**Journal of International Business Studies (2014) 45,** 321–337

www.jibs.net

# Signals and international alliance formation: The roles of affiliations and international activities

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**Abstract**
This paper extends signaling theory to the study of firms' international alliances. Signals can be valuable in facilitating these collaborations because they reduce the risk of adverse selection surrounding cross-border partnerships. We specifically investigate whether firms' affiliations with prominent financial intermediaries enable the formation of international collaborative agreements. We also argue and find that the signaling benefits of these affiliations diminish with the firm's engagement in international activities, which can function as alternative signals by which firms convey the quality of their resources and prospects. Examining firms' cross-border activities helps to identify new and important signals that are unique to the international setting. Moreover, this also helps contextualize prior theory and findings that exist in the domestic setting on the effects of affiliations with financial intermediaries such as venture capitalists and investment banks. We conclude that signaling theory offers a promising addition to existing theories of international alliances and other cross-border activities. We contrast some of the main arguments and predications of signaling theory with other theories used in international business, and we emphasize the research opportunities that exist for employing this perspective in international business studies in the future.
*Journal of International Business Studies* (2014) **45,** 321–337. doi:10.1057/jibs.2014.3

**Keywords:** signaling theory; strategic alliances; initial public offerings (IPOs); venture capital

## INTRODUCTION

Firms employ international alliances to leverage their resources as well as access other partners' capabilities to pursue growth opportunities in new geographic markets (e.g., Cuypers & Martin, 2010; Garrette, Castañer, & Dussauge, 2009; Gomes-Casseres, Hagedoorn, & Jaffe, 2006; Kogut, 1988; Lavie & Miller, 2008; Tallman & Phene, 2007). International alliances also present many unique challenges to firms, and academic research has used different theoretical perspectives to study the risks posed by collaborative agreements and the remedies firms might employ. For instance, studies relying upon transaction cost economics, internalization theory, and the OLI paradigm have emphasized the knowledge appropriation problems and other *ex post* hazards that partners contend with during the implementation of cross-border partnerships (e.g., Beamish & Lupton, 2009; Brouthers & Hennart, 2007; Buckley & Casson, 1976; Caves, 1996; Dunning, 1995; Gatignon & Anderson, 1988; Hennart, 1989).

**Received: 28 August 2012**
**Revised: 2 November 2013**
**Accepted: 10 November 2013**
**Online publication date: 27 February 2014**

Among the many theories within economics and other disciplinary traditions that scholars can draw upon to study international alliances, signaling theory has received comparatively little attention in international business. This stands in contrast with the theory's growing development and recent applications in fields such as financial economics, strategic management, and entrepreneurship (e.g., Connelly, Certo, Ireland, & Reutzel, 2011). For example, signaling theory has been useful in advancing understanding of different corporate development activities such as acquisitions, initial public offerings, venture capital financing, and strategic alliances, among others (Certo, 2003; Chang, 2004; Gulati & Higgins, 2003; Hsu, 2006; Levitas & McFadyen, 2009; Nicholson, Danzon, & McCullough, 2005; Pollock & Gulati, 2007; Reuer & Ragozzino, 2012). This research emphasizes that asymmetric information across exchange partners creates the risk of adverse selection, and this *ex ante* exchange hazard can hinder valuable transactions from occurring in the first place (Akerlof, 1970), unless certain remedial mechanisms such as signals are available. Signals are actions by firms that are positively related to their unobservable characteristics such as their underlying capabilities and future prospects, and these actions are costly for firms of lower quality to duplicate (e.g., Spence, 1974). For example, privately held firms and new ventures that have not developed a track record can secure governmental subsidies to export (Bagwell & Staiger, 1989), initiate overseas operations (e.g., Katayama & Miyagiwa, 2009; Shaver, 2011), or seek to differentiate themselves by some other means to convey their underlying quality and attract exchange partners in product and factor markets (Riley, 2001).

While research has not used signaling theory to understand international alliance formation, one would expect signals to be particularly valuable for such transactions because information asymmetries and the risk of adverse selection are significant in the international context. Foreign firms often face information disadvantages compared with their domestic counterparts for several reasons (e.g., Huberman, 2001; Ke, Ng, & Wang, 2010; Tallman & Phene, 2007; Xu, Zhou, & Phan, 2010). To begin with, foreign firms have inferior information about local market opportunities, organizations, and cultures, all of which contribute to a liability of foreignness during partner selection and negotiations (e.g., Hymer, 1976; Zaheer, 1995). Moreover, information asymmetry tends to increase with geographic distance (Bae, Stulz, & Tan, 2008; Garmaise & Moskowitz, 2004; Malhotra & Gaur, 2014) and foreign transactions often involve distant partners. A lack of information institutions can compound the problems associated with foreign firms' unfamiliarity with local organizations and market conditions (e.g., Ahuja & Yayavaram, 2011; Jandik & Kali, 2009). Despite the expected value of signals for international alliances, however, it is also possible that prospective exchange partners might attend to signals less in cross-border contexts. Like other types of information, signals might not travel efficiently across countries due to firms' tendency to attend to proximate organizations and the information available through local interactions and relationships (e.g., Rangan, 2000). Given this potential tension between the value and usage of signals for cross-border activities, we wish to empirically examine whether signals indeed facilitate international alliances. We also wish to investigate conditions under which certain signals are more or less valuable for international alliance formation.

In this paper, we study whether signals stemming from newly public firms' affiliations with reputable investment banks and prominent venture capitalists (VCs) enable firms to establish collaborative agreements with international partners. Research using signaling theory has argued and shown that these affiliations are relevant for newly public firms seeking domestic exchange partners (e.g., Brau, Sutton, & Hatch, 2010; Chang, 2004; Gulati & Higgins, 2003; Hsu, 2006; Pollock & Gulati, 2007; Stuart, Hoang, & Hybels, 1999), but this research has not considered whether these signals can also be beneficial in the international setting in general and with respect to international alliances in particular. Given the uncertainty surrounding international alliance formation discussed above, these signals can potentially reduce the market frictions that otherwise hinder international transactions such as collaborative agreements (e.g., Dikova, Sahib, & Witteloostuijn, 2009; Ke et al., 2010).

