO activity*. This variable is included because the probability of a firm's corporate activity in a given year is likely to be dependent on the momentum and inertia from its activity in prior years (Amburgey and Miner, 1992; Haleblian et al., 2006). In order to arrive at this variable, we computed the number of corporate transactions in the IPO year by simply adding the estimated beta coefficients stemming from regression (1) above multiplied by their corresponding covariates. The next control in the model is *Hot state*. This variable aims at accounting for geographic considerations that might explain the levels of post-IPO corporate activity of the focal firm. For instance, there is evidence that certain areas of the United States witness more entrepreneurial and corporate activities than others (Gupta and Sapienza, 1992; Sorenson and Stuart, 2001; Stuart and Sorenson, 2003). Thus, we implemented an indicator variable which took a value of one if the focal firm was situated in California, Massachusetts or New York and zero otherwise. Second, we introduced firm age, size and return on assets (ROA) all measured on the year of the IPO. These controls can play a role in the model as longevity, size and performance characteristics can affect the adverse selection problem often present in corporate transactions involving entrepreneurial firms (Amit et al., 1990; Schaller, 1993; Petersen and Rajan, 1994; Casson, 1995).

At the IPO level, we controlled for several factors. First, we introduced *Underpricing* defined as the difference between the closing price at the end of the first day of trading and the offer price, divided by the offer price. A great deal of work in financial economics has studied underpricing and although differing theoretical views have emerged from this research, they all point at the role that this variable can have in determining firms' post-IPO growth opportunities (Allen and Faulhaber, 1989; Demers and Lewellen, 2003). We also implemented a dummy variable to indicate whether the focal firm was backed by a VC, because a growing body of work has shown that these affiliations can shape the corporate development of newly-public firms in the aftermaths of their offerings (Gulati and Higgins, 2003; Hsu, 2006; Ragozzino and Reuer, 2007;

Bussgang, 2010; Ramsinghani, 2011). Third, we included a control for the reputation of the lead underwriter drawing from the indices developed by Carter and Manaster (1990) and subsequently updated by Loughran and Ritter (2004) as well as by Ritter alone on his website (http://bear.warrington.ufl.edu/ritter/ipodata.htm). These indices range from 0 to 9 with higher numbers indicating higher ranked investment banks. Paralleling our previous logic, the endorsement of the firm by a credible figure can trigger the interest of prospective partners and improve upon the attractiveness of the focal firm following its IPO (Booth and Smith, 1986; Carter and Manaster, 1990; Carter et al., 1998; Gulati and Higgins, 2003; Higgins and Gulati, 2003).

The last two IPO-level variables are *Major exchange* and *Analyst coverage*. The first was introduced because listings on such exchanges as NYSE and NASDAQ can be more demanding in terms of information disclosure requirements and they also offer superior visibility to the investment community to over the counter markets (Draho, 2004). Thus, we assigned a value of one if the focal firm was either on NYSE or NASDAQ, and zero otherwise. *Analyst coverage* accounts for the possibility that higher number of analysts covering a firm will translate into greater visibility and consequently more post-IPO corporate opportunities for the firm (Aggarwal et al., 2002). We followed prior research in finance and obtained data on the number of analysts following a firm from the I/B/E/S database (Angel, 1997).

The last variables in the model are time- and industry-based controls. IPO volume reflects the total number of IPOs in the United States in the year of the focal firm's IPO and it accounts for the macroeconomic cycle of IPO markets as a potential predictor of corporate activity. Activity volume reflects the total number of domestic corporate transactions in the time period spanning the year of the IPO to three years after the offering. As we note in the tables, this variable matches the dependent variable in that if the DV comprises acquisitions, equity joint ventures and non-equity alliances, then Activity volume is also all-inclusive. In contrast, when the DV is limited to only one of these three types of corporate events, then this variable is also limited to the same. Lastly, we introduce an industry control that separates the two broad categories of firms in our sample. Manufacturing takes a value of one if the focal firm main SIC code resided between 20 and 39 and zero if it resided between 70 and 89.

Model specification

The basic structure of the main multivariate statistical model is as follows:

$$(2) \; \text{Post} - \text{IPO activity} = \beta_0 + \beta_1 \text{Unusual pre} - \text{IPO activity} + \gamma \text{ Controls}.$$

Our initial estimation was carried out using a Poisson regression, but when we tested for the equality of the mean and variance of the responses — one of the key assumptions of this model (Cameron and Trivedi, 1990) — we found strong evidence of over-dispersion. Specifically, we performed two tests: First, we divided the Pearson chi-square value obtained from the model estimation by its degrees of freedom. This operation resulted in a value of 4.62, which is far greater than the threshold value of one typically used. A second more formal test is obtained by a log-likelihood test computed as twice the negative difference of the log-likelihoods resulting from negative binomial and Poisson model estimations. The chi-square was equal to 3199.68 with 2091 degrees of freedom, which was highly significant by all standards (i.e., $p < 0.001$). Based on these results, we opted for the less restrictive negative binomial model.[1] In order to study the likelihood of the first post-IPO corporate event as well as its timing, we used standard logistic models, and hazard models (not shown). Below we discuss the results of our analyses.

Results

Fig. 2 presents a graphical representation of the average amounts of activity exhibited by the firms in our sample in the two key periods. It is noteworthy that without exception across the 20 years comprising our investigation, there is heightened activity in the IPO year than in the years preceding the IPO. Specifically, the mean ratio of IPO-year activity to the average activity in the preceding three years is 3.20 and the median is 2.28. Based on these descriptive results, a firm with an average of 0.18 events per year in the three years preceding the IPO year engages in 0.44 events, or 2.5 times more events, in the year leading up to the IPO. This ratio reaches a maximum average of 10.71 and the first and third quartiles of its distribution are bound between 1.71 and 3.7. Taken together, these values provide descriptive evidence that firms approaching their IPO tend to engage in corporate activity far more than previously.

