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The Impact of External Contexts on Alliance Governance in Biotech–Pharmaceutical Firm Alliances

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The interest in strategic alliances has increased over the years, especially in high tech global industries such as biotechnology, as firms seek to gain access to needed resources, expertise, and knowledge for developing and commercializing new products and technologies. The governance structure of these alliances, which is an important consideration in understanding alliance formation and performance, is influenced by both external and internal contexts of the alliance partners. However, evidence from prior research has been inconclusive regarding the impact of external contexts on alliance governance selection. To better understand this impact, we simultaneously examine three key partner external contexts - international, technological, and social contexts, and their influence on biotechnology-pharmaceutical alliance governance structure selection. Using a sample of 389 alliances formed during the six-year period 1995 through 2000, we find that the international context, specifically national cultural distance between alliance partners, and the social context, specifically credibility of the biotechnology partner in the alliance network, influence governance structure selection. We offer implications of our findings for theory, future research, and management practice. *Organization Management Journal*, 12: 110–122, 2015. doi: 10.1080/15416518.2015.1073134

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Interest in strategic alliances has increased over recent years, particularly in high-technology industries such as biotechnology, where individual firms seldom have the all resources, expertise, and knowledge needed to develop and market their products or technologies (Bessy & Brousseau, 1998; Hagedoorn, 1993; Teece, 1992; Maier, Moultrie, & Clarkson, 2012; Ndofor, Sirmon, & He, 2011). Since the early 1980s, the biotechnology industry has served as a promising new source of pharmaceutical products that complement the chemistry-based competencies of many pharmaceutical firms (Van Brundt, 2001).

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The biotechnology industry has seen a dramatic growth of strategic alliances, greater than any other sector, with an annual average growth rate of 25% (Feldman, 2001; Fisher, 1996; Hagedoorn, 1993). Biotech firms have specialized technological expertise that is of value to the pharmaceutical industry, and these firms often lack the resources needed for successful commercialization of their technologies (Rebentisch & Ferretti, 1995; Dunne, Gopalakrishnan, & Scillitoe, 2009). For pharmaceutical firms, allying with a biotech firm provides an opportunity to enhance their research and development (R&D) pipeline by complementing existing resources, skills, and knowledge (Santoro & McGill, 2005; Mullin, 2005; Rothaermel, 2001). Specifically, pharmaceutical firms often have resources, knowledge, and capabilities in manufacturing, regulatory, standard of care, distribution, and marketing that can help leverage and commercialize the biotech firm's technological expertise (Deeds, DeCarolis, & Coombs, 2000; Ernst & Young, 2013; Rothaermel & Deeds, 2006).

For example, Bristol-Myers Squibb had an alliance valued at $2 billion with ImClone to get the cancer drug Erbitux through Food and Drug Administration (FDA) approvals. Bristol-Myers Squibb provided up-front payments and later payments to ImClone and put one of its own senior vice-presidents in charge of the Erbitux regulatory team (Wharton, 2002). Erbitux was eventually approved by the FDA and had $1.87 billion in global sales in 2013 (FiercePharma, 2014).

Another company, GlaxoSmithKline, had made licensing a critical part of its research and development strategy and preferred to buy late-stage products because of the lower risk. When negotiating with smaller biotech firms, GlaxoSmithkline's resources and large sales force provided an advantage when competing for access to promising drugs. Corixa allied with GlaxoSmithKline for the development and approval of Bexxar, a new cancer drug. Although the Bexxar application was initially turned down by the FDA, it was eventually approved (Wharton [Knowledge@Wharton], 2002). GlaxoSmithKline eventually purchased Corixa in 2005 (*Seattle Times*, 2005), and sales peaked for Bexxar in 2006. GlaxoSmithKline stopped selling Bexxar in February 2014, a

little more than a decade after it was approved by the FDA, due to reduced usage related to a variety of industry factors (Timmerman, 2013).

A large and growing literature focused on alliance formation and performance has investigated questions such as what motivates firms to form an alliance (Folta, 1988; Williamson, 1985), why firms ally with one another (Al-Laham, Amburgey, & Bates, 2008; Chung, Singh, & Lee, 2000; Coombs & Deeds, 2000; Gulati, 1995a; Zhang & Baden-Fuller, 2010), the types of alliances formed (Ahuja, 2000; Dunne, Gopalakrishnan, & Scillitoe, 2009; Pangarkar & Klein, 2001; Rothaermel, 2001; Rothaermel & Deeds, 2006), and alliance success (McConnell & Nantell, 1985; Mitchell & Singh, 1996). This research suggests that the governance structure of alliances, specifically the presence or absence of equity involvement (Das & Teng, 1996; Gulati, 1995a; Santoro & McGill, 2005; Osborn & Baughn, 1990), is an important decision that can influence alliance success (Sampson, 2004) by mitigating opportunism, providing a framework for cooperation (Pangarkar & Klein, 2001), and safeguarding intellectual assets (Li, Eden, Hitt, & Ireland, 2008). Prior studies examining alliance governance structure have focused on internal and external factors of the alliance partners, such as alliance objectives (Shah & Swaminathan, 2008; Teng & Das, 2008), degree of joint collaboration (Pangarkar & Klein, 2001), cultural similarity (Gulati, 1995b; Pangarkar & Klein, 2001), alliance management experience (Al-Laham et al., 2008; Teng & Das, 2008), legitimacy (Dacin, Oliver, & Roy, 2007), partner credibility (Dunne et al., 2009), and international differences (Teng & Das, 2008). Thus, previous research indicates that the choice of the governance structure is a defining event in the alliance formation process that can be influenced by both external and internal contexts of the partners.