Our study offers three contributions to the international business literature. First, we highlight signaling theory as a useful complement to other theories that have been used to investigate international alliance formation. As one example, theories rooted in organizational economics (e.g., internationalization theory and the OLI paradigm) highlight the *ex post* exchange hazards that arise at the contract execution stage, and this research emphasizes that firms can address market failures by internalizing transactions if formal and informal governance mechanisms are inadequate. By contrast, signaling

theory emphasizes that information signals ameliorate the risk of adverse selection, which is an *ex ante* exchange hazard surrounding partner selection and negotiation that also contributes to market failures. Thus signaling theory offers a valuable addition not only to the literature on international alliances, but also potentially to research on a wide variety of international corporate activities and cross-border exchanges in different factor and product markets. Second, we extend prior research on the benefits of affiliating with prominent financial intermediaries (i.e., VCs and investment banks) to the international context. Our arguments and findings contribute to research in this stream by identifying the formation of international alliances as a benefit of such affiliations. Third, beyond testing whether or not these affiliations matter in the international context, we also contextualize previous theory in this research stream by identifying other signals associated with the firm's international activities that can also reduce the risk of adverse selection and thereby diminish the effects of firms' affiliations. Given the heterogeneity of signals available to firms in the international context, it is important to gauge the extent to which alternative signals might offer similar benefits to newly public firms and the conditions under which specific signals matter.

## THEORY AND HYPOTHESES

### Background Theory

International alliances provide a fertile context in which to investigate signaling theory because of the information asymmetries and risk of adverse selection that attend cross-border transactions. The problems related to the presence of asymmetric information between exchange partners have been widely documented in the broad business and economics literatures. For instance, evidence exists that when information asymmetry exists, unless appropriate remedies are put in place, transactions may fail to occur or firms may not obtain the intended gains from their exchanges (e.g., Dewally & Ederington, 2006; Garmaise & Moskowitz, 2004; Hsu, 2006; Nicholson et al., 2005). In the international business context, links between cross-border exchanges and information asymmetry can be found in the early work of Hymer (1976), who discussed the gaps in knowledge about local opportunities, markets, culture, etc., between domestic and foreign firms. Zaheer (1995) formalized these ideas into the concept of the liability of foreignness, and international business scholars have devoted attention to its various implications for some time (e.g., Bell, Filatotchev, & Rasheed, 2012; Mezias, 2002; Zaheer, 2002).

While this research discusses the information disadvantages of foreign firms and the different uncertainties they encounter in overseas markets, recent research has also focused more specifically on the adverse selection problem that crops up in cross-border exchanges. Information asymmetries generally rise with geographic distance between partners (e.g., Chan, Covrig, & Ng, 2005; Kang & Kim, 2010), so international exchanges are naturally prone to adverse selection. The lack of familiarity with foreign organizations and market opportunities places firms at an information disadvantage in appraising other organizations' resources and capabilities when carrying out transactions with them (e.g., Luo, 1997; Tallman & Phene, 2007). As a consequence, a home bias results in different market settings since investors prefer to utilize proximate interactions and relationships when making certain investment decisions (e.g., Baik, Kang, Kim, & Lee, 2013; Huberman, 2001; Ke et al., 2010). In a context similar to ours, studies of international acquisitions have examined how adverse selection problems have implications for deal structuring, negotiations breakdowns and inefficiencies, and lower acquirer returns (e.g., Boeh, 2011; Dikova et al., 2009; Moeller & Schlingemann, 2005; Raff, Ryan, & Stähler, 2009; Xu et al., 2010). While alliances often involve smaller resource commitments than acquisitions (e.g., Cuypers & Martin, 2010), adverse selection risk can hinder their formation and a partner's ability to capture value (e.g., Hsu, 2006; Nicholson et al., 2005).

Given the salience of adverse selection in cross-border transactions, signals and other remedies to this problem take on particular importance in the international context. In his foundational paper, Spence (1974) showed that job candidates whose productivity was higher, yet unobserved to employers, can differentiate themselves from others and land a job with higher wages by obtaining an education. In market settings outside of the labor market, other signals are available to convey the unobserved quality of firms and facilitate transactions, and a few studies have begun to apply Spence's (1974) seminal paper to the international business context. For instance, a firm can signal a product's quality in a host country by bearing the costs associated with foreign direct investment instead of using a less commitment-intensive mode of entry (Katayama & Miyagiwa, 2009). Other research in international

economics has argued that advertising or securing export subsidies can work as signals and reduce adverse selection in foreign markets (e.g., Bagwell, 2007; Bagwell & Staiger, 1989).

In the alliance literature, recent studies using signaling theory have focused on private and newly public firms and have argued that their affiliations with prominent financial intermediaries such as reputable investment banks and prominent venture capitalists can provide signals. In the hypotheses developed below, we focus on newly public firms and these types of affiliations for three reasons: First, IPO firms have significant signaling opportunities, so an investigation of such firms lends itself to our research question. Second, using previously established sources of signals such as firms' affiliations with prominent investment banks and venture capitalists allows us to rely on strong precedent to determine whether signaling theory holds explanatory power in the context of international alliance formation. For example, research has shown that the reputation of an IPO firm's investment bank is one of the most important signals of the firm's quality (e.g., Carter & Manaster, 1990; Higgins & Gulati, 2003), and that having a prominent venture capitalist can be important to the success of new ventures and their future opportunities (e.g., Gulati & Higgins, 2003; Hochberg, Ljungqvist, & Lu, 2007; Hsu, 2006). Lastly, these signals also match well with our dependent variable because they represent interorganizational relationships enabling ventures to acquire resources. In extending signaling theory to the context of international alliances, we then consider two additional signals that are unique to firms carrying out cross-border transactions (e.g., international alliances prior to the firm going public and the firm's foreign sales activities). We investigate whether the signals associated with these international activities reduce the effects of affiliations since both sets of signals are most valuable when a firm faces a significant risk of adverse selection, and individual signals work to reduce this risk.

Let us first consider the signals associated with affiliating with prominent underwriters when firms go public. Such affiliations can facilitate IPO firms' subsequent collaborations because of the way in which firms and investment banks match and the information this conveys to prospective alliance partners. From the IPO firm's perspective, higher quality companies are willing and able to pay for the services of the most reputable investment banks in order to distinguish themselves from other firms by bonding themselves to the reputations of these financial intermediaries. From the perspective of the investment bank, risk signaling explains why reputable underwriters seek to take public higher quality firms: Such investment banks have a desire to underwrite those firms that do not put in jeopardy the investment bank's future business, so they wish to back firms that present less risk to their accumulated reputational capital (Carter & Manaster, 1990; Gulati & Higgins, 2003). As a consequence of bonding and risk signaling in these markets, it is difficult for lower quality firms to be able to imitate the affiliations that higher quality firms can secure. For these reasons, prior research has argued that affiliating with a reputable underwriter is one of the most important signals firms might obtain during the process of going public (Higgins & Gulati, 2003).