---

[1] We also tested whether a zero-inflated negative binomial (ZINB) model should be preferred to a standard negative binomial (Greene, 2003). We separated the two classes of firms using the median level of corporate activity as the threshold and then estimated the ZINB and the corresponding Vuong test. The z-score was far from significant (i.e, $p < 0.50$), indicating that the ZINB was not a better fit than a standard negative binomial model (Vuong, 1989).
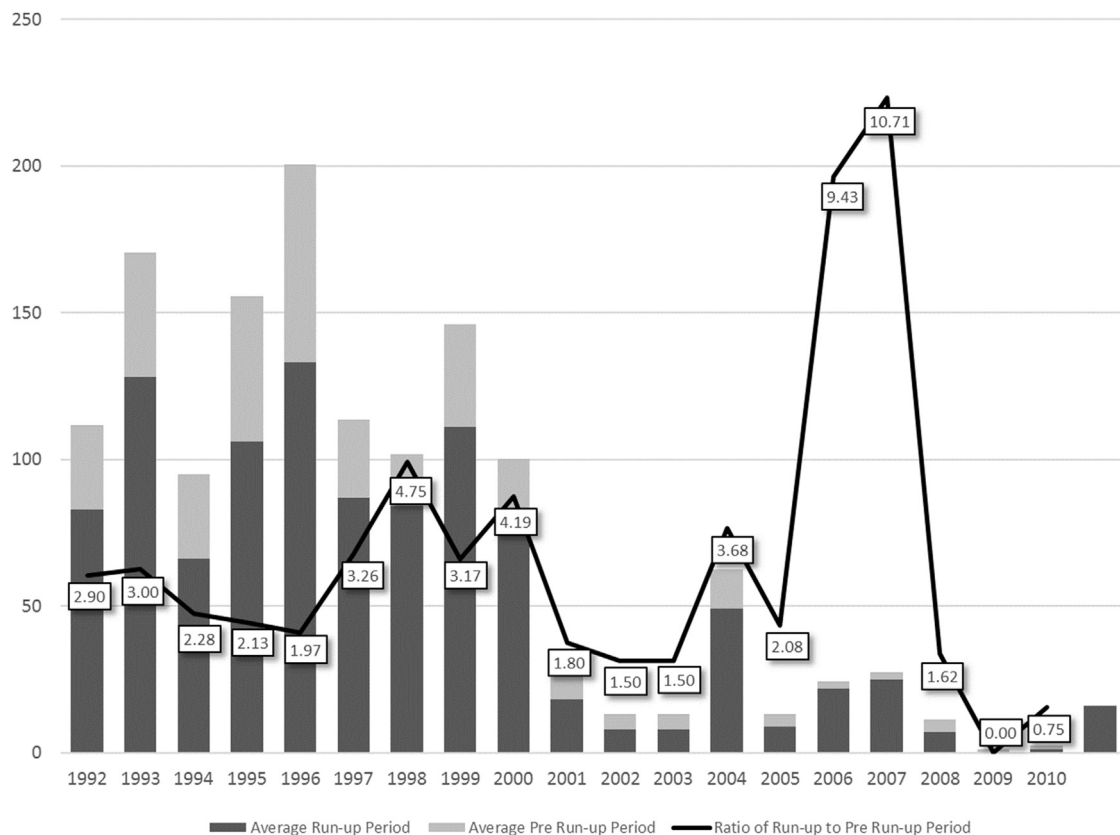
Fig. 2. Distribution of pre-IPO Activity − Run-up vs. Pre Run-up Period.

Table 2 presents the mean and standard deviation for each variable in our model as well as a correlation matrix. The average firm had 3.83 corporate events in the three years following its IPO, of which 2.09 were acquisitions, 0.17 were equity joint ventures and 1.57 were non-equity alliances. To provide some additional perspective on the distribution of post-offering transactions, the median number of total deals was 2 and the first and third quartiles were 1 and 5, respectively. These values changed significantly when we split our sample between manufacturing and service industries, indicating far greater activity in the latter (i.e., $t = 11.27$, $p < 0.001$). Predictably, a comparison of the pre- and post-2001 time windows showed greater activity earlier in the sampled period (i.e., an average of 4.15 post-IPO transactions before 2001 and 2.47 transactions after 2001, $t = 7.29$, $p < 0.001$).

A parallel analysis of the *Days to first post-IPO activity* variable shows that it took well over a calendar year for the average firm to close its first corporate transaction (i.e., 438 days), while the median number of days was 261 and the first and third quartile values were 104 and 791 days, respectively. As before, a comparison of the mean activity value between industries and time periods showed significant differences across these categories. Specifically, firms in service industries were able to close their first post-IPO deal in 336 days after the IPO, while it took about 533 days for manufacturing firms (i.e., $t = 11.71$, $p < 0.001$). Firms were also far quicker to execute their first transaction before 2001, taking on average 406 days, versus the 574 days of the post-2001 period (i.e., $t = 7.38$, $p < 0.001$).

Turning our attention to the *Unusual pre-IPO activity* variable, the statistics in Table 2 show the values for the deviance residuals, which offer little intuitive interpretation. Thus, it is worthwhile to discuss the raw numbers of pre-IPO transactions entered into by the firms in our dataset. Our firms engaged in 0.50 deals in the year preceding the IPO and in 0.52 total deals in the three years prior to the IPO. Similarly, the mean number of acquisitions, equity joint ventures and non-equity alliances in the run-up period were 0.18, 0.03 and 0.29, respectively, versus 0.14, 0.03 and 0.35 for the earlier period. The correlation matrix (Table 2) also shows that the unusual pre-IPO activity variable was positively and significantly correlated with the total post-IPO activity and negatively and significantly correlated with the days to first post-IPO activity (i.e., both $p < 0.001$). These statistics provide descriptive support for the hypothesized relationships, although we will test our predictions more formally below.

Aside from the direct relationship between the corporate activity pre- and post-IPO by the focal firms, additional statistics pertaining to the other variables are also noteworthy. First, firms that went public and experienced large first-day returns

were more likely to be active in the aftermaths of their offerings and quicker to close their first deal (i.e., both $p < 0.001$). Likewise, firms that received the endorsement of a reputable underwriter at IPO and that were followed by more equity analysts post-IPO also engaged in more and quicker corporate transactions (i.e., $p < 0.01$ and $p < 0.001$). Unsurprisingly, underpricing, IB reputation and analyst coverage are all positively correlated with one another, although the relatively low coefficients in the table do not indicate multicollinearity problems. The backing of a VC does not seem to affect the volume or timing of post-IPO activity, although the VC-backed variable is positively correlated with IB reputation, major exchange and underpricing (i.e., $p < 0.001$ and $p < 0.01$), which is consistent with prior work that has examined these variables (Gulati and Higgins, 2003). Lastly, the location of the focal firm in California, New York or Massachusetts is not correlated with pre- or unpredicted post-IPO corporate activity, although it is correlated with underpricing, VC backing and IB reputation (i.e., all $p < 0.001$).