However, the body of work examining the relationship between external context and alliance governance selection is limited and inconclusive, requiring more research. Specifically, Gulati (1995b), Gulati and Singh (1998), and Teng and Das (2008) suggest that international alliances (i.e., alliances with differences in culture and regulations) tend to result in equity governance structures, while Pangarkar and Klein (2001) found that national cultural differences between partners did not influence the type of governance structure selected. Meanwhile, Yiu and Makino (2002) found that cultural differences resulted in equity alliances rather than wholly owned subsidiaries. Thus, more clarity is needed regarding the impact of international context on alliance governance structure. With respect to social contexts, Dunne et al. (2009) found that lower social capital of a biotech firm resulted in lesser prevalence of alliance equity structures, while the social capital of the pharmaceutical firm had no impact on alliance governance structure. This work suggests that social context is a complex phenomenon requiring more research. Additionally, we include the technological context as an additional external context that has received attention in the alliance formation literature. Specifically, prior work suggests the local technological munificence of the biotech firm plays an important role in the alliance formation process (Coombs, Mudambi, & Deeds, 2006). However, little is known about the effect of technological munificence on alliance governance structures, requiring further research.

In this study, we focus on key determinants of alliance governance structure associated with the external context (international, social, and technical) of the biotech firm that have been identified as important external context considerations in alliance formation dynamics. We focus on the biotechnology firm's perspective for three important reasons. First, the differences in resources and capabilities of the smaller biotechnology firm and larger pharmaceutical firm create unique and complex dynamics. Research has demonstrated that typically the larger pharmaceutical firms with more financial resources have greater power in negotiating with the biotechnology firm (Lerner & Merges, 1998), but the pharmaceutical firms must also convince biotech firms of their capabilities, particularly in clinical development, and that they have an established worldwide infrastructure that can support and readily distribute newly developed drugs (Wharton, 2002).

In addition, there is considerable heterogeneity among the biotechnology firms with respect to strength of intellectual property possessed and stage of the technology that impacts how the biotechnology partner will exert its influence within the alliance. Biotechnology firms with partners significantly larger than themselves can still have bargaining power to get their interests met when the two parties have opposing governance interests (Bosse & Alvarez, 2010). More recent research on co-development argues that a biotechnology firm (upstream partner) and a pharma firm (downstream partner) often have different objectives or goals with different challenges (Fang, Lee, & Yang, 2015). Thus, although the objectives and insights of both partners are important, in this study we focus on the biotechnology firm's perspective of alliance governance selection since the biotechnology firm often has sufficient influence and decision-making power in the negotiation process.

Finally, in studies of biotech–pharma alliances, the biotechnology firm has been less studied. Moreover, because biotech firms are often resource strapped, they are at a greater potential risk for survival. We therefore believe it is useful to understand how biotech firms leverage their resources and position within an alliance and contend this can make a significant contribution to the literature.

Here, we consider three key factors that constitute the environment or context of the biotechnology firm and how these factors affect the choice of governance structure. First, we consider national cultural distance between the biotech firm and its partner as being representative of the international context, local technological munificence of the biotech firm as the technological context, and biotechnology firm credibility as a part of the social context.

THEORY AND HYPOTHESES

Governance structure, a legal agreement between allying firms, is an important consideration in the alliance formation process that can impact alliance success. Alliances are subject to opportunism costs related to partner uncertainty and a lack of authority to ensure compliance (Parkhe, 1993; Santoro & McGill, 2005), particularly when valuable knowledge and technology are being disclosed (Alvarez & Barney, 2001; Sampson, 2004). Selecting the appropriate governance structure can mitigate opportunism, provide a framework for cooperation (Gulati, 1995a), align incentives to encourage partner transparency and knowledge transfer, reduce free-riding (Dyer & Singh, 1998; Kogut, 1989), and improve managerial control (Das & Teng, 1996; Gulati, 1995a; Gopalakrishnan, Scillitoe, & Santoro, 2008; Osborn & Baughn, 1990).

Governance structures are broadly classified as the presence or absence of equity involvement (Das & Teng, 1996; Gulati, 1995a; Osborn & Baughn, 1990). Equity alliances involve equity commitments by each partner firm and include both majority and minority equity arrangements (Das & Teng, 1996; Yoshino & Rangan, 1995). Nonequity alliances are contractual arrangements that do not involve an equity commitment by the allying partners. Nonequity arrangements are generally closer to market transactions, involving less hierarchy and structure, whereas equity arrangements are more akin to a hierarchical form of governance (Gulati, 1998; Santoro & McGill, 2005), involving tightly coupled arrangements through formal structures, joint ownership, and greater interdependence (Dacin et al., 2007). Overall, studies have shown that equity structures result in greater commitment and adaptability to changing environments, often leading to greater alliance success (Dacin et al., 2007; Pangarkar & Klein, 2001). However, the choice of an equity or nonequity governance structure is a complex decision that needs to be made by the allying partners.