The implications of such associations extend beyond the IPO itself to the newly public firm's future economic exchanges in international markets. When a prospective international partner has inferior information about the firm's underlying resources (e.g., Luo, 1997; Tallman & Phene, 2007), the fact that the firm is underwritten by a reputable investment bank reduces the international partner's adverse selection risk, given the matching process described above. Prospective international partners who are less familiar with the firm's capabilities and prospects (e.g., Huberman, 2001; Ke et al., 2010) face reduced uncertainty and information costs by relying on the signal provided by the firm's affiliation with a reputable investment bank. This signal can also diminish the chances for negotiation breakdowns and inefficiencies as well as the risk of lower returns from an international collaboration in the presence of information asymmetries (e.g., Boeh, 2011; Dikova et al., 2009; Nicholson et al., 2005; Xu et al., 2010). We therefore specify the following hypothesis as a baseline prediction:

**Hypothesis 1:** International alliance formation by a newly public firm will be greater when its IPO is underwritten by a more reputable investment bank.

We anticipate that affiliations with prominent venture capitalists will stimulate international alliance for related reasons. Venture capitalists are highly selective in making investments in firms, funding less than 1% of the proposals they receive (Megginson & Weiss, 1991) and, like underwriters, prominent VCs rely on reputation capital, so it is critical for them to stand behind the ventures they represent and to avoid misrepresentations (e.g., Podolny, 1994). Venture capitalists indicate

they carefully evaluate the management of the firm and market potential by assessing management's experiences, qualifications, competence, courage, potential to disrupt a market, and integrity (Bussgang, 2011; Ramsinghani, 2011). Venture capital financing has several unique characteristics that shape the signaling value of firms' affiliations with VCs and can stimulate international alliance formation (e.g., Hsu, 2006). For instance, venture capitalists stage their investments and thus have longer relationships with IPO firms compared to investment banks. Before making each investment, VCs have time to gather additional information on the firm's progress and developing capabilities (Gompers, 1995), so backing by a venture capitalist at the IPO stage indicates that the firm has been vetted multiple times. As a second illustration, venture capitalists invest in firms by forming syndicates with other VCs, and the connections that prominent VCs have with other investors enable them to pool private information when conducting due diligence (Hochberg et al., 2007). If a firm is able to secure funding from a prominent VC, it also must accept a lower valuation (Hsu, 2004), so higher quality firms are also more likely to be able to bear this cost compared with other firms. International partners can find such signals valuable because these prospective partners often lack familiarity with the firm's resources and prospects, and they confront information disadvantages and the risk of adverse selection as result (Huberman, 2001; Ke et al., 2010; Tallman & Phene, 2007). Such signals can therefore enhance the efficiency of negotiations and partner selection, mitigate the risk of deals falling through, and increase the likelihood of a successful collaboration (Boeh, 2011; Dikova et al., 2009; Nicholson et al., 2005; Xu et al., 2010), all of which can stimulate international alliances with the newly public firm:

**Hypothesis 2:** International alliance formation by a newly public firm will be greater when the IPO is backed by a prominent VC.

### International Activities by IPO Firms

While affiliations with prominent financial intermediaries have been argued and shown to be instrumental in facilitating future deals involving private firms as well as newly public firms (e.g., Hsu, 2006; Pollock & Gulati, 2007; Ragozzino & Reuer, 2007, 2011), there are other potential signals that might contribute to international alliance formation by these firms. Broadening the theory to consider signals unique to the international context is therefore valuable in order to extend signaling theory to international alliances and to investigate potential interdependencies across such signals in order to contextualize existing theory and consider boundary conditions for predictions in previous research. The core proposition we develop below is that signals associated with firms' international activities will mitigate the effects of the signals discussed above. The value of one signal (e.g., affiliating with a prominent VC) is greater when the risk of adverse selection is significant, yet the risk of adverse selection is reduced by the presence of other signals associated with the firm's international activities. By contrast, the absence of signals associated with the firm's international activities will lead to a higher risk of adverse selection surrounding international alliances, so the positive effects of affiliations are expected to be greater in stimulating cross-border collaborations under such conditions.

In the hypotheses advanced below, we consider two signals that are unique to the international context that might mitigate the signaling benefits a firm obtains from affiliating with prominent financial intermediaries. We begin by considering a firm's pre-IPO international alliances. Previous research has considered the value of inter-firm collaborations in facilitating transactions in different markets (e.g., Nicholson et al., 2005; Stuart et al., 1999), and given our focus on the determinants of international alliance formation by IPO firms, we are interested in the firm's ability to obtain international partnerships before it goes public. Below we also draw upon studies that have ascribed signaling benefits to a firm's foreign sales activity (e.g., Shaver, 2011), and we likewise suggest that this signal will weaken the effects of a firm's affiliations with prominent financial intermediaries.

Previous research would suggest that international alliance formation provides a valuable signal for a number of reasons. International alliances are widely observable and indicate that the firm's resources are in demand by other organizations and exhibit attractive growth opportunities in other markets (Cuypers & Martin, 2010; Xu et al., 2010). Partners who select the firm as a collaborator also carry out due diligence on its intangible resources and capabilities (e.g., Hitt, Ahlstrom, Dacin, Levitas, & Svobodina, 2004; Luo, 1997; Shah & Swaminathan, 2008). In comparison with venture capitalists, however, international partners tend to be more involved at an operational level and therefore accumulate tacit knowledge on the firm's technologies, marketing capabilities, and other resources

(Almeida, Song, & Grant, 2002; Balakrishnan & Koza, 1993; Vanhaverbeke, Duysters, & Noorderhaven, 2002; Zaheer, Hernandez, & Banerjee, 2010). To the extent that the firm is able to gain visibility and credibility from engaging in international alliances on its own prior to going public, then such collaborations will reduce the risk of adverse selection for prospective partners following the IPO. The reduced risk of adverse selection in turn implies that the impact of affiliations with prominent financial intermediaries on the formation of international alliances will be diminished. By contrast, we expect that a firm that has not formed international collaborations by the time it has gone public will benefit to a greater degree from its affiliations with financial intermediaries. We therefore hypothesize that the firm's pre-IPO international alliances will mitigate the value of signals associated with affiliations with prominent investment banks and VCs:

**Hypothesis 3:** The positive effect of investment bank reputation on the IPO firm's formation of international alliances will be mitigated by the firm's pre-IPO international alliances.

**Hypothesis 4:** The positive effect of affiliating with a prominent VC on the IPO firm's formation of international alliances will be mitigated by the firm's pre-IPO international alliances.

There are also opportunities for firms to signal the value of their resources and prospects through their international activities without relying upon the interorganizational relationships discussed above. In particular, previous research has argued and found that firms initiating sales overseas are able to convey information about their productivity and other unobserved capabilities (e.g., Bernard & Jensen, 1999; Delgado, Fariñas, & Ruano, 2002), because these firms have to be more productive than rivals, or have distinctive capabilities in order to compete with foreign companies. Selling overseas involves taking on a number of upfront and ongoing costs to commence operations, adapt products, and transport goods, among others. Recent research by Shaver (2011) develops the argument that such signals enable firms to obtain funds on better terms in order to make capital investments. Inasmuch as foreign sales are observable and enable firms to convey their productivity and distinguish themselves from others, then like other signals discussed above they can be expected to have implications for the formation and efficiency of other exchanges in factor and product markets. As our theory in previous sections has suggested, prospective partners to international alliances face information disadvantages, experience inefficiencies during partner selection and negotiation, and contend with the risk of adverse selection, so signals such as foreign sales activities that convey information on a firm's capabilities and prospects may facilitate such transactions.

