The Impact of Industry IPOs on Acquisitions of New Ventures:

An Information Spillovers Perspective

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ABSTRACT

The announcements of initial public offerings (IPOs) in an industry can convey to potential acquirers information about the growth prospects of the rivals of ventures undertaking IPOs, thereby increasing their likelihood of being acquired. We investigate several information diffusion mechanisms to examine how information conveyed by industry IPOs shape such acquisitions. We also develop a contingency perspective on how the value of such information spillovers will vary across acquirers. Our empirical evidence indicates that information in the IPO market channeled via media coverage, analyst coverage, and IPO underpricing raises an acquirer's likelihood of acquiring a private venture. Thus, the information intermediated as a consequence of IPOs relaxes the constraints of an acquirer's information environment, and this is particularly the case for diversifying acquirers.

JEL classification: G34; L26; M13

Keywords:

Initial Public Offerings; Mergers and Acquisitions; Information Spillovers; Ventures

INTRODUCTION

Search for growth opportunities has been one of the major motives for acquirers to engage in acquisitions (e.g., Angwin, 2007; Hitt *et al.*, 2009; Graebner, Eisenhardt, and Roundy, 2010; Ransbotham and Mitra, 2010). Acquisitions, especially those involving private ventures, can provide an acquirer with access to the target's resources and capabilities to enhance product and technology development (e.g., Graebner *et al*., 2010; Ransbotham and Mitra, 2010). However, acquirers often face obstacles when looking for private ventures as acquisition targets. Due to the lack of publicly-available information on private ventures, it can be costly for potential acquirers to locate and identify private targets (e.g., Hayek, 1945). Moreover, since private ventures' capabilities and growth potential are unproven, acquirers face a risk of adverse selection (e.g., Akerlof, 1970). Given the constraints that acquirers often face in their information environments (Schildt and Laamanen, 2006), it is important to investigate the factors that would facilitate such acquisitions.

The environment in which acquirers operate provides stimuli that directs their attention and affects their decision-making as a consequence (Ocasio, 1997). As one illustration, if an acquisition is recognized by the market as evidence of the management's foresight or superior information about industry opportunities, other firms would undertake similar strategic actions and thus waves of acquisitions may occur (e.g., Carow, Heron, and Saxton, 2004; McNamara, Haleblian, and Dykes, 2008). As a second example, previous research suggests that firms look for market signals from other organizations or external capital markets when considering entries into new geographic markets (e.g., Henisz and Delios, 2001).

IPO announcements can also reveal the value of industry-specific resources and growth opportunities (e.g., Akhigbe, Borde, and Whyte, 2003; Lee, Bach, and Baik, 2011). Even though

there is less information about the quality of private ventures' resources and prospects, acquirers can rely on information spillovers from industry IPOs and locate private ventures competing directly with IPO firms as potential acquisition targets. For example, along with the ever-growing number of IPOs such as MuleSoft, Cloudera, and MongoDB in the open-source software market, Microsoft acquired privately-held GitHub for $7.5 billion in 2018, which would accelerate GitHub's growth and advance Microsoft's services for software developers. More broadly, research has shown that information generated from industry IPOs can trigger acquisitions involving IPO firms' private rivals (e.g., Aktas, Cousin, Ozdakak, and Zhang, 2016). Therefore, external stimuli from industry IPOs would shape acquirers' attention and reduce their search costs. Acquirers lacking direct information regarding private ventures could then rely on information spillovers from the IPO market to inform their acquisition decisions.

Although prior research on the industry effects of IPOs has identified industry IPOs as a source of information that can have ramifications for IPO firms' rivals, it has not delved into the specifics of the information dissemination process (e.g., Akhigbe *et al.*, 2003; Hsu, Reed, and Rocholl, 2010; Lee *et al.*, 2011). It has also not considered how information receivers might vary in the benefits they obtain from the information produced from industry IPOs. In this paper, we aim to fill these research gaps, and our paper offers at least two specific contributions to the literature. First, our study builds upon and extends research on the role of information environments affecting firms' acquisition decisions (e.g., Schildt and Laamanen, 2006). This prior research suggests that firms' technological, geographic, and network domains will focus their acquisition search behavior. We suggest that information spillovers in the IPO market can extend firms' search and identification of private targets. Specifically, we investigate the particular diffusion mechanisms behind such information spillovers and show that information

about industry IPOs can reach out to potential acquirers through channels such as the media, research analysts, and capital markets (e.g., Zuckerman, 1999; Demers and Lewellen, 2003; Pollock and Rindova, 2003; Pollock and Gulati, 2007). Our arguments and findings therefore help explain how IPOs can facilitate acquisitions of other firms in an industry by relaxing the constraints of acquirers' information environments.

Second, we account for information receiver heterogeneity and propose that bidders outside the private ventures' industry would rely more on the information spillovers from industry IPOs. Even if information generated from industry IPOs generally can increase the visibility of private ventures and thus mitigate the adverse selection risk faced by potential acquirers, we suggest that acquirers diversifying from other industries are more likely to benefit from such information spillovers. Diversifying entrants are more likely to encounter difficulties in identifying and evaluating private targets' resources and prospects due to higher information asymmetry (e.g., Coff, 1999; Capron and Shen, 2007; Bergh, Ketchen, Orlandi, Heugens, and Boyd, 2019). Information intermediated as a consequence of IPOs also helps put technology ventures on these firms' radars to a greater extent. The fact that information spillovers have more pronounced effects on acquirers outside an industry provides another indication that the information intermediaries we study can broaden firms' search and identification of acquisition targets and relax the constraints of their information environments.