Biotech firms, particularly new startups, tend to have few, if any, commercialized products or commercialization expertise and are often dependent upon their proprietary technological knowledge for competitive advantage (Coombs & Deeds, 1998, 2000). Biotech firms use their proprietary technological knowledge to signal the strength of their resource base to create alliance opportunities for commercialization but are hesitant to disclose details of this technology for fear of opportunism (Coombs & Deeds, 2000). Conversely, pharmaceutical firms must learn enough about the biotechnology firm to determine its potential commercial value when leveraged with their alliance management and downstream commercialization expertise as part of the alliance formation decision (Coombs & Deeds, 2000; Rothaermel & Deeds, 2006).

Equity and nonequity alliances offer positives and negatives for both partners. Equity alliances allow the pharmaceutical firm to have a greater financial investment (Coff, 1999), strategic and operational control (Gulati, 1995a), and more detailed, reliable, and accurate information about the biotech firm and its technologies (Osborn & Baughn, 1990). When taking an equity position in a biotech firm, the pharmaceutical firm also buys a call option for a subsequent equity purchase (Folta & Miller, 2002) or acquisition (Folta, 1988). This equity position can limit competitors from allying with the biotech firm, protecting privileged information that could be disclosed giving competitors an advantage. The pharmaceutical firm also better controls relational risk but can increase its performance risk (Das & Teng, 1996) since equity alliances are more difficult to terminate and modify and are more complex and costly to manage (Buckley & Casson, 1988; Pangarkar & Klein, 2001).

A biotech firm can benefit from an equity alliance by leveraging the commercialization and alliance management capabilities of its pharmaceutical partner (Al-Laham et al., 2008; Rothaermel & Deeds, 2006) and by sharing the performance risk of its technology (Das & Teng, 1996). An equity arrangement also signals to the market the potential value of the biotech technology, increasing the biotech firm's market valuation and ability to attract subsequent funding partners (Folta & Janney, 2004; Janney & Folta, 2006). However, the biotech firm loses control over its technology and, consequently, runs the risk of reducing its future profit streams (Hitt, Ireland, & Santoro, 2004). In nonequity arrangements, the biotech firm retains greater control of its technology and associated profit streams but may not gain as much commercialization help from its pharmaceutical partner (Das & Teng, 1996). Also, nonequity alliances can be more easily terminated than equity alliances, thereby minimizing partner costs and alliance-specific investments (Gulati, 1995a).

As mentioned earlier, our focus is on the biotechnology firm's perspective with respect to governance structure decisions within these alliances. Generally, the biotechnology firm is smaller, has fewer resources, and has less alliance experience and capabilities than its pharmaceutical partner. Often, in biotech–pharmaceutical firm alliances the much larger pharmaceutical firm is often the bigger winner (Alvarez & Barney, 2001), which can result in significant reduction of competitive advantage of the biotech firm. Thus, we believe the governance selection decision is very important for the biotechnology firm since it needs to balance its demands for monetary and commercialization resources with its ability to remain competitive. In this quest, the biotechnology firm desires to retain control of its technological knowledge as much as possible and to increase its profitability with commercialization support from its pharmaceutical partner.

PARTNER EXTERNAL CONTEXTS AND ALLIANCE GOVERNANCE STRUCTURE

Governance structure is a crucial aspect of the alliance formation process, and the alliance partners' contexts associated with their external environment are important considerations in governance selection as firms seek to best manage environmental uncertainty (Pangarkar, 2007; Pangarkar & Klein, 2001). Prior research on strategic alliances suggests key external

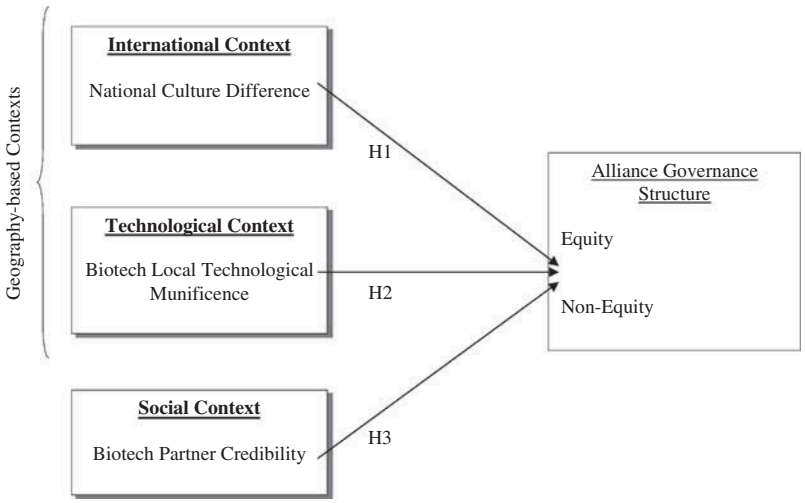

FIG. 1. External contexts and alliance governance.

contexts that influence alliance formation are international, technological, and social contexts. We elaborate upon each of these contexts next (see Figure 1).

International Context

The prevalence of international strategic alliances, those involving partners from differing countries, continues to increase dramatically (Hagedoorn & Narula, 1996; Gopalakrishnan et al., 2008; Pangarkar & Klein, 2001). However, international alliances encompass greater sociocultural, political, legal, and economic complexities in comparison to domestic alliances, and these complexities often influence alliance governance selection (Gulati, 1995a; Gulati & Singh, 1998; Teng & Das, 2008). One key aspect of the international context that can influence alliance governance selection is national culture.