While firms that have been able to engage in sales overseas are more apt to form future international collaborations, we also expect that this signal will mitigate the effects of the firm's affiliations with prominent financial intermediaries, paralleling the logic presented above for H3 and H4. More specifically, if a firm has signaled its productivity or other capabilities by bearing the costs of selling in foreign markets, prospective alliance partners will face a lower risk of adverse selection. As a result, the signaling effects of affiliations with prominent financial intermediaries in stimulating international collaborations after the firm goes public are expected to be less pronounced. By contrast, holding everything else constant, a firm that has not conveyed the productivity of its resources by carrying out foreign sales will present a greater risk of adverse selection to prospective partners, so the signals effects of affiliations with prominent investment banks and VCs will be more pronounced under this condition. We therefore posit:

**Hypothesis 5:** The positive effect of investment bank reputation on the IPO firm's formation of international alliances will be mitigated by the firm's foreign sales intensity.

**Hypothesis 6:** The positive effect of affiliating with a prominent VC on the IPO firm's formation of international alliances will be mitigated by the firm's foreign sales intensity.

## METHODS

### Sample and Data

Our base sample of IPOs was drawn from Thomson Financial's Security Data Corporation (SDC) database, which is a standard source of information on initial public offerings as well as alliances on a global level. We limited our investigation to IPOs that took place in the United States because markets differ with respect to the information content of IPOs and their institutions (Jenkinson & Ljungqvist, 2001), so focusing on US firms' IPOs controls for such differences across countries and potential unobserved

heterogeneity. Consistent with other studies of IPOs, we did not include newly public firms operating in the financial sector, nor transactions involving real-estate investment trusts, investment funds, ADRs, offerings of units of diversified firms, or reverse leveraged buy-outs. Our final data set comprises 1595 IPOs.

Our data sets spans the years 1990–2009. Because we track firms' pre- and post-IPO alliance activity for periods up to 5 years before and after the going public event, we included IPOs that occurred between 1995 and 2004 when constructing the sample. Not surprisingly, the second half of the 1990s comprises the lion's share of the deals (roughly 78%), while the years 2000–2004 exhibited a decline in the number of transactions. In order to compare the year-by-year distribution of our final sample against the population of IPOs in the period we consider, we ran both Pearson's $\chi^2$ and Kolmogorov–Smirnov tests and found that the two were extremely comparable (i.e., $p=0.98$ and $p=0.99$, respectively). The cross-sectoral distribution of our sample also closely follows the distribution of the general population of IPOs across industries ($p=0.99$ for both tests), with manufacturing and service industries accounting for about 80% of all IPOs and the high-tech sector representing 47% of the total.

## Variables and Measurement

### *Post-IPO international alliances*

The dependent variable is the number of international alliances formed by a firm during the 3 years following its IPO. Specifically, we include alliances formed by the focal IPO firm outside the US and the US-based alliances formed by the IPO firm and foreign partners. We include a broad spectrum of inter-firm cooperative agreements, ranging from licensing agreements, supply and manufacturing contracts, and so forth to equity joint ventures involving partial acquisitions of partners' businesses as well as greenfield joint ventures. We sought to be conservative in the specification of a 3-year time period for post-IPO alliance formation, given that characteristics of IPO firms are less likely to have an influence in more extended time periods as the firm evolves and other information accumulates on its resources and prospects, yet in supplemental analyses discussed below we also examined longer time frames.

Since the dependent variable is a count measure, we estimated a model using Poisson regression. However, this model assumes that the variance of the response equals its mean, while this assumption is often violated in social science research (Cameron & Trivedi, 1990). We therefore tested for potential over-dispersion in two ways. First, we divided the Pearson $\chi^2$ and deviance values obtained from the model estimation by the degrees of freedom. This yielded values of 2.00 and 3.05, both of which are well above the threshold of one, which indicates over-dispersion. Second, we performed a likelihood ratio test by calculating the double difference between the log-likelihood values of the Poisson and the equivalent negative binomial estimation. This test resulted in a chi-square statistic of 936.43 ($p<0.001$), so we rejected the null hypothesis of no over-dispersion being present, and we estimated the models with less restrictive negative binomial regressions.

We then tested whether it was necessary to use a zero-inflated negative binomial model (ZINB) to accommodate the number of zeros in our sample (i.e., firms that did not engage in international alliances right after going public) and the possibility they are generated from a qualitatively different process. The zero-inflated negative binomial model consists of a two-stage model estimation with a logistic regression separating the zero from the non-zero outcomes first, and then a conditional negative binomial estimation based upon the results from the first model (e.g., Greene, 1997). This approach, sometimes called a hurdle model, modifies the probability of the zero outcomes and rescales the probability of the non-zero outcomes in such a way as to have them add up to one (Mullahey, 1986). A formal test allows for the comparison of the results from both models, under the null that the zero-inflated negative binomial model is not a significant improvement over a standard negative binomial model (Vuong, 1989). This test yielded a z-score of 1.11 (n.s.), which did not allow us to reject the null hypothesis. Moreover, the ZINB model retained its overall significance, and the interpretations of the coefficients were virtually the same as those from standard negative binomial regressions presented below (results available upon request).

### *Explanatory variables*

The first theoretical variable in the model is the reputation of the investment bank that led the focal firm's initial public offering (i.e., *Investment bank reputation*). The measure we used has been employed in many studies in this literature (e.g., Stuart et al., 1999). Specifically, we matched

the lead investment bank with the reputation index developed by Carter and Manaster (1990) and then updated by Loughran and Ritter (2004) and by Ritter on his website (i.e., http://bear.warrington.ufl.edu/ritter/ipodata.htm). This variable is based on the position that each underwriter occupies in IPO tombstone announcements, such that investment banks that are consistently listed in the highest brackets receive higher ranks (i.e., the maximum rank is 9), and less prominent banks in lower brackets receive lower ranks (i.e., the minimum is 0).