THEORY AND HYPOTHESES

Information Asymmetry and the Information Environment

The discovery of acquisition opportunities provides acquirers with the access to added resources and capabilities that can enable them to better serve existing markets or build business in new markets (e.g., Betton, Eckbo, and Thorburn, 2008; Haleblian, Devers, McNamara,

Carpenter, and Davison, 2009). However, the information asymmetry problem between exchange partners such as the acquirer and its potential targets (e.g., Reuer and Ragozzino, 2008) could cause several frictions in the M&A market. Information asymmetry in an acquisition context arises when the target possesses superior information about its resources and prospects relative to the acquirer (e.g., Bergh *et al.*, 2019). Acquirers searching for acquisition targets would face several significant difficulties in the identification and the evaluation of possible targets. For example, compared with public targets, acquirers might be less aware of private targets due to the lack of the publicly available information and thus have to incur higher search costs when locating such targets (e.g., Capron and Shen, 2007). As another example, when acquirers and targets operate in different industries, acquirers may not have the relevant knowledge and information regarding targets' markets and underlying capabilities (e.g., Balakrishnan and Koza, 1993; Coff, 1999), thereby constraining their ability to accurately assess targets' assets. Therefore, information asymmetry in an acquisition context can constrain acquirers' search and identification of growth opportunities and expose them to adverse selection risks (e.g., Stigler, 1961; Akerlof, 1970).

Prior studies have offered insights into how the information environment both constrains acquisition activity as well as can reveal information to potential acquirers that can channel acquisition investments. Schildt and Laamanen (2006) examine how the environmental contexts in which the acquirer and the target are situated would affect their acquisition likelihood. Specifically, they suggest that acquisitions are more likely to occur when the acquirer and the target have prior alliances together, possess similar technologies, and reside in the same country. Additionally, Castellaneta and Conti (2017) show that in environments where information about a target firm is less publicly available, acquirers could rely on their acquisition experience to

create more value from acquisitions by selecting proper targets. Taken together, it follows that the information environment shapes the targets that acquirers pursue. Along these lines, we would like to build on this work by examining how acquirers can extend their search for private targets by referring to information spillovers arising from the IPO market and the specific information intermediaries that channel information about IPOs.

Information Spillovers from IPOs

During and after the process of going public, IPO firms are subject to disclosure and regulatory requirements, and thus a substantial amount of information on their resources and growth prospects is disseminated through registrations, road shows, prospectuses, and public listings (e.g., Blowers, Griffith, and Milan, 1999). Since all of the information is closely scrutinized by stakeholders in the IPO market and beyond, it has an important bearing on the IPO firms' future prospects (e.g., Blowers *et al.*, 1999; Brau and Fawcett, 2006). Research has shown that information so produced can increase IPO firms' visibility and help attract potential investors, business partners, and customers (e.g., Pagano, Panetta, and Zingales, 1998; Demers and Lewellen, 2003: Draho, 2004; Pollock and Gulati, 2007). Thus, the informational effects of going public can have far-reaching consequences for the IPO firm's performance as well as its own corporate development activities.

Although IPOs can enhance the IPO firm's visibility and ability to acquire external resources, proprietary information about the firm and its industry also becomes publicly available, including business operations, post-IPO investment plans, and market prospects. Research has shown that IPOs in an industry can send a positive signal to potential investors regarding industry-specific resources and growth opportunities (e.g., Akhigbe *et al.*, 2003). As a result, potential investors can also pay attention to industry IPOs to gain access to information

regarding other firms directly competing with IPO firms, especially in growing and highly uncertain industries (e.g., Lee *et al.*, 2011).

Acquirers are particularly apt to update their information on an IPO firm's private rivals because these rivals share similar profiles with those of the IPO firms themselves, and because the lack of other information sources on private ventures would make such information spillovers more important to the assessment of their prospects. Acquisitions have become an important means by which acquirers can gain access to private ventures' critical resources for further growth (e.g., Bayar and Chemmanur, 2011; Gao, Ritter, and Zhu, 2013). However, due to the information asymmetry and search costs in the M&A market, acquirers usually find it difficult to identify and evaluate private targets such as IPO firms' rivals. We therefore expect that the information generated from the IPO market might help reduce a potential acquirer's search costs when locating acquisition targets (e.g., Stigler, 1961). Although the detailed interpretation of information generated at the industry level is difficult, IPO firms in the same industry often share some basic characteristics in common such as growth opportunities, and thus general market information can be obtained through the analysis of similar firms (e.g., Draho, 2004; Alti, 2005). It follows that acquirers could rely on information generated from industry IPOs when acquiring private targets (e.g., Aktas *et al.*, 2016). We thus offer the following as a baseline hypothesis:

Hypothesis 1: The hazard of an acquirer buying a private venture will be positively associated with the level of IPO activity in the private venture's industry.

Information Intermediaries Shaping the Effects of Industry IPOs

While recent research has established that IPOs facilitate acquisitions, it has not delved into the information dissemination process and the particular mechanisms involved (e.g., Akhigbe *et al.*, 2003; Lee *et al.*, 2011). However, the quantity and quality of information

disseminated from industry IPOs could also depend upon specific information diffusion mechanisms, and thus we attempt to understand the roles played by particular information intermediaries that may have a bearing on the information environments of potential acquirers. Although several information intermediaries can disseminate information produced by industry IPOs, we focus on those that are closely tied to the IPO process and represent different types of information diffusion mechanisms.

For instance, the media serves as the broadest and most widely-available information source (e.g., Bushee, Core, Guay, and Hamm, 2010), which could provide information and shape the public's knowledge about important events or issues in the environment (e.g., Deephouse, 2000). Analysts constitute another information intermediary that disseminates information on the growth opportunities of an industry (e.g., Arya and Mittendorf, 2007). Since analysts are experts specializing in specific industries, their coverage occurs when they are optimistic about a firm's post-IPO future prospects and its industry's underlying growth opportunities (e.g., Das, Guo, and Zhang, 2006). By contrast, IPO underpricing reflects the assessments made by the capital market during the process of price discovery, so it is associated with investors' perceptions of growth opportunities of a firm and its industry (e.g., Aktas *et al.*, 2016). Following these conceptual precedents, we therefore further decompose information spillovers from industry IPOs into three mechanisms: industry media coverage, industry analyst coverage, and industry IPO underpricing, and unpack their influences in the subsequent hypotheses.