National culture reflects the stable, normative belief system within a nation that influences how work is done and, in the global marketplace, creates a simultaneous blending, battling, and ushering in of diverse connections (Kessler & Wong-Mingji, 2009). National culture is fostered within families, is reinforced in institutions, and influences the organization's structure and its integration and adaptation to the external environment (Barkema & Vermeulen, 1997; Hofstede, 1983). National culture also impacts employee motivation, interactions, belief systems, and management styles in the workplace (Gopalakrishnan & Kaur, 2009).

Although national culture is considered a stable force within nations (Barkema & Vermeulen, 1997), it differs widely among nations (Hofstede, 1980, 1983; House, Hanges, Javidan, Dorfman, & Gupta, 2004) and plays a role in alliance governance selection (Pangarkar & Klein, 2001; Yiu & Makino, 2002). Partners from more differentiated cultures experience lower trust and coordination, greater conflict and miscommunication, (Das, 2006), and differing frames of reference and behavior (Kumar & Nti, 2004; Parkhe, 1991), leading to increased costs of cooperation and the risk of alliance dissolution or less than stellar alliance performance (Barkema & Vermeulen, 1997). These difficulties are often magnified within international alliances, in comparison to domestic alliances that typically involve greater cultural homogeneity and shared beliefs, which in turn can reduce opportunism and transaction costs (Agarwal, 1994; Hofstede, 1996; Pangarkar & Klein, 2001).

Das (2006) suggests that the risks of opportunism are higher in alliances with greater national cultural distance between partners, and therefore partners in such alliances prefer to work within a shorter time horizon. However, the higher transaction costs and lack of trust between culturally dissimilar partners can result in the creation of "safer" organizational forms such as an equity alliance (Pangarkar & Klein, 2001). This is especially salient when one of the partnering firms (often the biotechnology firm) is smaller with lesser alliance experience and alliance management capabilities than its partner, causing the biotech firm to rely on contractual mechanisms (Rothaermel & Deeds, 2006) or equity governance structures (Hennart, 2006). Equity structures create hierarchical governance mechanisms that enable partners to align incentives and develop formal mechanisms for greater cooperation, knowledge sharing, and alliance management (Osborn & Baughn, 1990; Pangarkar, 2007).

Biotech firms typically prefer to retain independence and control over their operations and resources (Coombs & Deeds, 2000), but in light of the challenges associated with national cultural differences they are more willing to relinquish control via an equity governance structure to ensure greater mutual success in order to commercialize their technology. Thus, we propose:

Hypothesis 1: International alliances consisting of biotech firms with greater national cultural differences from the pharmaceutical firms will be positively related to equity governance structures.

Technological Context

The local technological context of allying partners is another important consideration in alliance governance (Almeida, 1996; Almeida & Kogut, 1997), including within the biotechnology industry (Coombs et al., 2006; Decarolis & Deeds, 1999). The local technological munificence associated with the biotech firm, defined as the knowledge base in the biotechnology firm's local area, offers both alliance partners access to relevant and new knowledge.

When firms are centered in an area with a strong supporting industry ecosystem, an environment of creativity facilitates idea exchanges and knowledge spillovers through formal and informal methods, fostering increased research productivity and innovation (Coombs et al., 2006). These ideas and spillovers tend to diffuse among local players quickly, but diffusion to other geographic regions occurs more slowly (Almeida & Kogut, 1997), making the association with the technologically munificent area attractive for both partners. Alliance partners are attracted to biotech firms in technologically munificent locations where significant activity related to the biotech industry is ongoing and new knowledge is available (Coombs & Deeds, 2000).

A technologically munificent local area also serves as a bonding network that encourages cohesiveness, the pursuit of common goals, and sharing of complex knowledge that becomes embedded within firms over time (Adler & Kwon, 2002; Coleman, 1988; Zaheer & George, 2004). March (1981) suggests that borrowing, not invention, is often a key driver and catalyst for innovation. We argue that it is this frequent borrowing from geographically proximate sources that forms the basis for new and enhanced organizational capabilities as new knowledge resulting from knowledge spillovers is absorbed into the firm (Deeds et al., 2000; De Jong & Freel, 2010; Teece, Pisano, & Shuen, 1997).

However, research also suggests that biotech firm innovativeness is not solely tied to one locality. Biotech firms often seek advantages through alliances not available locally (Zaheer & George, 2004). While bonding ties can be beneficial to gain deep and complex knowledge through strong ties (Coleman, 1988), a sparse network with structural holes for bridging opportunities offers the potential for new information (Burt, 1992, 1997; Zaheer & George, 2004). By reaching beyond the local region, the biotech firm enhances its innovativeness through more diverse and new contacts (Zaheer & George, 2004) and also gains access to regional, national, and global markets (Birch, 2008).

The biotech firm, when located in a technology munificent area, signals to potential partners as having access to quality knowledge and the power to gain value from it. Both domestic and international partners seek to ally with biotech firms in these locations (Coombs & Deeds, 2000). The biotech firm, subsequently, has greater leverage in governance structure determination. Biotech firms gain significant knowledge and alliance partner opportunities while associated with a technological munificent area and thus prefer to retain autonomy and control over their operations and resources (Coombs & Deeds, 2000). Also, the pharmaceutical firm may be concerned that a biotech firm located in a technologically munificent area has greater leverage through other partnering options and consequently may be more willing to give the biotech firm more leeway (with a nonequity alliance) in order to access its knowledge base. With a nonequity arrangement, the biotech firm is able to retain greater control of its technological assets yet benefit from the resources of its pharmaceutical partner to ensure greater mutual success for commercialization of its technology. Thus, we formally propose:

Hypothesis 2: Biotechnology firms located in more technologically munificent areas will be positively related to the formation of nonequity alliances.