Table 2
Descriptive statistics and correlation matrix.[a]

Variable	Mean	S.D.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1. Total post-IPO activity	3.83	5.37	—											
2. Days to first post-IPO activity	437.84	398.70	−0.48***	—										
3. Unusual pre-IPO activity	−0.33	0.77	0.21***	−0.17***	—									
4. Predicted pre-IPO activity	−0.94	0.66	0.15***	−0.15***	−0.01	—								
5. Hot state	0.49	0.50	−0.00	−0.01	0.03	0.22***	—							
6. Firm age	10.26	12.95	−0.04	0.05*	0.02	−0.16***	−0.12***	—						
7. Firm size[b]	73.95	169.98	0.16***	−0.02	0.05*	0.03	−0.06**	0.16***	—					
8. Firm ROA	−0.14	0.52	0.03	0.00	−0.02	−0.25***	−0.04	0.15***	0.07***	—				
9. Underpricing	0.30	0.80	0.11***	−0.09***	0.03	0.06**	0.08***	−0.09***	0.00	−0.02	—			
10. VC backed	0.56	0.50	−0.00	−0.02	−0.03	0.70***	0.25***	−0.20***	−0.11***	−0.09***	0.07**	—		
11. IB reputation	7.21	2.36	0.07**	−0.04†	−0.01	0.39***	0.12***	0.01	0.15***	0.12***	0.07**	0.27***	—	
12. Major Exchange	0.79	0.41	0.11***	−0.14***	−0.00	0.26***	0.01	0.01	0.04†	0.07**	0.06**	0.13***	0.22***	—
13. Analyst coverage	3.03	2.60	0.20***	−0.08***	0.09***	0.19***	0.02	0.05	0.53***	0.10***	0.10***	0.12***	0.36***	0.05*

[a] N=2106. † $p<0.10$, * $p<0.05$, ** $p<0.01$, *** $p<0.001$. [b] The firm size values are expressed in millions.

Table 3 presents the results for the negative binomial regression models. Columns II-V show the *Unusual pre-IPO activity* variable for all types of corporate activity, acquisitions only, equity joint ventures only and non-equity alliances, respectively. All models are highly significant on an overall basis (i.e., all $p < 0.001$) and the introduction of the theoretical variable in the models consistently yields a significant improvement over the controls-only specification. Moreover, in order to flag issues related to multicollinearity, which might have cropped up based on some of the high correlation coefficients shown in Table 2, we estimated standard OLS models and computed variance inflation factors and condition indices and found that none of these values were close to the cutoffs of 10 and 100, which are associated with multicollinearity (Neter et al., 1985; Belsley et al., 2005).

Our first hypothesis predicted a positive relationship between the amount of unusual pre-IPO corporate activity and the number of activities entered into by a firm after its IPO. These predictions are strongly supported (i.e., all $p < 0.001$). However, the impact of each type of pre-IPO activity on post-IPO engagements is not the same. For example, while the coefficient for the overall activity shows that for an increase by one unit in pre-IPO activity the likelihood of a post-IPO event goes up by about 28 percent (i.e., $e^{\beta} = e^{0.25} = 1.28$), the same increase in the acquisition domain produces an increase in the probability of a post-offering deal of 41 percent. In contrast, in the case of equity joint ventures and non-equity alliances these probabilities amount to 71 and 61 percent. Two main conclusions can be drawn from these initial results: First, the unusual corporate activity by firms in the year running up to the IPO produce very consequential effects on the amount of post-offering transactions experienced by a firm. Second, the type of unusual activity chosen by a firm before its IPO will play an important role on its ability to be active in that same corporate market after the firm goes public.

Two more insights can be gained from Table 3. First, when one compares the unusual and the predicted amounts of pre-IPO activity of a firm, it is apparent that the two play out very differently, depending on which type of activity is being scrutinized. For example, on an overall basis, the general point that can be made from column I is that firms that are active in the pre-IPO period will continue to be active after going public. However, the impact of predicted activity on acquisitions is far smaller, as the probability of a post-IPO event is only increased by 26 percent by each routine acquisition before the offering. In the case of equity joint ventures, it appears as though prior activity does not explain future deals at all. In sharp contrast, each predicted non-equity alliance by a firm prior to its IPO will increase the probability of a transaction after the IPO by over 200 percent, on average. The second additional takeaway from the table is less apparent, but worth mentioning. The coefficients for the unusual and the predicted pre-IPO activity show that the latter produces greater odds of post-offering corporate events than the former, as already discussed.

Table 3
Negative binomial regressions for Post-IPO total corporate Activity.[a]