Industry Media Coverage. The media plays an important role in disseminating information as investors rely on them as primary sources for firm information (e.g., Alvesson, 1990). Since media organizations compete to attract readers, information disseminated through the media not only reflects investors' demand for specific information, but also shapes investors'

attention to market events (e.g., Liu, Sherman, and Zhang, 2014). In particular, prior research has shown that media coverage could help improve firm performance by enhancing market awareness of the firm. For example, internet IPO firms associated with more media coverage during the IPO process would attract more post-IPO web traffic (e.g., Demers and Lewellen, 2003). In addition, media coverage could also allow IPO firms to raise more funding in the capital market (e.g., Pollok and Rindova, 2003; Liu *et al.*, 2014). It follows that information diffusion through media coverage can have far-reaching consequences across different market contexts.

The public attention generated by media coverage can be strengthened by the fact that media organizations may try to differentiate themselves from each other by focusing their coverage on selective issues, events, or actors (e.g., Hoffman and Ocasio, 2001). Therefore, the coverage of industry IPOs would increase the salience of industry growth opportunities and channel potential acquirers' attention toward other firms possessing similar prospects in the industry. As a consequence, acquirers may be better able to locate private ventures as acquisition targets. Inasmuch as industry media coverage can draw acquirers' attention to IPO firms' closely related peer firms, their likelihood of acquiring private ventures would be increased. As such, we posit:

Hypothesis 2: The hazard of an acquirer buying a private venture will be positively associated with the cumulative number of media mentions surrounding IPOs in the private venture's industry.

Industry Analyst Coverage. IPO firms' coverage by analysts also provides useful information to investors because analysts can mediate information flows between companies and create awareness and knowledge about firms. Analysts specialized in particular industries issue regular reports and forecasts on the quality and investment potential of firms they cover. There is

a cost of covering firms because analysts' incorrect forecasts or recommendations would damage their reputation and even jeopardize their job security (e.g., Mikhail, Walther, and Willis, 1999). Therefore, analysts are more likely to cover firms they expect to perform favorably (e.g., McNichols and O'Brien, 1997; Das *et al.*, 2006), and firms falling inside analysts' consideration set will not only be perceived of having attractive prospects but will also be more visible among investors for potential economic exchanges (e.g., Zuckerman, 1999).

In addition, analysts disseminate information about market and industry conditions (e.g., Arya and Mittendorf, 2007) that would attract broad market attention. Research in accounting suggests that analyst accuracy improves with their ability to identify the common industry component of each firm's news events (e.g., Clement, 1999; Jacob, Lys, and Neale, 1999), so the information about the market potential of an industry is reflected in analysts' forecasts (e.g., Piotroski and Roulstone, 2004). Since analysts initiate coverage of newly-public firms when they are optimistic about an IPO firm's future prospects and its industry's underlying growth opportunities (e.g., Das *et al.*, 2006), the analyst coverage garnered by industry IPOs generally indicates that there are attractive long-term prospects in the focal industry. Therefore, acquirers could rely on the information generated from analysts covering an industry's IPOs to assess other private ventures' growth prospects in the same industry. We therefore hypothesize:

Hypothesis 3: The hazard of an acquirer buying a private venture will be positively associated with the cumulative number of analysts following IPOs in the private venture's industry.

Industry IPO Underpricing. While information from industry IPO that is disseminated through the media and financial analysts is likely a valuable source of information on growth opportunities, information conveyed from the functioning of equity markets could also spill over to the M&A market and reduce the informational problems surrounding private ventures.

Specifically, we focus on the information property of IPO underpricing, which occurs when the initial offer price of an IPO is lower than the closing price at the first day of trading for the IPO. Prior work has noted that by discounting shares on the day of the IPO, firms have an opportunity to reveal the quality of their resources and prospects to outsiders (e.g., Allen and Faulhaber, 1989; Welch, 1989). Thus, firms with more growth opportunities can underprice their offerings to leave a good taste in investors' mouths, and the firms can recoup this offer price discount by receiving higher subsequent valuations when they return to the capital market.

Although prior research has focused primarily on the effects of underpricing on equity markets, the information effects of underpricing can be extended into other market contexts as well. For example, IPO firms underpricing their offerings can attract more alliance partners through greater market visibility (e.g., Pollock and Gualti, 2007), and industry IPO underpricing could facilitate acquisitions by revealing growth opportunities in the industry (e.g., Aktas *et al.*, 2016). To the extent that industry IPO underpricing conveys information that can extend to acquirers' search and identification of private ventures, we thus expect:

Hypothesis 4: The hazard of an acquirer buying a private venture will be positively associated with the aggregate magnitude of IPO underpricing in the private venture's industry.

Information Spillovers from IPOs within and across Industries

The foregoing hypotheses apply to all acquirers in general, but we also expect that the effects of information spillovers from industry IPOs will vary across different potential acquirers. Searching for potential exchange partners is costly, and this is even more so when there is more uncertainty regarding the identification and evaluation of exchange partners (e.g., Geertz, 1978). Evidence has shown that M&A markets involving private ventures are not efficient because of the challenges acquirers encounter in searching for and selecting such

targets, and the greater valuation uncertainty especially prevents acquirers from buying private targets outside of their core business (e.g., Capron and Shen, 2007). M&A research has also suggested that the industry overlap of companies serves as a key determinant of information costs in M&A transactions (e.g., Balakrishnan and Koza, 1993; Coff, 1999; Datar, Frankel, and Wolfson, 2001; Kohers and Ang, 2001). When the acquirer and the private target are from different industries, the acquirer without relevant information regarding potential targets would thus incur even higher information costs looking for acquisition targets (e.g., Stigler, 1961; Rangan, 2000). Since information spillovers generated from industry IPOs could mitigate the adverse selection risk faced by the acquirer, the acquirer would rely more on the information intermediaries to act on the information conveyed by industry IPOs. On the other hand, when the acquirer and the target are both in the same industry, the acquirer already faces a lower cost and risk in identifying and evaluating private ventures, so the marginal value of any information is diminished under such situation (e.g., Long, 2002). As a consequence, we expect that the information diffusion mechanisms we have considered will broaden the acquiring firms' search for targets and will be more consequential for diversifying entrants. The degree to which information intermediated as a consequence of IPOs loosens the constraints of acquirers' information environments, particularly for diversifying acquirers. Focus on diversifying versus non-diversifying acquirers therefore helps us identify the effects of information intermediation on the M&A market. We therefore posit:

Hypothesis 5: The positive relationship between the hazard of an acquirer buying a private venture and the level of IPO activity in its industry will be stronger for inter-industry acquisitions than for intra-industry acquisitions.