Social Context

The social context of an alliance network is also important since interorganizational social networks are conduits of information about the credibility of an alliance partner (Al-Laham et al., 2008; Gulati, 1999; Stuart, Hoang, & Hybels, 1999). The information is gained either directly or through trusted informants within the alliance network regarding the reliability, integrity, and trustworthiness of the partner (Gulati, 1993; Stuart et al., 1999; Gopalakrishnan et al., 2008), belief in partner capabilities, and partner access to other embedded actors (Ahuja, 2000; Mizruchi, Mariolis, Schwarz, & Mintz, 1986). In the absence of direct ties, indirect ties, such as gaining information from a trusted informant about a partner's credibility, can help firms protect against moral hazards, lower search and opportunism costs (Gulati, 1999), and increase the potential for alliance success (Adler & Kwon, 2002; Granovetter, 1985; Nahapiet & Ghoshal, 1998).

Often, both the pharmaceutical and biotech firms have an alliance history that can provide information about their reputation and alliance capabilities. In this study, we focus on the biotech firm's alliance history, specifically credibility, and its impact on choice of alliance governance structure. Biotech firms with prior alliance experience and a positive reputation within the alliance network are better able to negotiate and manage alliances with more diverse and influential partners (Levitt & March, 1988) and create new alliances with fewer contractual provisions (Hitt, Ireland, Santoro, & Viney, 2004; Robinson & Stuart, 2004).

A credible biotech firm is also more valued by pharmaceutical partners compared to a biotech firm without alliance experience since there is a greater assurance of biotech firm capability, technology value, and trustworthiness, thus reducing relational risk. This credibility endows the biotech firm with leverage to create a nonequity alliance, providing it greater safeguards to its proprietary technology and thus managing the alliance with greater influence. Also, since the pharmaceutical

firm may be concerned that a credible biotech firm has other alliance partnering options, it may be more willing to yield on its insistence for an equity stake and agree to a nonequity arrangement. Thus:

Hypothesis 3: The credibility of the biotech firm will be positively related to the formation of nonequity alliances.

METHOD

Sample and Data

We focus on alliances in the biotechnology industry since the high cost of research and development, complexities of product approval, and high rates of product failure have stimulated the widespread use of alliances in this sector (Gopalakrishnan et al., 2008; Hitt, Ireland, & Hoskisson, 2001; Rothaermel, 2001). The Recombinant Capital Biotechnology (ReCap) Database, created specifically to track alliances within the biotechnology industry, was our principal data source to identify alliance activity among biotechnology and pharmaceutical firms. ReCap is a California-based consulting firm that tracks the alliances of U.S. and non-U.S. firms in the biotechnology and pharmaceutical industries. Data was collected by ReCap from amendments to 10-K, 10-Q, S-1, and 8 K documents, as well as material contract statements, submitted to the Securities and Exchange Commission.

In addition, we used several other sources including www.geert-hofstede.com for the culture measure, Coombs et al. (2006) for the technological munificence, and Compustat. When triangulating the data from these various independent sources, we identified 650 alliances formed between 1995 and 2000 involving biotechnology firms. Of these 650 alliances, 389 of them had complete data relevant to this study.

We selected the years 1995–2000 for data collection for two key reasons: data availability and the unique dynamics in the biotechnology–pharmaceutical sectors during that time period. The ReCap database did not have alliance formation data available prior to 1995. Regarding industry dynamics, there are two key issues considered: a shift to federal funding, and a "new normal" evolving from the global financial crisis. At the end of year 2000, federal funding increased significantly for biotech research so biotech firms had greater opportunities to gain funds from the government beginning in the year 2001 (Industry Studies, 2000), reducing the need for R&D alliances. However, the global financial crisis impacted the industry in late 2008, evolving to the current paradigm of efficiency and demonstrated value. Efficiency is directly related to the limited financial capital available via initial public offerings (IPOs), venture capitalists, and federal funding extended time to industry exit, and subsequent increasing debt, particularly for small biotech firms with precommercial technologies (Ernst & Young, 2013; Whitehouse.gov, 2012). Demonstrated value is the expectation driven by the evolving health care industry standard of care, where biotech firms must not just answer "will it work" but also "who cares" as they progress toward commercialization. This new normal is creating a renewed need by biotech firms to partner with pharmaceutical firms to gain needed standard-of-care expertise and share these mounting risks toward commercialization, while pharmaceutical firms continue to seek new products for commercialization and secure acquisition options with biotech firms (Ernst & Young, 2013).

Thus, we believe that data from 2001–2011 reflect industry dynamics that do not reflect the current paradigm and pre-2001 data offer the best insights for unanswered alliance governance questions, particularly for multiyear consideration. As a result, we used the year 2000 as our cutoff to ensure consistency within our sample and results.