Independent variables	All activity	Acquisitions	Equity JVs	Non-equity alliances
	(I)	(II)	(III)	(IV)
Intercept	−4.95*** (1.29)	−5.48*** (1.92)	−16.11*** (4.10)	−5.22** (1.89)
Unusual pre-IPO activity	**0.25*** (0.03)**	**0.34*** (0.05)**	**0.54*** (0.16)**	**0.47*** (0.05)**
Predicted pre-IPO activity	0.42*** (0.06)	0.23*** (0.07)	0.16 (0.23)	0.70*** (0.07)
Other unusual pre-IPO activity[b]	–	12.21**	0.16	14.60***
Other predicted pre-IPO activity[b]	–	13.48**	8.65*	5.65†
Hot state	−0.06 (0.05)	−0.24*** (0.06)	−0.05 (0.14)	0.19** (0.07)
Firm age[c]	−0.14** (0.05)	−0.15† (0.08)	−0.30 (0.19)	0.10 (0.10)
Firm size[c]	0.09** (0.03)	0.05 (0.05)	0.43*** (0.11)	0.16** (0.05)
Firm ROA[c]	1.09*** (0.32)	2.12*** (0.55)	−0.56 (0.99)	−0.23 (0.49)
Underpricing[c]	1.10** (0.41)	1.12* (0.54)	3.01* (1.20)	1.22* (0.61)
VC backed	−0.37*** (0.07)	−0.26* (0.11)	−0.16 (0.25)	−0.34** (0.12)
IB reputation	−0.03* (0.01)	−0.06*** (0.02)	−0.04 (0.04)	0.04 (0.20)
Major exchange	0.12† (0.07)	0.24** (0.08)	−0.25 (0.20)	−0.11 (0.11)
Analyst coverage	0.04*** (0.01)	0.02† (0.01)	0.09** (0.03)	0.10*** (0.02)
IPO volume (10^{-2})	0.05*** (0.01)	0.04* (0.02)	0.09† (0.05)	0.00 (0.02)
Activity volume (10^{-3})	0.00*** (0.00)	0.00 (0.00)	0.14*** (0.03)	0.02*** (0.00)
Manufacturing	−0.60*** (0.05)	−0.78*** (0.06)	−0.11 (0.14)	−0.40*** (0.07)
χ^2	539.27***	421.97***	163.79***	634.45***

N = 2106. [a] Standard errors appear in parentheses. † p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001. [b] These variables represent all activity types other than the type indicated at the top of each column. Chi-square tests are shown. [c] This variable was logged for the model estimation to remedy skewness.

Turning our attention to the logit models, Table 4 reveals several noteworthy results. First, as before the significance and magnitudes of the *Unusual pre-IPO activity* coefficients are remarkably high across all models (i.e., columns II-V), providing strong support for our second hypothesis. As a few illustrations, the probability of entering into any post offering transaction goes up by roughly 56 percent for every unusual deal before the IPO. This number rises to 63, 95 and 95 percent when we examine acquisitions, equity joint ventures, and non-equity alliances, respectively (i.e., all p < 0.001). Second, the predicted pre-IPO activity also provides explanatory power in the main model (i.e., column II). However, paralleling the results presented earlier, this variable plays out very differently depending on the type of activity. For example, when we examine all transaction types, each pre-offering deal will raise the probability of experiencing a transaction after the IPO by 186 percent (i.e., $e^{\beta} = e^{1.05} = 2.86$). However, contrary to unusual pre-IPO activity, the predicted activity coefficient weakens in the acquisition model and it even loses its significance in the equity joint venture model (i.e., n.s.). In contrast, column IV reveals that routine activity holds strong predictive power only in the case of non-equity alliances (i.e., p < 0.001).

Table 4
Logistic regressions for the likelihood of a Post-IPO corporate Activity.[a]

Independent variables	All activity	Acquisitions	Equity JVs	Non-equity alliances
	(I)	(II)	(III)	(IV)
Intercept	3.92* (1.73)	1.62 (1.71)	4.04† (2.35)	−2.51 (1.69)
Unusual pre-IPO activity	**0.45*** (0.09)**	**0.49*** (0.11)**	**0.67*** (0.16)**	**0.67*** (0.09)**
Predicted pre-IPO activity	1.05*** (0.20)	0.24† (0.12)	0.81 (0.21)	1.32*** (0.14)
Other unusual pre-IPO activity[b]	–	4.65†	12.07**	3.85
Other predicted pre-IPO activity[b]	–	3.63	9.79**	16.74***
Hot state	0.11 (0.12)	−0.10 (0.10)	0.02 (0.15)	0.41*** (0.10)
Firm age[c]	−0.00 (0.00)	0.01 (0.00)	0.01 (0.01)	0.01* (0.01)
Firm size[c]	−0.02 (0.09)	0.06 (0.08)	0.26* (0.11)	0.19* (0.08)
Firm ROA[c]	0.44*** (0.12)	0.47*** (0.11)	0.28 (1.17)	−0.11 (0.12)
Underpricing[c]	0.12 (0.11)	0.33** (0.10)	0.05 (0.17)	−0.03 (0.07)
VC backed	−0.84** (0.20)	−0.71*** (0.18)	−0.66** (0.24)	−0.91*** (0.20)
IB reputation	−0.09** (0.03)	−0.06* (0.03)	−0.08* (0.04)	−0.00 (0.03)
Major exchange	0.43** (0.15)	0.33* (0.13)	−0.06 (0.21)	0.25† (0.14)
Analyst coverage	0.06 (0.03)	0.05† (0.03)	0.04 (0.03)	0.08** (0.03)
IPO volume (10^{-2})	0.05** (0.02)	0.05** (0.02)	0.11*** (0.04)	0.04 (0.03)
Activity volume (10^{-3})	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.04*** (0.00)
Manufacturing	−0.85*** (0.12)	−0.83*** (0.10)	0.06 (0.14)	−0.42*** (0.10)
χ^2	182.59***	229.74***	112.46***	417.06***

N = 2106. [a] Standard errors appear in parentheses. † p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001. [b] These variables represent all activity types other than the type indicated at the top of each column. Chi-square tests are shown. [c] This variable was logged for the model estimation to remedy skewness.

We test for differences in the timing of the first post-IPO event in two ways. First, we calculate the ratio of the median endpoint times of the firms in the bottom quartile of unusual pre-IPO activity and the firms in the top quartile. Unlike in the hazard ratio, which represents the instantaneous risk of experiencing the event in the next point in time, the median-time ratio offers perspective on how much faster the second group of firms engaged in post-IPO activity vis-à-vis the first group

(Spruance et al., 2004). This ratio was 1.57 (i.e., 263 days divided by 167 days), which indicates that firms with high amounts of unusual pre-IPO activity experience the first post-offering transaction nearly 60 percent faster than firms with low amounts of the same. Thus, this test offers convincing support for our third hypothesis. As a second way to shed light on the timing differences between high and low pre-IPO activity firms, we inspected stratified cumulative hazard functions (not shown) and found that there was an immediate difference in the hazards experienced by the firms in the upper quartiles versus the firms in the lower quartiles. Furthermore, it was apparent that the hazard of an event increased much faster for all firms within the first 200 days of the IPO, while it tended to flatten out between the second and the third year.