Hypothesis 6: The positive relationship between the hazard of an acquirer buying a private venture and the cumulative number of media mentions surrounding IPOs in its industry will be stronger for inter-industry acquisitions than for intra-industry acquisitions

Hypothesis 7: The positive relationship between the hazard of an acquirer buying a private venture and the cumulative number of analysts following IPOs in its industry will be stronger for inter-industry acquisitions than for intra-industry acquisitions

Hypothesis 8: The positive relationship between the hazard of an acquirer buying a private venture and the aggregate magnitude of IPO underpricing in its industry will be stronger for inter-industry acquisitions than for intra-industry acquisitions.

METHODS

Sample and Data

Our primary sources of data came from separate modules of the Refinitiv's Securities Data Corporation (SDC) database, which publishes information pertaining to firms' IPO activities, startup companies' financing, and mergers and acquisitions. We first constructed a sample of all IPOs conducted by U.S. firms from 1990 to 2000 using the information offered by the SDC New Issues database. Following previous IPO studies (e.g., Ritter, 1991; Pollock and Rindova, 2003), we excluded transactions involving real estate investment trusts (REITs), closed-end mutual funds, unit offerings, spin-offs, leveraged buyouts (LBOs), and offerings by firms in the financial services industry. To study the effect of industry IPOs' characteristics on the focal venture's hazard of being acquired, we first identified the private ventures by using the VentureXpert database, which offers comprehensive information on private firms that were venture-capital backed and has been used extensively in prior studies on startups (e.g., Katila, Rosenberger, and Eisenhardt, 2008; Park and Steensma, 2012). Prior research has shown that firms backed by venture capitalists are more likely to have innovative technologies as well as commercial products (e.g., Hellman and Puri, 2000), making them more comparable to their IPO counterparts. We then used VentureXpert's industry classification system, Venture Economics Industry Classification (VEIC), to categorize private ventures' businesses and recode them into

Fama-French 49 industry classifications according to Loughran and Shive's (2011) concordance table. Industry IPOs are thus defined as IPOs occurring in the same Fama-French industry as that of the focal venture. As a robustness check, we also employed alternative Fama-French industry classifications (i.e., Fama-French 38 and 48 industry classifications) and obtained qualitatively similar results as to those reported below. Finally, we traced the potential acquisition deals involving these private ventures from 1991 to 2001 by using VentureXpert's Mergers and Acquisitions database. We excluded other corporate restructuring transactions and deals such spinoffs, carveouts, recapitalizations, self-tenders, exchange offers, buybacks, and acquisitions of remaining interests in targets. After these procedures were implemented, we identified a total of 1,584 private ventures associated with 5,350 yearly spells in total, which comprised our final sample.

Statistical Model

We used hazard models to test the hazard of an acquirer buying a private venture following IPOs in the venture's industry. Hazard models are designed to investigate the determinants of an event's occurrence as well as competing events, or risks, correcting for the effects of censoring. Specifically, we employed Cox's (1972) proportional hazard model to test our hypotheses, which does not require the functional form of time dependence to be specified. The Cox model assumes the hazard at different levels of an independent variable is proportional to an unspecified baseline function. Following Allison (1995), we examined the Schoenfeld residuals on functions of time to check the proportionality assumption. For each variable examined, we found no evidence that our specification violates the proportional hazard assumption. In this study, the dependent variable is a hazard rate indicating the likelihood that a

private venture will become an M&A target. The Cox hazard regression model is specified as follows:

$$h\,(t|\mathbf{x}_j) = h_0\,(t)\,\exp\,(\mathbf{x}_j\,\boldsymbol{\beta}_x),$$

where $h\,(t|x_j)$ is the hazard function (i.e., the rate of acquisition) at time t, $h_0\,(t)$ is the baseline hazard function, $\boldsymbol{\beta}_x$ are the estimated regression weights, and $\mathbf{x}_j$ are the explanatory variables. The coefficients were estimated using partial likelihood estimation. Multiple yearly spells for the same private venture may create correlations between the error structure and the independent variables, thereby leading to the underestimation of the standard errors. In the results reported below, we thus estimated all models with robust standard errors proposed by Lin and Wei (1989).

Variables

Dependent Variable. Our first dependent variable, *M&A Event*, represents whether or not the private venture became an M&A target. Private ventures that were still operating independently without being acquired at the end of the sample period were treated as right censored. To avoid the loss of timing information, we incorporated competing risks by treating other events such as initial public offering and "living dead" (i.e., startups that fail to produce attractive investment returns for VCs and thus did not receive further VC investments for more than seven years; see Ruhnka, Feldman, and Dean, 1992) as distinct events removing the venture from the risk set (Cox and Oakes, 1984). We also examined whether or not the acquirer is from the same industry as the private firm based on Fama-French industry classifications and treated inter-industry acquisitions (i.e., *Inter-Industry M&A Event*) and intra-industry acquisitions (i.e., *Intra-Industry M&A Event*) as competing risks, respectively. Within our sample of the total 703

M&A events, the number of the inter-industry deals is 258, whereas the number of the intra-industry transactions is 445.

Independent Variables. Our first independent variable is the IPO activity in an industry. IPOs can generate information about the firms' prospects and industry growth opportunities to their potential investors (e.g., Jain and Kini, 2006), which could enhance the visibility of private ventures in the same industry and thus their hazard of being acquired (e.g., Aktas *et al.*, 2016). We used the SDC database to track an industry's IPO activity and accumulated the number of industry IPOs that occurred one year prior to each time spell. To address the skewness of this variable, we took the log of the number of IPOs plus one to construct this measure (i.e., *Industry IPO Activity*).