The second theoretical variable is *Venture capitalist prominence* (e.g., Gulati & Higgins, 2003). We took three steps in calculating this measure. First, we obtained information on the identity of all VCs that were involved with the focal firm at the time it went public. These data came from the IPO module of SDC. Second, we tracked each VC's activity for a period of 5 years prior to the year of the focal IPO, in order to determine the number of other IPO firms that the VC backed. Finally, we identified a VC as prominent (i.e., value equal to one) if the number of IPOs it backed was above the median number of IPOs for all VCs, and as not prominent otherwise (i.e., value equal to zero) (Gulati & Higgins, 2003). When the newly public firm had received no VC backing at all, a value of zero was assigned to venture capital prominence, and when multiple VCs were present in the IPO firm, we took the most prominent VC as the point of reference for coding the variable. In supplemental analyses, we also used two alternatives to examine the sensitivity of this measure. First, we used a dummy variable that took a value of one if any VC backed the focal firm at the time of its IPO, and zero if the focal firm had no venture capitalist backing when it went public. Second, we employed a count of the number of IPOs in which each VC had participated in the 5 years prior to the focal transaction. Findings for these alternative measures of VC backing and prominence are also discussed in the results section.

Finally, we incorporated two independent variables that capture the IPO firm's international activities that can also provide signals on its resources and prospects. The variable *Pre-IPO international alliances* was calculated in the same fashion as the response variable, except that we counted alliances up to 5 years before the firm went public. If pre-IPO international alliances provide signaling benefits that reduce the effects of affiliating with prominent financial intermediaries (i.e., underwriters and VCs), then interactions between these variables will be negative, as posited in Hypotheses 3 and 4. We also measured the foreign sales intensity of IPO firms as a second dimension of international involvement that can provide signals of the IPO firms' resources and prospects and might reduce the effects of affiliations with prominent underwriters and VCs (i.e., H5 and H6). Using data available from the Compustat Segments database, we calculated the proportion of firm sales obtained outside the US in the year in which the firm went public (i.e., *Foreign sales intensity*). We also controlled for the direct effects of these variables in addition to other controls discussed below.

### Control variables

We incorporated a number of control variables at the firm and industry levels to accommodate other factors that might be related to the aforementioned theoretical variables or IPO firms' propensities to engage in international alliances. For instance, larger firms tend to have broader scope and often greater resources with which to engage in corporate growth activities. We operationalized *Firm size* as the firm's total sales in the year of the IPO. A log transformation was used in the model estimation in order to remedy positive skewness that was evident for this variable.

As we discussed previously, the central problem of adverse selection arises due to the fact that the quality of the focal firms in our data is largely unobservable. However, in designing our model we included indicators of the firm's resources and prospects. First, we incorporated the firm's *Tobin's Q*, which is a widely used measure of firms' intangible assets, performance, and growth opportunities (e.g., Villalonga, 2004). This measure was calculated as the ratio of the year-end market value of the focal firm plus the book value of its debt, divided by the firm's total assets (Chung & Pruitt, 1994). Second, we introduced the firm's sales growth, computed as the percentage growth in revenues from the year prior to the IPO to the year of the offering. The data for Tobin's Q and firm sales growth were obtained from the Compustat data files.

The next three controls capture characteristics of the focal firm's initial public offering. First, we include *Underpricing* as a control because prior research has found that firms might signal their value to outsiders by discounting shares when information asymmetry is present (e.g., Welch, 1989), though there are many other theoretical determinants of underpricing in finance and management research. The magnitude of underpricing can also have a significant effect on a firm's post-IPO opportunities and performance (e.g., Demers & Lewellen, 2003). This measure was calculated as the difference

between the price at the close of the first day of trading minus the offer price, divided by the offer price. We also included an indicator variable *Major exchange*, which took a value of one if the IPO firm went public on the New York Stock Exchange or Nasdaq, and zero otherwise. Listing on these exchanges can enhance a firm's visibility and act as a screening mechanism, as major exchanges set higher requirements regarding auditing, conflict of interests, and corporate responsibility compared with over-the-counter markets (e.g., Draho, 2004). To proxy for the awareness of the newly public firm by prospective partners, we incorporated a variable for coverage in the press (i.e., *Media attention*). This variable reflects the number of mentions in the top 50 newspapers in the United States as measured by circulation, as well as major English-language newspapers published outside of the US (e.g., Demers & Lewellen, 2003). Data for the underpricing and the major exchange variables were obtained from the SDC database, while the media attention variable was computed via searches in Lexis-Nexis Academic Universe.

Finally, we wanted to account for potential industry and temporal effects that might also explain the IPO firm's propensity to engage in international alliances. We included a set of dummies to capture the year in which the firm went public, as well as an indicator variable called *High-tech industry*, which assumes a value of one if the firm was in a high-tech industry, and zero otherwise. Firms in such industries can be attractive alliance partners as well as have different IPO characteristics, including backing by venture capitalists, and such industries are also characterized by significant intangibles and growth opportunities. We define high-technology industries following the definitions provided by TechAmerica, which identifies a set of 45 four-digit SIC codes such as software, medical devices, semiconductors, telecommunications, etc. In supplemental analyses, we also examined a set of sector fixed effects to account for industry heterogeneity, and the interpretations were the same as those presented in the results section below.

## RESULTS

### Descriptive Statistics

Table 1 presents descriptive statistics for the variables as well as correlations. Thirty-six percent of the IPO firms formed an international collaboration within the 3 years after going public, and of

**Table 1** Descriptive statistics and correlation matrix[a]

| Variable | Mean | SD | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Post-IPO international alliances | 0.93 | 2.14 | | | | | | | | | | | |
| 2. Investment bank (IB) reputation | 8.37 | 1.43 | 0.10*** | | | | | | | | | | |
| 3. Venture capitalist (VC) prominence | 0.46 | 0.50 | 0.17*** | 0.17*** | | | | | | | | | |
| 4. Pre-IPO international alliances | 0.17 | 0.59 | 0.12*** | 0.02 | 0.10*** | | | | | | | | |
| 5. Foreign sales intensity | 0.08 | 0.18 | 0.10*** | 0.11*** | 0.03 | 0.05† | | | | | | | |
| 6. Firm size | 250.44 | 1297.0 | 0.18*** | 0.06** | −0.13*** | 0.01 | 0.14*** | | | | | | |
| 7. Tobin's Q | 4.13 | 4.30 | 0.30*** | 0.13*** | 0.21*** | 0.02 | 0.04 | −0.09*** | | | | | |
| 8. Sales growth | 1.23 | 4.54 | 0.05† | −0.02 | 0.07** | −0.01 | −0.07** | −0.04 | 0.07** | | | | |
| 9. Underpricing | 0.36 | 0.63 | 0.17*** | 0.15*** | 0.21*** | 0.04† | 0.04† | −0.06* | 0.35*** | 0.03 | | | |
| 10. Media attention | 4.91 | 17.23 | 0.29*** | 0.06* | 0.06* | 0.03 | −0.04† | −0.02 | 0.15*** | 0.05* | 0.16*** | | |
| 11. Major exchange | 0.91 | 0.29 | 0.02 | 0.15*** | 0.14*** | 0.05† | 0.06* | 0.05* | 0.03 | −0.00 | 0.06* | 0.03 | |
| 12. High-tech industry | 0.47 | 0.50 | 0.23*** | 0.08** | 0.28*** | 0.07** | 0.15*** | −0.09*** | 0.28*** | 0.04 | 0.26*** | 0.03 | −0.03 |