MEASURES

Dependent Variable: Alliance Governance Structure

The dependent variable was the governance structure within the alliance, where the data for this measure were collected from the ReCap database for the period 1995–2000. Based on Gulati and Singh (1998), alliances were coded as being either nonequity alliances (coded 1) or equity alliances (coded 2). Equity alliances included both majority and minority arrangements. In our sample, we found our total sample of 389 alliances comprised of 307 nonequity alliances and 82 equity alliances.

Independent Variables

National Cultural Distance

For our measure of cultural distance, we used Hofstede's (1983) dimensions of national culture (power distance, individualism–collectivism, masculinity–feminism, uncertainty avoidance). We collected data across these four dimensions for each nation from www.geert-hofstede.com. A composite index of culture for each nation was created and the cultural distance between nations based upon these indices was calculated. using the following formula adapted from Kogut and Singh (1988):

$$CD_j = \left| \sum_{i=1}^{4} \left\{ \left(I_{ij} - I_{iu} \right) / V_i \right\} / 4 \right|$$

where I_{ij} stands for the index for the ith cultural dimension and jth country, V_i is the variance of the index of the ith dimension, u indicates the national country of the biotech firm, and CD_j is the cultural difference of the jth country from the biotech nation.

Local Technological Munificence

This variable data was procured from Coombs and colleagues and was measured based upon the Metropolitan Statistical Area (MSA) of the firm and is a factor measure based upon five variables: grant value, number of grants, competitors, medical schools, and graduate science departments

(Coombs et al., 2006). Grant value was measured as the total value of National Institutes of Health (NIH) grants awarded to universities that were among the top recipients of NIH grants in the given year and located within the biotech firm MSA. Number of grants was measured as the total number of NIH grants awarded to universities who were the top 100 recipients of NIH grants in the given year and located within the biotech firm MSA. Competitors were measured as the percentage of the total population of biotech firms operating within the biotech firm's MSA. Medical schools were measured as the number of the top 100 ranked medicals schools within the biotech firm's MSA. Science departments were measured as the number of universities with ranked graduate science departments in the areas biochemistry, biology, botany, chemistry, and microbiology within the biotech firm's MSA. A factor analysis conducted on these five contributing variables generated a single factor explaining 80.15% of the variance (Coombs et al., 2006). Since this measure was already used in previous studies (e.g., Coombs et al., 2006; Gopalakrishnan, Scillitoe, & Santoro, 2008), we used this same measure in this study. The firms in our sample were located in 21 clusters, and the clusters with significant number of alliances were located in California, Massachusetts, Washington state, New York and Northern New Jersey, Philadelphia-Camden area and Houston-Sugarland area in Texas. (see Table 1).

Biotech Credibility

Following Gulati (1993, 1999), credibility for the biotechnology firm was measured as the total number of alliances that a firm had with other firms prior to the formation of the alliance under examination along with any other current alliances the firm has with the partnering firm. The credibility measure was calculated based on data provided by the ReCap database for the time period January 1995 to December 2000.

Control Variables

Firm Size

We use the log of total assets of the biotechnology firm at the time of alliance formation as a measure of firm size. Value of total assets in dollars was collected from the Compustat database. Due to skewness in this measure, a log transformation was used.

Stage of Technology Development

The stage of technology development refers to the development stage of the technology associated with the alliance at the time of alliance formation. Nine stages were identified in the ReCap database for the development and commercialization of technologies in the biotech–pharmaceutical alliances examined (Discovery, Lead Molecule, NDA Approved, Formulation,

TABLE 1
Sample MSA distribution

U.S. metropolitan statistical area	Number of alliances	Percent of alliances
San Francisco–Oakland–Fremont, CA	81	20.82%
Boston–Cambridge–Quincy, MA–NH	51	13.11%
San Jose–Sunnyvale–Santa Clara, CA	50	12.85%
San Diego–Carlsbad–San Marco, CA	36	9.25%
Seattle–Tacoma–Bellevue, WA	34	8.74%
New York–Northern New Jersey–Long Island, NY–NJ–PA	28	7.20%
Philadelphia–Camden–Wilmington, PA–NJ–DE–MD	27	6.94%
Trenton–Ewing, NJ	15	3.86%
Houston–Sugar Land–Baytown, TX	11	2.83%
Washington–Arlington–Alexandria, DC–VA–MD–WV	9	2.31%
New Haven–Milford, CT	7	1.80%
Portland–Vancouver–Hillsboro, OR–WA	7	1.80%
Salt Lake City, UT	7	1.80%
Minneapolis–St. Paul–Bloomington, MN–WI	6	1.54%
Baltimore–Towson, MD	5	1.29%
Boulder, CO	4	1.03%
Miami –Fort Lauderdale–Pompano Beach, FL	4	1.03%
Durham–Chapel Hill, NC	3	0.77%
Los Angeles–Long Beach–Santa Ana, CA	2	0.51%
Phoenix–Mesa–Glendale, AZ	1	0.26%
Columbus, OH	1	0.26%
Total alliances in sample	389	100.00%

Preclinical, Phase 1, Phase 2, Phase 3, and Approved). We relied on three additional independent sources to triangulate our classification for technology development: (a) input from a panel of five biotechnology and pharmaceutical experts, (b) the Hambrecht and Quist Road Map for Investing in the Drug Business, and (c) the stage typology proposed by Rothaermel (2001). Using these three independent sources as our guide, we were able to cluster the original nine stages from the ReCap database and consolidate them into the four main stages of Discovery, Early Clinical trials, Late Clinical trials, and Launch. We then coded alliances in the discovery stage with a "1," alliances operating in the early clinical stage with a "2," alliances operating in the later clinical stage with a "3," and alliances operating in the launch stage with a "4."