To further examine the mechanisms of information spillovers from industry IPOs, our second theoretical variable is the media coverage associated with industry IPOs that occurred one year prior to each time spell, which reflects market attention to growth prospects in an industry during the IPO process. Following prior research (e.g., Demers and Lewellen, 2003; Pollock, Rindova, and Maggiti, 2008), we counted the number of newspaper articles mentioning each industry IPO from major newspapers available on Lexis-Nexis from one month before each industry IPO to three months after. Results are robust to alternative measures based on different time windows (e.g., from two months before each industry IPO to two months after). Since the deal size of each industry IPO varies, we took value-weighted averages based on IPO proceeds (i.e., industry-level proceeds scaled by whole market proceeds in each year). The log transformation of media coverage variable was also used in the analysis to account for its skewness (i.e., *Industry Media Coverage*).

Our third theoretical variable is the number of analysts following industry IPOs in the post-IPO period, which could also enhance potential investors' perception of the future prospects regarding an industry (e.g., Arya and Mittendorf, 2007). To measure industry IPOs' analyst coverage in one year prior to each time spell, we used data from the Institutional Brokers Estimate System (I/B/E/S) to count the industry weighted average number of analysts who provide earnings forecasts of the IPO firms within one year after their IPOs. Due to skewness that was evident for this variable, we used the log of the number of analysts plus one to define the variable *Industry Analyst Coverage*, and we followed prior research in assuming firms not covered by I/B/E/S have no analyst coverage (e.g., Jensen, 2004).

Finally, high initial returns at the time of industry IPOs are related to industry growth opportunities and can enhance the visibility of private ventures in the industry (e.g., Aktas *et al.*, 2016). Thus, our final theoretical variable is the weighted average of industry IPOs' initial returns, which was measured as the percentage difference between each IPO firm's first day closing price and its offer price (i.e., *Industry IPO Underpricing*). Data for this measure were assembled from the SDC database.

Controls. We incorporated a number of control variables capturing other characteristics of private ventures as well as their industries to account for other factors that might be related to the above theoretical variables or the hazard of private ventures being acquired. At the private venture level, we first considered its age, as the uncertainty associated with a venture decreases as it ages (e.g., Davila *et al.*, 2003), and more information is available for potential acquirers to judge the venture's history of operations. However, organizational inertia can also increase with age, which makes it more difficult for the acquirers to integrate and exploit a venture's resources and capabilities (e.g., Ransbotham and Mitra, 2010). We measured *Firm Age* by accumulating

the number of years from the venture's founding date to each time spell. Since many firms lack valid founding dates in VentueXpert, we followed Sorenson and Stuart (2001) and assigned a founding date to those firms as one year prior to the first investment date recorded by VentureXpert. Second, *Early Development Stage* indicates whether the venture is at the startup/seed or early stage in VentureXpert's classification, as the early developmental stage of a technology venture involves a short track record and thus less available information for potential acquirers to assess the venture's resources (e.g., Sorenson and Stuart, 2001; Guler, 2007; Li and Mahoney, 2011). Third, we controlled for *Number of Rounds* by tracking the number of financing rounds that a private venture has received by each time spell. Since venture capitalists are very selective in choosing companies for investments (e.g., Megginson and Weiss, 1991), they conduct due diligence over time to assess a venture's progress before making additional round of investment (e.g., Guler, 2007; Li, 2008). Thus, ventures going through multiple VC funding rounds are perceived to have less valuation uncertainty and thus are more likely to be acquired. Data for this variable were collected from the VentureXpert database. Fourth, we included *Venture Capitalist Funding* by taking the logarithms of the cumulative amount of venture capital financing received by a private venture by each time spell, using data from the VentureXpert database. Since ventures' survival and growth depend upon their access to financial capital (e.g., Evans and Jovanovic, 1989), especially when they are extensively involved in R&D activity, acquisitions might be viewed as one large financing round (e.g., Gompers, 1995), and thus ventures facing financial constraints would find M&A offers attractive for further growth (e.g., Ransbotham and Mitra, 2010).

We also incorporated controls for potential differences in M&A activity across industries and time. We included *Industry Tobin's Q* as a proxy for industry investment opportunities (e.g.,

Servaes, 1991; Jovanovic and Rousseau, 2002), which was measured as the industry average of the sum of book value of long-term debt and market value of equity, divided by the book value of firms' assets at each time spell. In addition, as the industry profitability would also affect new market entry through acquisitions, we calculated industry average return on equity (i.e., firms' net income divided by their total equity) and controlled for *Industry Profitability* (e.g., Berger, Bonime, Goldberg, and White, 2004). Data for the above two variables were collected from Compustat. Additionally, we included a series of industry fixed effects to account for heterogeneity in resources, prospects and other factors across industries. Finally, we controlled for *Year Fixed Effects* to account for the potential influence of economy-wide factors.

RESULTS

Table 1 presents the descriptive statistics and correlations for all the variables in the analyses. Overall, forty-four percent of private ventures in our sample were acquired (i.e., 703 M&A deals out of 1,584 private ventures). Industry IPO firms, on average, were followed by two analysts after going public, and obtained roughly seventeen media mentions. Private ventures on average have operated for about five years since founding and have gone through three VC funding rounds. We also noted several interesting relationships among the variables. For instance, industries with more investment opportunities (i.e., Tobin's Q) are more likely to be associated with the activity of industry IPOs ($p<0.001$), followed by more financial analysts ($p<0.001$), and underprice more ($p<0.001$). There are no particularly high correlations among independent variables, and an investigation of the variance inflation factors suggested that multicollinearity is not a concern for model estimations (i.e., the maximum is 4.37).

Insert Table 1 about here

Table 2 presents the results from the event history analysis conducted to examine how industry IPOs and particular information intermediaries shape the hazard of an acquirer buying a private venture. Model 1 is a baseline specification comprising the control variables. Model 2 augments Model 1 by adding the variable for industry IPO activity, and an increase in explanatory power is evidenced by the likelihood ratio test (χ^2=52.21, p<0.001). Models 3, 4, and 5 add industry media coverage, industry analyst coverage, and industry IPO underpricing variables, respectively. Model 6 is the full model incorporating all of the information diffusion channel variables and control variables. All of baseline and full models are highly significant (p<0.001), and compared to Model 1, Models 3, 4, 5, and 6 all exhibit significant improvement over the baseline specification (i.e., χ^2=44.68, p<0.001; χ^2=28.65, p<0.001; χ^2=40.89, p<0.001; and χ^2=56.62, p<0.001, respectively).

