

## *Risk-based perspective on the choice of alliance governance in high-tech industries*

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### **Abstract**

This paper examines the influence of risks on alliance governance modes in high-tech industries. The extant literature has devoted little attention to the preferred governance mode based on the risks surrounding alliances. In this paper, we examine why risks are key factors in the alliance governance decision and investigate the choice of alliance governance mode in high-tech industries. Hypotheses are formulated based on risk perspectives; these hypotheses are empirically tested using data on 3,228 alliance records generated over the past 5 years in high-tech industries. The results suggest that risk perspectives provide an effective rationale for choosing an alliance governance mode in a high-tech industry. In the conclusion, we discuss critical issues in the current debates on predicting alliance governance modes.

**Keywords:** alliances and joint ventures, risk perspectives, governance, transaction cost economics

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### **INTRODUCTION**

The main purpose of this paper is to analyze how the risks involved in alliances formed by high-tech firms influence the choice of governance mode. Firms are regarded as high-tech firms when they dedicate a considerable amount of research and development (R&D) spending to new product and/or service development<sup>1</sup>. These firms operate in a highly turbulent and uncertain technological and business environment, which leads to a high level of risk in managerial decision making. Therefore, alliances are considered a pivotal strategic means of hedging or sharing such risks to reduce costs and acquire complementary resources, market power and social recognition (Eisenhardt & Schoonhoven, 1996; Cyr & Re, 1999).

Traditionally, a few theories have predominated as effective arguments and empirical methodologies to explain why firms form alliances and prefer certain governance modes (Parmigiani & Rivera-Santos, 2011). At the forefront of these theories, transaction cost economics (TCE) is quite powerful in explaining alliance formation and the selection of governance modes from the perspective of cost efficiency (David & Han, 2004; Lee, Johnson, & Grewal, 2008). The resource-based view provides

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<sup>1</sup> Smith (2005) categorized industrial sectors as high/medium/low tech, depending on the level of R&D expenditures. Industries with an R&D intensity of over 5% are regarded as 'high-tech' industries, where R&D intensity is measured as the ratio of R&D expenditures to total revenue (Smith, 2005).

rationales for creating value through the exchange and sharing of resources (Eisenhardt & Schoonhoven, 1996). In addition, social networks theory has been used as either an explanatory or moderating factor that initiates and/or facilitates alliance formation and influences the choice of governance mode (Borgatti & Foster, 2003; Borgatti, Everett, & Johnson, 2013). While these theories provide complementary perspectives on alliance formation and governance modes, they are lacking with respect to considering the *risks* perceived by decision makers. Firms' decision makers are likely to face two opposing perceptions when forging alliances: opportunity (Eisenhardt & Schoonhoven, 1996) and risk (Das & Teng, 2001). Thus, they opt for strategic alliances because there are opportunities to create value, but there are also risks associated with these opportunities. While the opportunities gained through strategic alliances, such as cost efficiency, resource complementarity and social recognition, and preferred governance modes have been vigorously studied (Parmigiani & Rivera-Santos, 2011), how such risks influence alliance governance has largely been ignored. Among the rare cases addressing the latter topic, Hsieh, Rodrigues, and Child (2010) attempted to identify how risks affected post-formation alliance governance modes in international joint ventures formed by Taiwanese firms. The authors found that when confronted with high risks, contractual arrangements, such as renegotiation, monitoring and reporting, are strengthened. However, their study was based on post-formation alliance governance and did not provide implications for decision makers with respect to the risk–governance relationship during the alliance formation stage (which is a more common situation in business practice). There is also a limited stream of literature that examines the situations in which firms prefer a certain alliance governance mode based on the level of risk (Hsieh, Rodrigues, & Child, 2010). Thus, we identify a substantial empirical gap in the risk and alliance governance literature.

Based on strategic decision-making perspectives, Das and Teng (1999, 2001) asserted that a managerial perception of risk is critical in decision-making processes such as alliance governance modes (broadly classified as contract-based alliances<sup>2</sup> or equity joint ventures [EJVs]). A risk-based perspective suggests that if the risk perceived in an interfirm alliance is low, firms are likely to choose EJVs; conversely, if the perceived risk is high, firms will prefer contract-based alliances (i.e., non-EJVs) as the alliance governance mode. When high risk is present, EJVs may not be an appropriate alliance governance mode (Das & Teng, 1999, 2001). Because EJVs require assets to be invested in newly established firms for specific purposes (i.e., they require high asset specificity), they have a negative impact on alliance flexibility, including the ability not only to switch alliance partners but also to change both alliance goals and the terms and conditions of alliance contracts.

Trends in alliance governance modes also demonstrate that high-tech firms in which uncertainty and risk are predominant prefer contract-based alliances (i.e., flexible alliance governance modes) to EJVs because the former address both the high uncertainty and the risk inherent in such firms' business environments (Das & Teng, 1999; Hagedoorn, 2002). The problem with the extant organizational studies is that poor arguments and scant – if any – empirical tests are found to explain why more non-EJV, contract-based alliances are formed in high-tech industries characterized by high uncertainty and risk. In this study, we adopt the risk perspective and empirically test the choice of alliance governance mode in the context of high-tech industries. Based on the literature review, we begin by discussing how the levels of risks affect alliance governance modes and which modes are preferred. Next, we explore five risks identified in this study to develop our hypotheses and perform empirical analyses. Finally, we discuss implications for researchers and practitioners.

<sup>2</sup> We use 'contract-based alliances' and 'non-EJVs' interchangeably in this paper. The main purposes of such arrangements are to conduct collaborative work, not to establish a new entity such as an EJV. Joint R&D, subcontracted R&D, technology licenses (e.g., license in/out, cross-licenses), joint marketing alliances, supply chain alliances, distribution alliances and brand alliances are some forms of contract-based alliances.