Discussion and conclusion

This paper draws from signaling theory to investigate whether unusually high amounts of pre-IPO activity explain the corporate growth of newly-public firms. We study a sample of US-based firms that underwent an IPO between 1992 and 2011 and track these firms' activity for a period ranging from four years prior to three years after their offering. Our analyses show that when firms are active in corporate markets above and beyond their predictable momentum before they go public (i.e., unusual activity), they engage in significantly more corporate activity in the aftermath of their IPOs. This result holds regardless of whether we consider all corporate activity, or separate acquisitions, equity joint ventures and non-equity alliances. Besides affecting the volume of post-offering corporate activity, we show that unusual pre-IPO activity also plays an important role at explaining the probability of entering into a first transaction, which increases by about 56 percent and the median time to said transaction is roughly half for unusually active firms than for their counterparts.

A number of studies have related IPOs and their characteristics to the growth of entrepreneurial firms in the aftermaths of their IPO event (Pagano and Panetta, 1998; Field and Karpoff, 2002; Gulati and Higgins, 2003; Brau and Fawcett, 2006; Pollock and Gulati, 2007; Ragozzino and Reuer, 2007; Arikan and Capron, 2010). Prior work has mostly studied the signaling effects of the endorsements of reputable institutions affiliated with the entrepreneurial firm upon its going public, and it has shown that they can function as effective signaling mechanisms. However, the ability to obtain these endorsements may depend on a host of conditions exogenous to an entrepreneurial firm (Gompers and Lerner, 2004), making them either inaccessible or very costly to obtain in some cases. For this reason, the investigation of other signaling opportunities available to entrepreneurial firms to establish their credibility and legitimacy in the eyes of prospective investors is valuable. This paper represents an attempt at understanding the mechanisms concerning this topic.

From a broader theoretical viewpoint, the discussion above highlights the notion that different signals can generate significantly different outcomes for entrepreneurial firms. To the extent that signals serve the main purpose of reducing asymmetric information between the entrepreneurial firm and outsiders, it may be tempting to assume that all outsiders will indiscriminately benefit from any given signal. However, it is possible that each signal will be received positively by some recipients and less so by others. Given that all signals involve costs (Spence, 1973; Connelly et al., 2011) and that cheap signals do not fool prospective investors (Lee, 2001), those firms considering the use of signals to improve upon their odds of experiencing a targeted outcome should recognize the cause-and-effect link of their (costly) actions. Prior work has shown the positive effects of third-party affiliations on the likelihood of dual tracking, for instance, while this paper demonstrates the positive effect of unusually high pre-IPO corporate activity on post-IPO corporate development.

Limitations/future research

Like any study, our paper also has its own limitations. As one illustration, there might be theoretical drivers besides signaling that may also explain the corporate growth activity by firms nearing their IPOs. Our main objective was to single out the role of signaling theory as a powerful lens through which to study the linkages between pre- and post-IPO corporate activity. However, other theories, such as organizational learning and the resource-based view of the firm might offer alternate perspectives on the linkages above. Clearly, any future work that aims to enhance our under-standing of the theoretical drivers of relevant phenomena like the one we explore would be extremely valuable to the scientific community. From an empirical viewpoint, our design's focus on specific industries caused us to exclude thousands of other newly-public firms from our sample. Moreover, we were also inherently assuming that no firm-specific variation existed with respect to firms' preferences to grow organically, rather than via corporate deal mak-ing. These issues introduce could raise concerns related to whether our sample accurately represents entrepreneurial firms, and perhaps smaller-scale studies that rely on qualitative data might be able to overcome the limitations of our work.

Furthermore, one implicit assumption that we make about our sample is that firms that go through an IPO are by definition entrepreneurial. Much of the logic we develop to highlight the importance of signaling for the firms we examine is based on this assumption. Many recent papers have proceeded in the same way as we do (e.g., Brau et al., 2010; Bruton et al., 2009; Chen et al., 2010; Pástor et al., 2009; Onur and Chemmanur, 2012), so we stayed as close to precedent as we could. How-ever, the question of what characteristics make up an entrepreneurial firm is still open, both conceptually and empirically.

Indeed, prior work has used a host of different criteria to separate entrepreneurial firms from their counter-parts, including size, age, founder's presence, ownership structure, growth orientation, risk propensity, innovativeness, etc. (see among others Audretsch, 2002; Brush and Vanderwerf, 1992; Hulburt and Scherr, 2003; Marino et al., 2002; McDougall et al.,

1994; Zahra et al., 2000). Depending upon the metric used to define entrepreneurial firms, it is possible to develop arguments against how we relate the usefulness of signaling to the firms in our sample. Likewise, the generalizability of our results to the population of entrepreneurial firms is also potentially put into question by our approach. As a weak counter-argument, by examining newly-public firms we arrive at sample comprising firms that were 9 years old and less than $75 million in total assets, on average. Thus, albeit only fortuitously, we conform with other work that used either age or size as defining characteristics of entrepreneurial firms.

An opportunity for future research pertains to the study of the incentives held by underwriters and VCs endorsing the firm during its IPO. Even when an entrepreneurial firm manages to affiliate with such figures, it is unclear whether underwriters and VCs will favor the firm's engagement in pre- and post-IPO corporate activity. For example, the acquisition of another firm before the IPO might be attractive to underwriters, since such a deal would likely generate new fees. However, VCs may feel ambivalent about this type of transaction, because on one hand a successful acquisition may provide an opportunity for a higher investment return for VCs (Brau and Kohers, 2005), but on the other hand, given the resource-intensity of M&A and the evidence on their poor short-term performance, VCs may find such an endeavor incompatible with their objectives. Similarly, VCs may oppose the firm's engagement in joint ventures and non-equity alliances, because these cooperative agreements may improve the competitiveness of the firm over time, but they also tend to require significant upfront resources and they often offer limited short-term gains. Future work in this area would be valuable, as it would help us to understand whether costly signals might produce negative spillover effects for entrepreneurial firms. These and other questions present fertile ground for future research in this area.

References

Aggarwal, R.K., Krigman, L., Womack, K.L., 2002. Strategic IPO underpricing, information momentum, and lockup expiration selling. J. Financial Econ. 66 (1), 105—137.