Insert Table 2 about here

Hypothesis 1 proposes that a greater level of IPO activity in an industry increases the hazard of an acquire buying a private venture in that industry. In Table 2, the coefficient for industry IPO activity is positive and significant (p<0.001), providing support for Hypothesis 1. An increase of one standard deviation in the industry IPO activity from its mean level leads to a 74 percent increase in the hazard of the private venture being acquired. This result is consistent with the argument that IPO events can reveal information on the prospects of an industry, thereby enhancing the acquirer's hazard of acquiring a private venture following industry IPOs.

To further discern the effects of specific information diffusion mechanisms stemming from industry IPOs, we introduce three theoretical variables, including industry media coverage, industry analyst coverage, and industry IPO underpricing. Specifically, Hypothesis 2 suggests

that information generated by media coverage during industry IPOs can facilitate potential acquirers' search for and recognition of private ventures. In support of Hypothesis 2, the industry media coverage variable is positive and very significant in Models 3 and 6 (both $p<0.001$). Specifically, an increase of one standard deviation in the industry media coverage from its mean level leads to a 34 percent increase in the hazard of the private venture being acquired.

In a parallel fashion, Hypothesis 3 predicts that the number of analysts following industry IPOs also conveys industry-relevant information that reflect industry growth potential and prospects, thereby drawing acquirers' attention to the private venture. We find that the coefficient of the industry analyst coverage variable to be positive and significant in Model 4 ($p<0.001$), but insignificant in Model 6. The partial support for Hypothesis 3 may result from the fact that analysts may have different incentives in producing firm-specific information and industry-specific information (e.g., Piotroski and Roulstone, 2004; Liu, 2011), and thus potential acquirers' attention to industry analyst coverage may vary accordingly.

Hypothesis 4 posits that industry IPO underpricing is also a reflection of industry growth opportunities, and thus will also direct acquirers' attention to private ventures. As shown in Models 5 and 6, the coefficient of the industry IPO underpricing variable is positive and highly significant (both $p<0.001$), so Hypothesis 4 is supported. Specifically, an increase of one standard deviation in the industry IPO underpricing from its mean level leads to a 31 percent increase in the hazard of the private venture being acquired.

To better understand what acquirers are more likely to attend to information spillovers arising from industry IPOs, we distinguish whether or not the acquirer and the private venture are within the same industry. Hypotheses 5 to 8 suggest that information produced by industry IPO activity in general and information disseminated by industry media coverage, industry analyst

coverage, and industry IPO underpricing in particular will be more likely to facilitate inter-industry acquisitions than acquisitions within an industry. For the testing of these hypotheses, we split the acquisition hazard into two competing risks and reran the analyses. In Table 3, Models 1 to 5 show results of the Cox regression for acquisition hazards involving acquirers from outside the private venture's industry, and the same equations were estimated in Table 4 for acquisition hazards involving acquirers from within the focal venture's industry. Consistent with Hypotheses 5 to 8, the coefficients of industry IPO activity, industry media coverage, industry analyst coverage, and industry IPO underpricing are larger for inter-industry acquisition deals than for intra-industry ones. Then, we compare individual coefficients' difference in competing risk model estimations (e.g., Allison, 2010). Specifically, the coefficient for industry IPO activity in inter-industry acquisitions is significantly higher than that in intra-industry acquisitions (i.e., χ^2=5.417, p=0.020, in Model 1). Further, the coefficients between inter-industry and intra-industry acquisitions are also compared for industry media coverage (i.e., χ^2=3.845, p=0.050, in Model 2; χ^2=2.325, p=0.127, in Model 5), industry analyst coverage (i.e., χ^2=5.775, p=0.016, in Model 3; χ^2=4.813, p=0.028, in Model 5), and industry IPO underpricing (i.e., χ^2=6.225, p=0.013, in Model 3; χ^2=3.968, p=0.046, in Model 5). Thus, except for Hypothesis 6, we have sufficient statistical justification for concluding that information spillovers generated from industry IPO activity, and especially such spillovers through information intermediaries such as industry analyst coverage and industry IPO underpricing are more pronounced for inter-industry acquisitions, thereby offering support for Hypotheses 5, 7, and 8 respectively. And the partial support for Hypothesis 6 may suggest that information revealed by industry media coverage, to some extent, is important both for acquirers within and outside the private venture's industry.

Insert Tables 3 and 4 here

We also observed several noteworthy results for the control variables. First, an acquirer's hazard of buying a private venture declines as the venture gets older (i.e., $p<0.01$ in Table 2), potentially because younger private targets are easier to integrate after acquisitions (c.f., Capron and Shen, 2007; Ransbotham and Mitra, 2010). Second, acquirers are more likely to acquire ventures situated in industries with higher Tobin's Q and higher profitability (i.e., $p<0.001$ and $p<0.05$ respectively in Tables 2), as ventures within such industries are often associated with more growth opportunities (e.g., Jovanovic and Rousseau, 2002; Berger *et al.*, 2004). Third, consistent with the financial constraints argument (e.g., Ransbotham and Mitra, 2010), acquirers will be less likely to acquire private ventures that have better abilities of raising capital from VCs (i.e., $p<0.10$). Finally, year fixed effects are jointly significant in all of the models, indicating the relevance of economy-wide factors in affecting the occurrence of acquisitions.

DISCUSSION

Contributions and Implications

In this study, we examine whether the greater number of IPOs in an industry can increase acquisitions of IPO firms' private rivals by reducing informational frictions in the target selection process and thereby relax some of the constraints of acquiring firms' information environments. The core idea is that as more firms publicly disclose information in an industry during the IPO process, a more complete picture of the growth opportunities for the industry emerges, and thus such information spillovers can be used by potential acquirers to identify and evaluate private ventures as acquisition targets. Our study therefore contributes to the understanding of the important role played by the information environment surrounding

acquisitions (e.g., Schildt and Laamanen, 2006; Castellaneta and Conti, 2017) by illustrating that the information spillovers produced by industry IPOs could extend acquirers' search for private targets. The information environment refers to the quality and quantity of information produced by related firms and by information intermediaries (e.g., Shroff, Verdi, and Yu, 2014). A lack of observable means through which information can be disseminated would become a strategic barrier leading to information asymmetry (e.g., Bergh *et al.*, 2019). To the extent that various information intermediaries may represent different ways information from industry IPOs are disseminated, our study also provides insights into the particular mechanisms through which acquirers obtain relevant information for carrying out acquisitions. Specifically, we find that acquirers are more likely to acquire private ventures within the industry where IPOs occurred when industry IPOs are associated with more media coverage, more analyst coverage, and higher IPO underpricing.