[a]N = 1595.
† $p<0.10$, * $p<0.05$, ** $p<0.01$, *** $p<0.001$.

those that did, the mean number of international collaborations was 2.6. Forty-six percent of the sampled firms were backed by prominent VCs, and many firms lacked international exposure prior to going public. For instance, only 11% of the firms engaged in international alliances in the 3 years before going public, and 26% of the sampled firms had foreign sales. Cross-tabulations indicated that firms affiliating with the most reputable underwriters with a score of 9 (i.e., 77.3% of the total) are also more likely to form alliances after going public (i.e., $\chi^2 = 13.56$, $p<0.001$). Specifically, of the firms backed by a prominent underwriter, 39% formed international alliances after going public, while 28% of those lacking such affiliations engaged in cross-border partnerships. Similar patterns are evident for affiliations with VCs, as 46% of the firms backed by a prominent venture capitalist engaged in international alliances after going public, while only 28% of those without such affiliations formed post-IPO international collaborations.

## Model Estimation Results

Table 2 presents the multivariate results from the negative binomial estimations. Column I is the baseline model comprising control variables, Column II introduces the direct effects of the variables for underwriter and VC prominence, Columns III and IV add the interactions, and Column V is the full model testing all interactions at once. All models are highly significant overall and each specification represents a significant improvement over the baseline model (all $p<0.001$).

We find strong support for H1, which hypothesized a positive relationship between the underwriter's reputation and the IPO firm's international alliance activities after going public ($p<0.001$ for all models). Similarly, the VC prominence variable also has a positive and significant effect on post-IPO international alliance formation in all of the models ($p<0.001$), lending strong support for H2. Combined, these results support our predictions that these types of affiliations with financial intermediaries produce important signals that facilitate the formation of international alliances in particular.

Hypotheses 3 and 4 suggested that the positive effects of these signals would diminish for firms that already were able to engage in international alliances prior to going public. The results provide support for the prediction that the impact of affiliations with prominent VCs will be lower for firms with pre-IPO international alliances (i.e., $p<0.05$ in Columns III and V, respectively). However, the interaction between IB reputation and pre-IPO international alliances is insignificant, so we find support for H4 but not for H3. The significant interaction for prominent VCs alone might reflect the fact that VCs often specialize by industry, are involved in successive funding rounds and due diligence for years before the firm goes public, and often continue in their involvement with the IPO firm after it goes public (e.g., Gompers & Lerner, 2004). In these respects, venture capitalists' and alliance partners' relationships are more similar than those of investment banks. In a similar fashion, we find evidence that the firm's foreign sales activities mitigate the effects of affiliating with a prominent VC (i.e., $p<0.05$ in Columns IV and V), so support exists for H6, but not H5 regarding investment bank reputation. Taken together, these results demonstrate that having a relationship with a prominent VC can be valuable for IPO firms attracting international alliance partners, especially when the firm did not engage in international collaboration or foreign sales activities itself prior to going public.

Because firms build relationships with VCs and engage in international activities over time, we wanted to explore the implications of this timing, in case international involvement might attract VCs. Venture capitalists became involved early after the firms' founding dates (i.e., the median number of years it took a VC to invest was one, while the 25th and 75th percentiles were 0 and 4 years, respectively), and the number of cases in which the firm experienced international alliances or foreign sales before a VC invested was extremely low (e.g., 0.8% and 0.9%). When we re-estimated the models excluding these few observations, we found that the direct effect of VC prominence remained positive and significant (both $p<0.001$); the interactions retained their sign, magnitude and significance (i.e., $p<0.05$); and the coefficients for the other variables were nearly identical to the ones shown in Table 2.

Finally, the findings for several of the control variables are noteworthy, and most of them appear to have significant explanatory power in the models. As would be expected, firms with pre-IPO international alliances tend to form post-IPO international alliances, whether due to the signaling value of these relationships, learning, momentum, or other theoretical considerations ($p<0.001$). We also wished to separate those pre-IPO alliances that were still ongoing at the time of our observation from the

**Table 2** Negative binomial regression results[a]

| Independent variables | (I) | (II) | (III) | (IV) | (V) |
|---|---|---|---|---|---|
| Constant | −1.77*** | −1.90*** | −1.84*** | −1.87*** | −1.81*** |
| | (0.41) | (0.41) | (0.41) | (0.41) | (0.41) |
| Firm size[b] | −0.02 | −0.00 | −0.01 | −0.02 | −0.02 |
| | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) |
| Tobin's Q | 0.06*** | 0.06*** | 0.06*** | 0.06*** | 0.06*** |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) |
| Sales growth | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) |
| Underpricing | 0.21* | 0.16* | 0.16* | 0.17* | 0.17* |
| | (0.08) | (0.08) | (0.08) | (0.08) | (0.08) |
| Media attention[b] | 0.13*** | 0.12** | 0.12** | 0.12** | 0.11** |
| | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) |
| Major exchange | 0.16 | 0.01 | −0.00 | 0.00 | −0.01 |
| | (0.17) | (0.17) | (0.17) | (0.17) | (0.17) |
| High-tech industry | 0.80*** | 0.70*** | 0.69*** | 0.71*** | 0.70*** |
| | (0.10) | (0.10) | (0.10) | (0.10) | (0.10) |
| Pre-IPO intl. alliances[c] | 0.21*** | 0.20*** | 0.33*** | 0.20*** | 0.34*** |
| | (0.05) | (0.05) | (0.08) | (0.05) | (0.08) |
| Foreign sales intensity[c] | 0.36*** | 0.34*** | 0.34*** | 0.44*** | 0.45*** |
| | −0.07 | (0.07) | (0.07) | (0.10) | (0.10) |
| IB reputation[c] | — | 0.19*** | 0.19*** | 0.19*** | 0.19*** |
| | | (0.06) | (0.06) | (0.06) | (0.06) |
| VC prominence | — | 0.38*** | 0.38*** | 0.42*** | 0.43*** |
| | | (0.11) | (0.11) | (0.11) | (0.11) |
| Pre-IPO intl. alliances × IB reputation | — | — | −0.01 | — | −0.01 |
| | | | (0.05) | | (0.06) |
| Pre-IPO intl. alliances × VC prominence | — | — | −0.21† | — | −0.22* |
| | | | (0.10) | | (0.10) |
| Foreign sales intensity × IB reputation | — | — | — | 0.12 | 0.12 |
| | | | | (0.14) | (0.14) |
| Foreign sales intensity × VC prominence | — | — | — | −0.28* | −0.29* |
| | | | | (0.12) | (0.12) |
| $\chi^2$ | 290.84*** | 317.23*** | 321.87*** | 323.15*** | 328.24*** |
| Log Likelihood, $L(\beta_k)$ | −621.54 | −627.04 | −624.72 | −624.08 | −621.54 |
| $-2[L(\beta_{l=1})-L(\beta_i]\sim\chi^2$ | — | 26.39*** | 31.04*** | 32.31*** | 37.40*** |