RESULTS

Table 2 presents the means, standard deviations, and correlations of the study variables. We used binary logistic regression for hypotheses testing with three models displayed in Table 3. Our base model (Model 1) included two control variables: firm size and stage of technology development at the time of alliance formation. In Model 2 we included two geography-based variables: national cultural distance and local technological munificence. In Model 3 we added a social context variable: biotechnology firm credibility. Our full model (Model 3) had a chi-squared of 47.80 ($p < .001$) and shows a Nagelkerke *R*-squared of .18. Among our control variables, firm size, measured as the log of total assets of the biotech firm upon alliance formation, was consistently significant across Models 1–3 ($\beta = -0.57$, -0.58, and -0.46, respectively, $p < .001$). This suggests that biotech firms with more assets are more likely to favor nonequity alliances. Stage of technology development, our other control variable, was not significant in Models 1–3 ($\beta = 0.16$, 0.18, and 0.09 respectively, *ns*). For Hypothesis 1, we argued that greater national culture distance among alliance partners would lead to equity governance structures. We found support for this hypothesis ($\beta = 25.37$, $p < 0.05$ in Model 2 and $\beta = 23.62$, $p < .05$ in Model 3). Hypothesis 2, which stated that greater technological munificence of the biotech firm's location will lead to more nonequity alliances, was not supported ($\beta = 0.02$, *ns*). We found support for Hypothesis 3 ($\beta = -0.15$, $p < .01$) where we posited that the greater the credibility of the biotechnology firm, the greater would

TABLE 2
Descriptive statistics and correlation matrix

Variables	Mean	*SD*	1	2	3	4	5	6
Governance structure of alliance	1.21	0.41	1.00					
Firm size	4.83	1.39	−0.20***	1.00				
Stage of technology development	1.58	0.90	−0.06**	0.07+	1.00			
National cultural distance	0.01	0.01	0.13**	0.03	−0.02	1.000		
Local technological munificence	1.24	3.71	−0.02	0.18***	−0.01	0.04	1.00	
Biotechnology firm credibility	5.34	4.04	−0.12***	0.35***	−0.10***	−0.04	0.09*	1.00

Note. $N = 389$.
$^{+}p < .10$, $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

TABLE 3
Logistic regression of governance structure of biotech–pharma alliances

	Model 1, control variables	Model 2, geographic context variables	Model 3, social context variables
Variables	Std. beta	Std. beta	Std. beta
Constant	1.01+	0.85	1.10*
Firm size	−0.57***	−0.58***	−0.46***
Stage of tech development	0.16	0.18	0.09
National cultural distance		25.37*	23.62*
Local technological munificence		0.02	0.02
Biotechnology firm credibility			−0.15**
Block chi-squared	31.45***	6.09*	10.27**
Model chi-squared	31.45***	37.53***	47.80***
Nagelkerke *R*-squared	0.12	0.14	0.18

Note. $N = 389$; nonequity alliances = 307 and equity alliances = 82.
$^{+}p < .10$, $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

be the likelihood of nonequity alliances. Overall, our results provide support for two of our three hypotheses and suggest both social and international contexts play a role in the alliance governancebr decision.

DISCUSSION

Previous research on the role of the external environment of alliance partners on alliance governance has offered limited and sometimes conflicting evidence. Our study contributes to this literature in several ways. First, we offer a more in-depth consideration of external context factors that influence alliance governance selection by clearly identifying and testing key contextual factors associated with international alliances, addressing conflicting insights from past research on the role of national culture, and providing new consideration of technological munificence on alliance governance. Second, we offer support to prior findings regarding the role of biotech firm credibility in alliance governance selection. Finally, we simultaneously focus on all key elements of the external context to offer a holistic insight of this context on alliance governance. This is a notable addition to the literature, since prior studies considered only pieces of this context without offering a more comprehensive understanding of their simultaneous influence and effect on alliance dynamics.

Our control variable findings show that biotech firms with greater assets, particularly financial assets, are more likely to secure a nonequity alliance governance structure. This finding is consistent with the notion that a biotech firm that has more resources available will prefer to leverage those resources and seek to retain control of its technology through nonequity arrangements. A biotech firm with more resources will have lesser need for external funding from current or future partners and will have less concern with survival, placing it in a better negotiating position.

Regarding our hypotheses, we posited within the international context that greater national cultural distance would result in equity alliances due to the increased complexities resulting in greater perceived mistrust and opportunism associated with more distant cultures. Our results support this argument. This finding appears to contradict some past research that suggested there was no relationship between national cultural distance and alliance governance choice (see Pangarkar & Klein, 2001) but is consistent with Yiu and Makino (2002), who found that national culture invites equity alliances over acquisition, and Gulati (1995b), who found that greater national cultural distance resulted in equity alliances. Perhaps our findings differ from Pangarkar and Klein's (2001) study since their sample included mostly R&D alliances and also included joint ventures in their sample. R&D alliances tend to be formed as equity arrangements (Gulati, 1995b), and this could overshadow other governance considerations. Gulati (1995b), in contrast, controlled for R&D alliances and found that national culture distance influenced governance in the form of equity arrangements. The dynamic between pharmaceutical and biotech firms is often based upon commercialization activities. In addition, joint ventures were not included in our study. Thus, it is possible that although Pangarkar and Klein (2001) suggest that the impact of cultural distance in the alliance formation process is overestimated, our findings and analysis of prior research suggest the focus of the alliance plays a significant role in the governance decision. For R&D activities, particularly in the context of joint ventures, scientists and technologists may have a greater opportunity to work together and develop personal relationships and trust that can lead to cultural understanding that may be less present in alliances focused on commercialization activities, such as biotech–pharmaceutical alliances that are linked forms with limited competency overlap (Pangarkar, 2007; Reuer, Zollo, & Singh, 2002). Differences in national cultures significantly influence the risks of opportunism and transaction costs when there is no prior relationship, and we surmise that equity structures can mitigate these perceived risks and costs. Thus, this premise highlights the probable role of relationship dynamics in the alliance formation and governance selection process. Further investigation into these dynamics is needed but beyond the scope of this study.