Therefore, our findings reveal that even though firms are limited contextually in their search for market information (e.g., Rosenkopf and Almeida, 2003), they may reach beyond their local contexts and use the information disseminated by information intermediaries surrounding industry IPOs to search for and evaluate private ventures as acquisition targets. We thus complement prior M&A research on information environments (e.g., Schildt and Laamanen, 2006) by suggesting that acquirers could also refer to the IPO market and particularly the information disseminated through information intermediaries to locate private targets. Collectively, these information intermediation mechanisms shape the information environment of potential acquirers and facilitate acquisitions.

Furthermore, connecting with recent research on information asymmetry (e.g., Bergh *et al*, 2019), our study also adds to the literature on the information environment by highlighting

the role of acquirer heterogeneity in information spillovers. Prior research has suggested that information asymmetry increases when the industry relatedness between the acquirer and the target decreases (e.g., Balakrishnan and Koza, 1993; Coff, 1999; Datar *et al.*, 2001; Kohers *et al.*, 2001). The comparison across related and unrelated acquisitions in our study reveals that the informational effect of industry IPOs is stronger when the acquirer comes from outside the private venture's industry. It follows that information spillovers in the IPO market become even more salient when the acquirer is less familiar with the private venture's industry. Our arguments and findings thus are consistent with the core idea that information spillovers channeled through the diffusion mechanisms we study can broaden the acquirer's search for targets outside of its immediate information environment (e.g., Schildt and Laamanen, 2006). We also answer the call for the specific consideration of information environments in diversifying acquisitions (Schildt and Laamanen, 2006: p128). Thus, our study highlights an important contingency shaping the heterogeneous effects of the information diffusion mechanisms we study.

Limitations and Future Research Directions

In addition to investigating the avenues for future research already noted, extensions might also address a number of limitations of our study. First, our empirical analyses focus on acquisitions of private ventures that are VC backed and operate in the US. Future research can therefore investigate the generalizability of our findings by studying the acquisition likelihood of more established firms, non-VC backed startups, or firms in other countries. For example, information spillover considerations might be especially relevant for private ventures without VC backing as such firms tend to have greater valuation uncertainty and inferior access to external capital and resources. In addition, IPO firms may engage in international expansion after going public to exploit growth opportunities and secure new resources. Therefore, it might also

be interesting to investigate the consequences of IPO firms' internationalization for their domestic and foreign rivals (e.g., Certo, Holcomb, and Holmes, 2009).

Second, our theory emphasizes how the information intermediated after IPOs can be particularly important for diversifying acquirers. Future studies might investigate other factors that shape information spillovers and the role of information intermediaries in enabling acquirers to search more broadly than the constraints imposed by their immediate information environment. For example, when a venture's potential acquirers themselves can directly access privileged information regarding the venture's resources and prospects through their own network ties, their adverse selection risk is reduced, and this could also make the information generated from industry IPOs matter less compared to cases in which acquirers and targets have no ties. Research in directions such as this might prove useful as management scholars applying the information spillovers perspective can explore other contingencies shaping the effects of industry IPOs.

Finally, our study has relied upon secondary data to identify factors that can help address the problem of adverse selection and facilitate acquisitions of private ventures. However, we are not able to measure directly the information costs or observe the underlying search process in which firms engage. It would therefore be valuable in future research to measure the search costs borne by the transacting parties and examine how such costs affect their M&A decisions. Moreover, such studies can also enable researchers to investigate the other means that acquirers employ to locate attractive private ventures, such as channels through interpersonal relationships, prior employment relations, consultants, and so on. Field research or survey methods may offer attractive opportunities to explore these issues.

CONCLUSION

Our study builds upon ideas on the information environment surrounding M&A to argue that information spillovers from industry IPOs could help acquirers identify and evaluate private ventures in that industry. Consistent with this argument, we provide empirical evidence that the level of IPO activity in the private venture's industry increases acquirers' likelihood of buying private ventures. Further analysis suggests that acquirers can benefit from information intermediated by the media, financial analysts, and the operation of capital markets themselves (i.e., IPO underpricing). The fact that the effects of these information diffusion mechanisms are even more pronounced for diversifying entrants suggests how information spillovers are important in enabling acquirers to extend their search and identification of acquisition targets. Our study therefore also contributes to existing research on the industry effects of IPOs by unpacking particular information channels that contribute to acquirers' deals involving private ventures.

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TABLE 1
Descriptive Statistics and Correlation Matrix [a]

Variables	Mean	S. D.	1	2	3	4	5	6	7	8	9	10
1. M&A Event	0.13	0.34	--									
2. Industry IPO Activity	35.56	42.64	0.059***	--								
3. Industry Media Coverage	16.78	21.51	0.036**	0.294***	--							
4. Industry Analyst Coverage	2.66	1.72	0.095***	0.406***	0.427***	--						
5. Industry Underpricing	0.42	0.48	0.056***	0.486***	0.368***	0.481***	--					
6. Firm Age	5.48	5.85	0.046***	-0.161***	-0.072***	-0.139***	-0.145***	--				
7. Early Development Stage	0.43	0.49	-0.070***	0.109***	0.072***	0.104***	0.098***	-0.305***	--			
8. Number of Rounds	2.66	2.14	0.102***	-0.166***	-0.101***	-0.183***	-0.179***	0.279***	-0.400***	--		
9. Venture Capitalist Funding (log)	0.08	0.10	0.052***	0.200***	0.067***	0.217***	0.243***	-0.009	-0.275***	0.336***	--	
10. Industry Tobin's Q	6.13	4.69	0.047***	0.414***	0.223***	0.413***	0.520***	-0.150***	0.087***	-0.157***	0.266***	--
11. Industry Profitability	0.04	1.31	0.022	-0.144***	-0.053***	-0.129***	-0.174***	0.018	0.003	0.036**	-0.030*	-0.154***

[a] N=5350. † p<0.10, * p<0.05, ** p<0.01, *** p<0.001.