[a] $N = 1595$. Year fixed effects included in all specifications. Standard errors appear in parentheses.
[b] These variables were logged.
[c] These variables were centered.
† $p<0.10$, * $p<0.05$, ** $p<0.01$, *** $p<0.001$.

ones that had been terminated (i.e., 4.9%). When we reran the models excluding the terminated alliances we obtained results that were very similar to the ones reported (i.e., the Pre-IPO international alliances variable was still positive and significant, $p<0.001$). Likewise, we find that firms with greater foreign sales activity are also more likely to engage in international collaborations after going public ($p<0.001$). In a separate analysis, we wished to test whether pre-IPO international alliances and foreign sales might function as alternative signaling mechanisms to boost firms' post-IPO alliance formation. We estimated a model that included an interaction term for these two variables and found that this was indeed the case. While both direct effects retained their signs and significance levels (i.e., both positive and $p<0.001$), the interaction term was negative and also highly significant (i.e., $b = -0.11$, $p<0.004$). Turning to the rest of the controls, the models reveal that the media attention generated by an IPO results in greater alliance formation after a firms goes public (i.e., $p<0.001$ in Column I and $p<0.01$ in Columns II-V). Moreover, firms with significant growth opportunities, such as high-tech firms with high Tobin's Q

values, are more likely to be active in entering into international collaborations after they undertake an IPO (both $p<0.001$). By contrast, prior sales growth does not seem to be associated with post-IPO international alliances. Finally, firms that underprice more when listing their shares are more likely to form post-IPO international alliances ($p<0.05$).

## Robustness Analyses

In addition to the tests noted above, we performed four sets of analyses in order to examine the robustness of our findings. First, we considered the possibility that unobservables might shape the relationship between the firm's affiliations with financial intermediaries and whether or not they experience international alliances. In order to account for this endogeneity concern empirically, we estimated separate first-stage models that predicted the probability of each firm in our sample being certified by either a highly reputable investment bank or a prominent VC (results available upon request). These models included variables that account for the geographic concentration of these financial intermediaries in the United States (e.g., Baker & Gompers, 2003; Loughran & Schultz, 2005), as well as other macro-level variables such as interest rates, capital gains tax rates, the number of rounds of VC funding flowing into the industry of the focal firms, the number of IPOs in the year the focal firm went public (e.g., Gompers & Lerner, 2004), the number of previous alliances formed by the focal firms and their size (e.g., Higgins & Gulati, 2003). The correction for self-selection in the second-stage international alliance formation models was insignificant for all of the specifications tested, indicating that the null hypothesis of exogeneity cannot be rejected, and the interpretations of the results were unchanged.

As a second set of robustness checks, we turned our attention to the measurement window for the dependent variable. While we used a conservative time frame for measuring firms' international alliance activities after going public, prior research has examined acquisitions involving IPO firms using even longer time frames (e.g., Celikyurt, Sevilir, & Shivdasani, 2010). Lengthening the time window for the dependent variable to 5 years after the IPO increased the average number of alliances per firm (i.e., from 0.88 to 1.07), but this did not bring about any meaningful departures from the interpretations offered earlier. Both investment bank reputation and VC prominence had a positive and highly significant effect on post-IPO international alliance formation ($p<0.001$), and H4 and H6 on the two interactions between VC prominence and pre-IPO international alliances and foreign sales intensity still found support (i.e., $p<0.05$).

Third, in supplemental analyses we also examined other operationalizations for our two measures of affiliations with reputable financial intermediaries. We changed the continuous investment bank reputation scores to a discrete variable that took a value of one if the lead underwriter was ranked highest (i.e., rank = 9) and zero otherwise. We also replaced the VC prominence measure discussed above with two alternatives. The first was a raw count of the number of firms a VC took public in the 5 years prior to the focal firm's IPO (when no VC was present, the variable took a value of zero), and the second was an indicator variable that took a value of one if a VC was present and zero otherwise. This latter measure was used because recent studies compare IPO firms that are venture capitalist backed vs those that are not (e.g., Brau et al., 2010). None of these alternative measures for our core theoretical variables led to changes in the interpretations of our findings, however. Firms backed by VCs in general or those actively involved in taking firms public were most heavily involved in international alliances after going public, and this effect was most pronounced for firms that had not engaged actively in international activities prior to their IPOs.

Fourth, given that many of the firms did not have international alliances or foreign sales prior to their IPOs, we replaced the continuous measures in our model with indicator variables. These additional tests might help to shed light on whether having engaged internationally, as opposed to the extent of the engagement, influences post-IPO international collaborations. The results from these analyses offer similar interpretations to the ones presented in Table 2. However, although the direct effects of the theoretical and moderating variables were identical (i.e., all $p<0.001$), their interactions changed somewhat. Specifically, the interaction of the VC prominence variable with foreign sales intensity kept its sign but lost its significance, suggesting the extent rather than the mere existence of foreign sales matters in shaping the value of the signal associated with affiliations with prominent VCs. In contrast, the interaction of the pre-IPO international alliances and the VC prominence variables remained the same (i.e., $p<0.05$).

## DISCUSSION

### Implications and Contributions

This paper extends signaling theory to the international business literature in general, and the stream of research on international alliance formation in particular. We specifically investigate whether newly public firms can benefit from affiliations with prominent organizations, such as venture capital firms and investment banks, in facilitating international alliances. Although previous research in the domestic setting has shown that these affiliations affect future economic exchanges (e.g., Gulati & Higgins, 2003; Hsu, 2006; Pollock & Gulati, 2007; Ragozzino & Reuer, 2007, 2011; Reuer & Ragozzino, 2012), it is unclear whether the information conveyed through signals such as these matters in cross-border transactions. In these deals, prospective partners might face substantial adverse selection problems since foreign firms tend to have information disadvantages about local organizations and market opportunities (e.g., Huberman, 2001; Ke et al., 2010; Tallman & Phene, 2007; Xu et al., 2010). At the same time, it is not clear whether prospective foreign partners attend to signals due to bounded rationality, the geographic distance separating them from these partners, their localized knowledge and interactions, and other potential limitations on how signals travel across countries (e.g., Rangan, 2000). This paper addresses this previously overlooked dilemma and shows that affiliating with prominent VCs and investment banks indeed results in an increase in new ventures' cross-border alliance activity.