Ahuja, G., Coff, R.W., Lee, P.M., 2005. Managerial foresight and attempted rent appropriation: insider trading on knowledge of imminent breakthroughs. Strategic Manag. J. 26 (9), 791—808.

Akerlof, G.A., 1970. The market for "lemons": quality uncertainty and the market mechanism. Q. J. Econ. 84 (3), 488—500.

Allen, F., Faulhaber, G.R., 1989. Signaling by underpricing in the IPO market. J. Financial Econ. 23 (2), 303—323.

Amburgey, T.L., Miner, A.S., 1992. Strategic momentum: the effects of repetitive, positional, and contextual momentum on merger activity. Strategic Manag. J. 13 (5), 335—348.

Amit, R., Glosten, L., Muller, E., 1990. Entrepreneurial ability, venture investments, and risk sharing. Manag. Sci. 36 (10), 1233—1246.

Angel, J.J., 1997. Tick size, share prices, and stock splits. J. Finance 52 (2), 655—681.

Arikan, A.M., Capron, L., 2010. Do newly public acquirers benefit or suffer from their pre-IPO affiliations with underwriters and VCs? Strategic Manag. J. 31 (12), 1257—1289.

Audretsch, D.B., 2002. The dynamic role of small firms: evidence from the U.S. Small Bus. Econ. 18 (1—3), 13—40.

Backes-Gellner, U., Werner, A., 2007. Entrepreneurial signaling via education: a success factor in innovative start-ups. Small Bus. Econ. 29 (1—2), 173—190.

Baron, R.A., 1998. Cognitive mechanisms in entrepreneurship: why and when entrepreneurs think differently than other people. J. Bus. Ventur. 13 (4), 275—294.

Barzel, Y., 1987. The entrepreneur's reward for self-policing. Econ. Inq. 25 (1), 103—116.

Belsley, D.A., Kuh, E., Welsch, R.E., 2005. Regression Diagnostics: Identifying Influential Data and Sources of Collinearity. John Wiley & Sons, New York.

Boulton, T.J., Smart, S.B., Zutter, C.J., 2010. Acquisition activity and IPO underpricing. Financ. Manag. 39 (4), 1521—1546.

Booth, J.R., Smith, R.L., 1986. Capital raising, underwriting and the certification hypothesis. J. Financial Econ. 15 (1), 261—281.

Brau, J.C., Fawcett, S.E., 2006. Initial public offerings: an analysis of theory and practice. J. Finance 61 (1), 399—436.

Brau, J.C., Kohers, N., 2005. "Dual Track IPOs Versus Single Track Takeovers: Does the Road Less Traveled Make all the Difference?" with Ninon Kohers, Brigham Young University Business Management Seminar, May 2005. Working Paper.

Brau, C.G., Sutton, N.K., Hatch, N.W., 2010. Dual-track versus single-track sell-outs: an empirical analysis of competing harvest strategies. J. Bus. Ventur. 25 (4), 389—402.

Brush, C.G., Vanderwerf, P.A., 1992. A comparison of methods and sources for obtaining estimates of new venture performance. J. Bus. Ventur. 7 (2), 157—170.

Bruton, G.D., Chahine, S., Filatotchev, I., 2009. Founders, private equity investors, and underpricing in entrepreneurial IPOs. Entrepreneursh. Theory Pract. 33 (4), 909—928.

Busaba, W.Y., Benveniste, L.M., Guo, R.J., 2001. The option to withdraw IPOs during the premarket: empirical analysis. J. Financial Econ. 60 (1), 73—102.

Busenitz, L.W., Barney, J.B., 1997. Differences between entrepreneurs and managers in large organizations: biases and heuristics in strategic decision-making. J. Bus. Ventur. 12 (1), 9—30.

Bussgang, J., 2010. Mastering the VC Game: a Venture Capital Insider Reveals How to Get from Start-up to IPO on Your Terms. Penguin, London.

Cameron, A.C., Trivedi, P.K., 1990. Regression-based tests for overdispersion in the Poisson model. J. Econ. 46 (3), 347—364.

Carter, R.B., Dark, F.H., Singh, A.K., 1998. Underwriter reputation, initial returns, and the long-run performance of IPO stocks. J. Finance 53 (1), 285—311.

Carter, R., Manaster, S., 1990. Initial public offerings and underwriter reputation. J. Finance 45 (4), 1045—1067.

Carter, N.M., Stearns, T.M., Reynolds, B.M., Miller, B.A., 1994. New venture strategies: theory development with an empirical base. Strategic Manag. J. 15 (1), 21—41.

Casson, M., 1995. Enterprise and Competitiveness: a Systems View of International Business. Oxford University Press, Oxford.

Castellucci, F., Ertug, G., 2010. What's in it for them? Advantages of higher-status partners in exchange relationships. Acad. Manag. J. 53 (1), 149—166.

Certo, S.T., 2003. Influencing initial public offering investors with prestige: signaling with board structures. Acad. Manag. Rev. 28 (3), 432—446.

Chen, H., Gompers, P., Kovner, A., Lerner, J., 2010. Buy local? The geography of venture capital. J. Urban Econ. 67 (1), 90—102.

Chen, H., Ritter, J.R., 2000. The seven percent solution. J. Finance 55 (3), 1105—1131.

Cohen, B.D., Dean, T.J., 2005. Information asymmetry and investor valuation of IPOs: top management team legitimacy as a capital market signal. Strategic Manag. J. 26 (7), 683—690.

Connelly, B.L., Certo, S.T., Ireland, R.D., Reutzel, C.R., 2011. Signaling theory: a review and assessment. J. Manag. 37 (1), 39—67.

Conti, A., Thursby, M., Rothaermel, F.T., 2013. Show me the right stuff: signals for high-Tech startups. J. Econ. Manag. Strategy 22 (2), 341—364.

Cooper, A.C., Woo, C.Y., Dunkelberg, W.C., 1988. Entrepreneurs' perceived chances for success. J. Bus. Ventur. 3 (2), 97—108.

Das, S., Guo, R., Zhang, H., 2006. Analysts' selective coverage and subsequent performance of newly public firms. J. Finance 61 (3), 1159—1185.