TABLE 2
Cox Regression Results [a]

Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Year Fixed Effects	Included	Included	Included	Included	Included	Included
Industry Fixed Effects	Included	Included	Included	Included	Included	Included
Firm Age	-0.035** (0.011)	-0.034** (0.012)	-0.035** (0.012)	-0.036** (0.012)	-0.037** (0.012)	-0.037** (0.012)
Early Development Stage	0.116 (0.084)	0.097 (0.084)	0.115 (0.084)	0.099 (0.084)	0.095 (0.084)	0.103 (0.084)
Number of Rounds	-0.045* (0.020)	-0.034 (0.021)	-0.031 (0.020)	-0.030 (0.021)	-0.036† (0.020)	-0.030 (0.020)
Venture Capitalist Funding	-0.405 (0.419)	-0.784† (0.428)	-0.713† (0.423)	-0.725† (0.429)	-0.728† (0.428)	-0.813† (0.426)
Industry Tobin's Q	0.074*** (0.008)	0.012 (0.015)	0.045*** (0.011)	0.043*** (0.011)	0.060*** (0.010)	0.043*** (0.012)
Industry Profitability	0.054 (0.053)	0.082 (0.057)	0.095† (0.054)	0.097† (0.051)	0.091† (0.050)	0.105* (0.052)
Industry IPO Activity		0.325*** (0.048)				
Industry Media Coverage			0.310*** (0.046)			0.216*** (0.065)
Industry Analyst Coverage				0.556*** (0.102)		0.009 (0.150)
Industry IPO Underpricing					0.823*** (0.127)	0.540*** (0.157)
χ^2	203.50***	249.01***	238.50***	226.90***	243.88***	243.67***
Log likelihood, $L(\boldsymbol{\beta})$	-4160.20	-4134.09	-4137.86	-4145.88	-4139.76	-4131.89
$-2[L(\boldsymbol{\beta}_{baseline}) - L(\boldsymbol{\beta}_i)] \sim \chi^2$		52.21***	44.68***	28.65***	40.89***	56.62***

[a] N=5,350. Robust standard errors appear in parentheses. † p<0.10, * p<0.05, ** p<0.01, *** p<0.001.

TABLE 3
Cox Regression Results for Inter-Industry M&As [a]

Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Year Fixed Effects	Included	Included	Included	Included	Included
Industry Fixed Effects	Included	Included	Included	Included	Included
Firm Age	-0.013 (0.016)	-0.013 (0.015)	-0.016 (0.015)	-0.015 (0.014)	-0.023 (0.014)
Early Development Stage	-0.044 (0.163)	-0.025 (0.162)	-0.086 (0.159)	-0.095 (0.158)	-0.063 (0.162)
Number of Rounds	-0.006 (0.028)	-0.005 (0.028)	-0.010 (0.028)	-0.027 (0.027)	0.008 (0.028)
Venture Capitalist Funding	-0.094 (0.606)	0.143 (0.603)	0.074 (0.616)	0.120 (0.621)	-0.490 (0.643)
Industry Tobin's Q	0.012 (0.026)	0.084*** (0.016)	0.078*** (0.017)	0.098*** (0.016)	0.032 (0.020)
Industry Profitability	0.138† (0.076)	0.053 (0.080)	0.163* (0.080)	0.132 (0.081)	0.082 (0.069)
Industry IPO Activity	0.473*** (0.078)				
Industry Media Coverage		0.394*** (0.065)			0.343*** (0.094)
Industry Analyst Coverage			0.841*** (0.168)		0.627* (0.245)
Industry IPO Underpricing				1.106*** (0.178)	0.822*** (0.189)
χ^2	165.69***	152.32***	154.99***	157.15***	160.39***
Log likelihood, $L(\boldsymbol{\beta})$	-1335.06	-1337.72	-1343.38	-1341.57	-1324.43

[a] N=5,350. Robust standard errors appear in parentheses. † p<0.10, * p<0.05, ** p<0.01, *** p<0.001.

TABLE 4
Cox Regression Results for Intra-Industry M&As [a]

Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Year Fixed Effects	Included	Included	Included	Included	Included
Industry Fixed Effects	Included	Included	Included	Included	Included
Firm Age	-0.050** (0.015)	-0.051** (0.015)	-0.051*** (0.015)	-0.054*** (0.016)	-0.055*** (0.016)
Early Development Stage	0.089 (0.105)	0.099 (0.106)	0.093 (0.105)	0.103 (0.106)	0.104 (0.106)
Number of Rounds	-0.078* (0.036)	-0.083* (0.036)	-0.077* (0.036)	-0.072* (0.036)	-0.070* (0.035)
Venture Capitalist Funding	-1.115† (0.623)	-0.982 (0.619)	-1.045† (0.620)	-1.102† (0.629)	-1.295* (0.640)
Industry Tobin's Q	0.002 (0.019)	0.027* (0.014)	0.033* (0.014)	0.044*** (0.012)	0.019 (0.014)
Industry Profitability	0.075 (0.069)	0.089 (0.066)	0.080 (0.063)	0.010 (0.040)	0.083 (0.064)
Industry IPO Activity	0.247*** (0.057)				
Industry Media Coverage		0.224*** (0.057)			0.167* (0.067)
Industry Analyst Coverage			0.342** (0.122)		-0.021 (0.165)
Industry IPO Underpricing				0.522*** (0.152)	0.330* (0.159)
χ^2	117.23***	111.68***	105.41***	118.09***	115.96***
Log likelihood, $L(\boldsymbol{\beta})$	-2800.29	-2814.53	-2822.69	-2818.45	-2806.62

[a] N=5,350. Robust standard errors appear in parentheses. † p<0.10, * p<0.05, ** p<0.01, *** p<0.001.