We also considered the technological munificence of the biotechnology firm that can influence alliance governance structure choice, a new consideration to this literature. While past research suggests that technological munificence, or technological hot spots, offer valuable benefits to affiliated firms such as knowledge spillovers, labor mobility, and informal and formal interactions that enable knowledge exchange (Coombs et al., 2006), our findings suggest biotech local technological munificence does not influence the choice of alliance governance structure. Biotech firms often locate in hot spots to gain knowledge benefits and to improve their access to technology personnel and R&D. Consequently, pharmaceutical partners can use these locations to identify quality biotech firms that they could partner with. While alliances with biotech firms in certain hot spots are desirable and can result in increased financial capital gained from international partners (Coombs & Deeds, 2000), there does not appear to be a significant link to the choice of governance structure of these alliances, since more than 90% of firms are located in clusters and there is limited variability in the measure. We surmise technological munificence only influences the determination of choosing an alliance partner, not the more micro issue of alliance governance.

Finally, our results also contribute to the social capital alliance literature by suggesting that, despite having less financial, physical, or human resources, credible biotech firms in the alliance network can engage in nonequity arrangements due to their reputational power and influence. For example, Al-Laham et al. (2008) found that general alliance experience affects the speed at which firms enter into alliances. Hoang and Rothaermel (2005) suggest that biotech firm credibility was an indicator of alliance success, while Dunne et al. (2009) found that biotech firm credibility resulted in the formation of

nonequity alliance governance structures. Our study extends these earlier works by further punctuating that alliance experience for the biotechnology firm confers leverage and credibility in the marketplace, which enables them to better negotiate with the pharmaceutical firm when structuring an alliance. We suspect that credible biotech firms are able to court the interests of several pharmaceutical firms simultaneously, further improving their leverage and even delaying alliance formation with the courting partners to find the best arrangement. Our study builds from prior research strengthening the assertion that previous alliance experience may be important in many aspects related to alliance formation, structuring, and management.

Managerial Implications

Our findings have implications for both biotech and pharmaceutical managers, suggesting that the type of alliance governance structure chosen is contingent upon international and social contexts of the external environment, providing management with clearer mechanisms useful for facilitating various alliance activities and outcomes.

A biotech firm may be better off expending time and resources seeking domestic pharmaceutical partners instead of international partners when desiring a nonequity alliance—understanding that an equity alliance would be the more likely outcome due to cultural differences that increase the perception of mistrust and opportunism. However, a biotech firm can leverage its reputation and clout within the alliance network as a credible potential partner to seek its desired terms, particularly a nonequity alliance, to retain greater control and profits associated with its technology.

Although this study is focused on the biotechnology firm partner, managerial implications can be found for the pharmaceutical firm as well. If a pharmaceutical firm desires a nonequity arrangement, governance that reduces its risk associated with a biotech's developing technology, it may focus its resources to identify a domestic biotech firm. Also, as another strategy to identify a partner for a nonequity alliance, a pharmaceutical firm may seek a biotech firm with a stronger alliance reputation where it can be more assured of the technological capabilities and trustworthiness of the partner. The technological munificence of the area of the biotech firm does not appear to influence governance structure. We know there can be disagreements and differing motivations that drive the choice of governance structure that go beyond the initial strategic objectives and external contextual considerations for an alliance. Our study offers a piece of the larger contingency perspective to governance choice where managers can consider a portfolio approach to alliances and alliance management, since a large number of alliances with different partners confronting different conditions may require a combination of both more or less hierarchical forms of control that often necessitate different alliance management skills, expertise, and backgrounds.

Limitations and Additional Suggestions for Future Research

Despite our contributions, there are limitations to this study. First, although we used several independent data sources, we relied solely on secondary data. While our focus on SEC filing firms offers a fairly comprehensive examination of biotech-pharmaceutical alliance dynamics, we did not include privately held, non-SEC filing firms in our sample since the availability of alliance formation and performance data of these firms is limited. Although research on these privately held firms is challenging, pursuing this line of inquiry could provide additional insights.

Second, demarcating the alliance formation process and consideration of the various factors influencing various stages of this process and their interactions would provide a clearer picture on alliance formation issues. For example, determining who to ally with and the up-front financial payments made to a biotech firm by the pharmaceutical firm partner could be further explored within the context of governance choice and the contingencies we propose here. Examining the extent of financial capital and the status gained through allying with a credible partner or with a firm in a locally technological munificent area could disclose additional forces that influence alliance formation.

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