At the broadest level, we suggest that signaling theory is a useful and complementary theoretical perspective that can shed additional light on the mechanisms that trigger international alliances and address some of the risks that collaborators face. For instance, previous studies using the resource-based view of the firm emphasize the intangible resources and unique capabilities that firms can access through alliances (e.g., Hitt et al., 2004), and we would note that these resources and capabilities can also give rise to adverse selection during the search for partners and alliance negotiations. To the extent that firms do not address these problems through signaling or some other means, they can hinder the formation of international alliances and the benefits they may bring to collaborators. As another illustration, significant research using transaction cost economics, internalization theory, and the OLI paradigm has considered knowledge appropriation and other *ex post* exchange hazards surrounding a focal firm's proprietary resources as it expands overseas, and these hazards increase the importance of certain remedies (e.g., formal and relational governance mechanisms) (e.g., Aulakh, Jiang, & Li, 2013; Beamish & Lupton, 2009; Brouthers & Hennart, 2007; Buckley & Casson, 1976; Caves, 1996; Dunning, 1995; Gatignon & Anderson, 1988; Hennart, 1989; Zhou & Xu, 2012). We complement this research by highlighting adverse selection as an *ex ante* hazard that can surround the intangible resources of prospective collaborators and by suggesting that signals can ameliorate this problem and facilitate the formation of cross-border collaborations. Signaling theory therefore complements prior research in international business using organizational economics by shifting the types of exchange hazards being considered.

While signaling theory has seen many applications in recent research in financial economics, strategic management, and entrepreneurship (e.g., Connelly et al., 2011), it has received far less attention in international business. We believe that this theory holds considerable promise for advancing our understanding of firms' cross-border activities and their internationalization. In this paper we focus specifically on the effects of affiliations with prominent VCs and investment banks for newly public firms, but future research might consider a range of other potential signals that firms might employ. As a few illustrations, prior work focused on the domestic setting has examined corporate name changes (i.e., Lee, 2001), insider trading in R&D-intensive firms (i.e., Ahuja, Coff, & Lee, 2005), the characteristics of boards, top management teams, and competitive actions and announcements (e.g., Certo, 2003; Cohen & Dean, 2005; Heil & Robertson, 1991) as other information signals that could be available to new ventures. The few studies that have considered signaling in an international context have explored additional signals such as cross-listing of shares (e.g., Siegel, 2009), obtaining governmental subsidies for exporting (Bagwell & Staiger, 1989), and carrying out international activities through foreign direct investment or exporting (e.g., Katayama & Miyagiwa, 2009; Shaver, 2011). It would be clearly useful to investigate whether these alternative signals might also facilitate collaborative agreements and the internationalization of firms by facilitating exchanges in various factor and product markets.

Given the multiple signals available to firms, the questions of whether signals offer similar benefits

and how firms might prioritize among them become important. Inasmuch as a given signal reduces the risk of adverse selection, it will reduce the value of a second signal in facilitating exchanges between firms. While our theory and evidence indicate that one form of signal mitigates the impact of another type of signal, there might be situations when different signals complement one another. For instance, if it becomes easier for others to imitate a company's actions, if signals convey information about different aspects of a firm's resources and prospects, or if significant uncertainty remains about the firm's quality, signals might be used in concert and complement one another. Thus understanding the degree to which various signals as well as alternative ways of addressing adverse selection (e.g., contingent contracts, familiarity and trust, etc.) might partially substitute or complement each other will enable new ventures to address adverse selection problems that might obstruct their access to resources, the formation of partnerships, and their internationalization objectives (e.g., Oviatt & McDougall, 1994). We demonstrate that affiliating with a prominent VC has a greater impact on future international collaborations when the firm did not collaborate before going public or engage in pre-IPO international alliances. However, to the extent that such international activities enable firms to convey the firm's resources and prospects to prospective collaborators, the effects of affiliating with a prominent VC diminish as a firm becomes engaged in significant international activities. Given the number of alternative signals available to firms and the various exchanges in which they engage in international factor markets and product markets as they internationalize, we hope that this paper helps to encourage additional research on signaling theory in the international business literature.

### Limitations and Future Research Directions

This study has a number of specific limitations that future work might address. For example, this paper focuses on signals available to IPO firms and the consequences they carry for cross-border alliance formation after firms go public. This focus is motivated by our desire to contribute to the research stream that has studied the links between firms' IPOs and their alliances (e.g., Gulati & Higgins, 2003; Hsu, 2006; Pollock & Gulati, 2007; Reuer & Tong, 2010). However, it would be valuable to consider other pre-IPO milestones in the lives of new ventures that might produce signals and stimulate international transactions. In the foregoing discussion, we have emphasized a number of signals available to all firms, but for new ventures specific signals such as patents and founder characteristics may take on particular importance. Given our focus on newly public firms, it would also be valuable to obtain primary data to examine privately held firms and their collaborations. Some of our findings on the determinants of international alliance formation and the evolution of firms upon going public might also reflect our focus on firms from the United States, so extensions could consider companies based in other markets, the role of foreign venture capitalists (e.g., Humphery-Jenner & Suchard, 2013), and IPOs on other stock exchanges as well as cross-listings.

Future work might also explore relationships between information signals and corporate development activities other than strategic alliances. The most obvious extension would be to study whether the signals we consider here will also trigger international acquisitions by firms, either as sellers or buyers, as well as the terms and performance consequences of such acquisitions. Given their high resource requirements, M&A are prone to the problem of adverse selection and can benefit from signals (Ragozzino & Reuer, 2007) and this appears to be particularly the case for international acquisitions given the risk of adverse selection in the international context (e.g., Dikova et al., 2009; Ke et al., 2010; Xu et al., 2010). Moreover, since prior work has suggested that strategic alliances might be remedies to information asymmetry in international M&A markets (i.e., Hennart & Reddy, 1997), it would be interesting to gauge whether the presence of various signals might have an effect on entry modes and their consequences by inducing partners to commit more resources to acquisitions rather than partnering. When expanding overseas through greenfield operations instead, firms can also face problems due to adverse selection in factor markets (e.g., labor and capital markets), so it would also be valuable to examine international expansion and organic growth using this theory (e.g., Acs, Morck, Shaver, & Yeung, 1997). Research in directions such as these holds the promise to utilize the insights of signaling theory to improve our understanding of international alliances, other modes of international expansion, and the performance of firms' internationalization activities.

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*Accepted by Ulf Andersson, Area Editor, 10 November 2013. This paper has been with the authors for two revisions.*