Datar, S., Frankel, R., Wolfson, M., 2001. Earnouts: the effects of adverse selection and agency costs on acquisition techniques. J. Law, Econ. Organ. 17 (1), 201—238.

Demers, E., Lewellen, K., 2003. The marketing role of IPOs: evidence from internet stocks. J. Financial Econ. 68 (3), 413—437.

Deutsch, Y., Ross, T.W., 2003. You are known by the directors you keep: reputable directors as a signaling mechanism for young firms. Manag. Sci. 49 (8), 1003–1017.

Dewally, M., Ederington, L., 2006. Reputation, certification, warranties, and information as remedies for seller-buyer information asymmetries: lessons from the online comic book market. J. Bus. 79 (2), 693–729.

Draho, J., 2004. The IPO Decision: Why and How Companies Go Public. Edward Elgar Publishing, Massachusetts.

Eckbo, B., Giammarino, R., Heinkel, R., 1990. Asymmetric information and the medium of exchange in takeovers: theory and tests. Rev. Financial Stud. 3 (4), 651–675.

Fazzari, S., Hubbard, R.G., Petersen, B.C., 1988. Financing constraints and corporate investment. Brookings Pap. Econ. Activity 1, 141–195.

Field, L.C., Karpoff, J.M., 2002. Takeover defenses of IPO firms. J. Finance 57 (5), 1857–1889.

Fishman, M.J., 1989. Preemptive bidding and the role of the medium of exchange in acquisitions. J. Finance 44 (1), 41–57.

Garmaise, M.J., Moskowitz, T.J., 2004. Confronting information asymmetries: evidence from real estate markets. Rev. Financial Stud. 17 (2), 405–437.

Gompers, P.A., Lerner, J., 2004. The Venture Capital Cycle. MIT Press, Cambridge.

Graebner, M.E., 2009. Caveat venditor: trust asymmetries in acquisitions of entrepreneurial firms. Acad. Manag. J. 52 (3), 435–472.

Greene, W.H., 2003. Econometric Analysis. Prentice Hall, Upper Saddle River, NJ.

Gulati, R., Higgins, M.C., 2003. Which ties matter when? The contingent effects of interorganizational partnerships on IPO success. Strategic Manag. J. 24 (2), 127–144.

Gupta, A.K., Sapienza, H.J., 1992. Determinants of venture capital firms' preferences regarding the industry diversity and geographic scope of their investments. J. Bus. Ventur. 7 (5), 347–362.

Hagedoorn, J., Sadowski, B., 1999. The transition from strategic technology alliances to mergers and acquisitions: an exploratory study. J. Manag. Stud. 36 (1), 87–107.

Haleblian, J.J., Kim, I., Rajagopalan, N., 2006. The influence of acquisition experience and performance on acquisition behavior: evidence from the US commercial banking industry. Acad. Manag. J. 49 (2), 357–370.

Hannan, M., Freeman, J., 1989. Organizational Ecology. Harvard University Press, Cambridge, MA.

Hansen, R.G., 1987. A theory for the choice of exchange medium in mergers and acquisitions. J. Bus. 60 (1), 75–95.

Hellwig, M.F., 1980. On the aggregation of information in competitive markets. J. Econ. Theory 22 (3), 477–498.

Higgins, M.C., Gulati, R., 2003. Getting off to a good start: the effects of upper echelon affiliations on underwriter prestige. Organ. Sci. 14 (3), 244–263.

Hochberg, Y.V., Ljungqvist, A., Lu, Y., 2010. Networking as a barrier to entry and the competitive supply of venture capital. J. Finance 65 (3), 829–859.

Holmstrom, B., Tirole, J., 1993. Market liquidity and performance monitoring. J. Political Econ. 101 (4), 678–709.

Hulburt, H.M., Scherr, F.C., 2003. Determinants of the collateralization of credit by small firms. Manag. Decis. Econ. 24 (6–7), 483–501.

Hsieh, J., Lyandres, E., Zhdanov, A., 2011. A theory of merger-driven IPOs. J. Financial Quantitative Analysis 46 (5), 1367–1405.

Hsu, D.H., 2004. What do entrepreneurs pay for venture capital affiliation? J. Finance 59 (4), 1805–1844.

Hsu, D.H., 2006. Venture capitalists and cooperative start-up commercialization strategy. Manag. Sci. 52 (2), 204–219.

Jenkinson, T., Ljungqvist, A., 2001. Going Public: the Theory and Evidence on How Companies Raise Equity Finance. Oxford University Press, Oxford.

Katayama, S., Miyagiwa, K., 2009. FDI as a signal of quality. Econ. Lett. 103 (3), 127–130.

Kohers, N., Ang, J., 2000. Earnouts in mergers: agreeing to disagree and agreeing to stay. J. Bus. 73 (3), 445–476.

Lee, I., Lochhead, S., Ritter, J., Zhao, Q., 1996. The costs of raising capital. J. Financial Res. 19 (1), 59–74.

Lee, P.M., 2001. What's in a name.com? The effects of '.com' name changes on stock prices and trading activity. Strategic Manag. J. 22 (8), 793–804.

Li, Y., Mahoney, J.T., 2011. When are venture capital projects initiated? J. Bus. Ventur. 26 (2), 239–254.

Loughran, T., Ritter, J.R., 2004. Why has IPO underpricing changed over time? Financ. Manag. 33 (3), 5–37.

Marino, L., Strandholm, K., Steensma, H.K., Weaver, K.M., 2002. The moderating effect of national culture on the relationship between entrepreneurial orientation and strategic alliance portfolio extensiveness. Entrepreneursh. Theory Pract. 26 (4), 145–160.

McDougall, P.P., Shane, S., Oviatt, B.M., 1994. Explaining the formation of international new ventures: the limits of theories from international business research. J. Bus. Ventur. 9 (6), 469–489.

Megginson, W., Weiss, K., 1991. Venture capitalist certification in initial public offerings. J. Finance 46 (3), 879–903.

Mitchell, W., Singh, K., 1992. Incumbents' use of pre-entry alliances before expansion into new technical subfields of an industry. J. Econ. Behav. Organ. 18 (3), 347–372.

Mody, A., 1993. Learning through alliances. J. Econ. Behav. Organ. 20 (2), 151–170.

Mudambi, R., Swift, T., 2014. Knowing when to leap: transitioning between exploitative and explorative R&D. Strategic Manag. J. 35 (1), 126–145.

Nayyar, P.R., 1990. Information asymmetries: a source of competitive advantage for diversified service firms. Strategic Manag. J. 11 (7), 513–519.

Neter, J., Wasserman, W., Kutner, M.H., 1985. Applied Linear Statistical Models. Regression, Analysis and Experimental Designs, Homewood: Illinois.

Nicholson, S., Danzon, P.M., McCullough, J., 2005. Biotech-pharmaceutical alliances as a signal of asset and firm quality. J. Bus. 78 (4), 1433–1464.

Onur, B., Chemmanur, T.J., 2012. IPOs versus acquisitions and the valuation premium puzzle: a theory of exit choice by entrepreneurs and venture capitalists. J. Financial Quantitative Analysis 46 (6), 1755–1793.

Ozmel, U., Reuer, J.J., Gulati, R., 2013a. Signals across multiple networks: how venture capital and alliance networks affect interorganizational collaboration. Acad. Manag. J. 56 (3), 852–866.

Ozmel, U., Robinson, D.T., Stuart, T.E., 2013b. Strategic alliances, venture capital, and exit decisions in early stage high-tech firms. J. Financial Econ. 107 (3), 655–670.

Pagano, M., Panetta, F., 1998. Why do companies go public? An empirical analysis. J. Finance 53 (1), 27–64.

Pástor, L., Taylor, L., Veronesi, P., 2009. Entrepreneurial learning, the IPO decision, and the post-IPO drop in firm profitability. Rev. Financial Stud. 22 (8), 3005–3046.

Petersen, M.A., Rajan, R.G., 1994. The benefits of lending relationships: evidence from small business data. J. Finance 49 (1), 3–37.

Pfeffer, J., Salancik, G.R., 1978. The External Control of Organizations: a Resource Dependence Perspective. Stanford University Press, Redwood City, CA.

Podolny, J.M., 1994. Market uncertainty and the social character of economic exchange. Adm. Sci. Q. 39 (3), 458–483.

Pollock, T.G., Gulati, R., 2007. Standing out from the crowd: the visibility-enhancing effects of IPO-related signals on alliance formation by entrepreneurial firms. Strateg. Organ. 5 (4), 339–372.

Pollock, T.G., Rindova, V.P., 2003. Media legitimation effects in the market for initial public offerings. Acad. Manag. J. 46 (5), 631–642.

Poulsen, A.B., Stegemoller, M., 2008. Moving firms from private to public ownership: selling out to public firms vs. initial public offerings. Financ. Manag. 37 (1), 81–101.

Puri, M., Zarutskie, R., 2012. On the life cycle dynamics of venture-capital and non-venture-capital financed firms. J. Finance 67 (6), 2247–2293.

Ragozzino, R., Reuer, J.J., 2007. Initial public offerings and the acquisition of entrepreneurial firms. Strateg. Organ. 5 (2), 155–176.

Ramsinghani, M., 2011. The Business of Venture Capital: Insights from Leading Practitioners on the Art of Raising a Fund, Deal Structuring, Value Creation, and Exit Strategies. John Wiley & Sons, New York.

Ravenscraft, D.J., Scherer, F.M., 1987. Mergers, Sell-offs, and Economic Efficiency. Brookings Institution Press, D.C, Washington.

Ritter, J.R., 1991. The long-run performance of initial public offerings. J. Finance 46 (1), 3–27.

Reuer, J.J., Ragozzino, R., 2008. Adverse selection and M&A design: the roles of alliances and IPOs. J. Econ. Behav. Organ. 66 (2), 195–212.

Reuer, J.J., Tong, T.W., 2010. Discovering valuable growth opportunities: an analysis of equity alliances with IPO firms. Organ. Sci. 21 (1), 202–215.

Schaller, H., 1993. Asymmetric information, liquidity constraints and Canadian investment. Can. J. Econ. 26 (3), 552–574.

Shane, S., Cable, D., 2002. Network ties, reputation, and the financing of new ventures. Manag. Sci. 48 (3), 364–381.

Shane, S., Stuart, T., 2002. Organizational endowments and the performance of university start-ups. Manag. Sci. 48 (1), 154–170.

Shaver, M.J., 2011. The benefits of geographic sales diversification: how exporting facilitates capital investment. Strategic Manag. J. 32 (10), 1046–1060.

Shen, R., Tang, Y., Chen, G., 2014. When the role fits: how firm status differentials affect corporate takeovers. Strategic Manag. J. 35 (13), 2012–2030.

Sorenson, O., Stuart, T.E., 2001. Syndication networks and the spatial distribution of venture capital investments. Am. J. Sociol. 106 (6), 1546–1588.

Spence, M., 1973. Job market signaling. Q. J. Econ. 87 (3), 355–374.

Spruance, S.L., Reid, J.E., Grace, M., Samore, M., 2004. Hazard ratio in clinical trials. Antimicrob. Agents Chemother. 48 (8), 2787–2792.

Stiglitz, J.E., 2002. Information and the change in the paradigm in economics. Am. Econ. Rev. 92 (3), 460–501.

Stinchcombe, A.L., 1965. Social structure and organizations. In: March, J.G. (Ed.), Handbook of Organizations. Routledge, Chicago, pp. 142–193.

Stuart, T.E., Hoang, H., Hybels, R.C., 1999. Interorganizational endorsements and the performance of entrepreneurial ventures. Adm. Sci. Q. 44 (2), 315–349.

Stuart, T.E., Sorenson, O., 2003. Liquidity events and the geographic distribution of entrepreneurial activity. Adm. Sci. Q. 48 (2), 175–201.

Vuong, Q.H., 1989. Likelihood ratio tests for model selection and non-nested hypotheses. Econometrica 57 (2), 307–333.

Zahra, S.A., Ireland, R.D., Hitt, M.A., 2000. International expansion by new venture firms: international diversity, mode of market entry, technological learning, and performance. Acad. Manag. J. 43 (5), 925–950.

Zuckerman, E.W., 2000. Focusing the corporate product: Securities analysts and de-diversification. Adm. Sci. Q. 45 (3), 591–619.