## LITERATURE REVIEW

Previous interfirm alliance studies have devoted relatively little emphasis to risk perspectives, which are prevalent in strategic decision making (Das & Teng, 2001; Hsieh, Rodrigues, & Child, 2010). Researchers have presented 'risk' and 'uncertainty' as key determinants of strategic decision making<sup>3</sup> (March & Shapira, 1987; Das & Teng, 1996; Delerue, 2004). From the strategic management perspective, strategic decision making involves both forming a strategic alliance and selecting an alliance governance mode (Das & Teng, 2001). Therefore, the choice of alliance governance mode can be affected by the risk surrounding firms' strategic decision making (Das & Teng, 1996, 2001; de Man & Roijakkers, 2009). In the series of conceptual works by Das and Teng (1996, 1998, 1999, 2001), the authors devoted particular attention to the relationship between risk and alliance governance, which had not previously been an area of focus. The authors proposed 'a risk perspective of alliance governance,' which suggests that firms choose specific types of alliance governance modes based on the level of risk they face. A central tenet of this perspective argues that firms prefer contract-based alliances to EJV's as the alliance governance mode when the level of alliance risk is high and vice versa. Strategic alliances are shown to have diverse risks, and the type of alliance governance mode can be influenced by the level of risk.

Das and Teng (1996, 1999, 2001) proposed two categories of risks in interfirm alliances: relational and performance risks. Those categories have been adopted by a number of scholars (Delerue, 2004; Coletti, Sedatole, & Towry, 2005; Paik, 2005; de Man & Roijakkers, 2009). Relational risk is defined as the 'probability and consequences that a partner firm does not commit itself to the alliance in the desired manner. It encompasses those relational problems that may hinder the achievement of strategic objectives, such as the partner's opportunistic behavior' (Das & Teng, 2001: 6). Williamson (1981: 554) explained opportunism as the nature of human characteristics in all transactions, describing it as 'self-interest seeking with guile.' Because economic agents engage in opportunistic behaviors, relational risk is present in transactions that include (but are not limited to) strategic alliances. Das and Teng (2001) referred to the following relational risk factors: 'opportunistic behavior,' 'inequity' and 'trust.'

Performance risk is defined as 'the probability and consequences that a firm's strategic objectives are not achieved, despite full cooperation. Specifically, it refers to the hazard that an alliance may fail despite the efforts and cooperation of the partners' (Das & Teng, 2001: 8). Even when partners are fully committed and cooperative, factors such as external environmental changes and insufficiently competent partners increase performance risk, leading interfirm alliances to fail. Das and Teng (2001) suggested the following performance risk factors: 'strategic risk,' 'international risk,' 'R&D risk' and 'corporate risk.'

Subsequent scholars have identified a number of alliance risks: 'the risk of rapid technological obsolescence' (Colombo, 2003), 'technological transfer complexity' (Phene & Tallman, 2012), 'allying with direct competitors' (Das & Teng, 2001; Casciaro, 2003; Oxley & Sampson, 2004), 'unintended knowledge leakage' (Jiang, Li, Gao, Bao, & Jiang, 2013), 'financial risk of alliance partners' (Hagedoorn, 1993) and 'a lack of institutional (legal or regulatory) safeguards' (Oxley & Sampson, 2004). This paper

<sup>3</sup> Baird and Thomas noted the ambiguity in distinguishing between risk and uncertainty. They stated, 'Risk is a condition in which the consequences of a decision and the probabilities associated with the consequences are known entities. Uncertainty exists when problem structure, consequences, and probabilities are not fully known' (Baird and Thomas, 1985: 231). However, under strategic decision-making conditions, it is difficult to ascertain those probabilities. Thus, the strategic management literature often treats 'risk' and 'uncertainty' as interchangeable (Baird & Thomas, 1985). However, we should note that, by definition, the relevant literature does not consider uncertainty and risk to be identical (Thompson, 1967). Uncertainty can be regarded as something that needs to be controlled (i.e., an unpredictable future), while risk can be regarded as something that needs to be avoided (i.e., a perceived negative outcome). To avoid confusion, this study focuses on 'risk,' not 'uncertainty' factors.

focuses on a number of alliance risks identified from an extensive literature review and devotes particular attention to performance or strategic risk factors that are common to alliance participants.

In an attempt to demonstrate how risks affect the choice of alliance governance mode, de Man and Roijakkers (2009) analyzed five alliance cases to present the interaction of risk, control and trust in the choice of an alliance governance mode. Based on these five case studies, they proposed that in the presence of high relational risk and low performance risk, stricter alliance control (i.e., EJV) is chosen; conversely, less strict governance (i.e., non-EJV) is preferred in the opposite situation. However, the results of the five cases reviewed in that work have limited generalizability and lacked theoretical foundation. In the study of how governance and trust affect the level of relational risk in the Dutch microelectronics assembly industry, Nooteboom, Berger, and Noorderhaven measured the risk perceptions of 97 managers while acknowledging that their results cannot be applied universally due to the variance in risk perception. They noted that 'some people are more sensitive to risks than others' (Nooteboom, Berger, and Noorderhaven, 1997: 322) and that multiple factors affect the configuration of governance modes.

Yoshino and Rangan (1995), Nielsen (2010) and Lee (2014) asserted that choosing an appropriate alliance governance mode is important for the success of a strategic alliance. Different types and typologies of alliance governance modes have been suggested. Some scholars have argued for four types of alliance governance modes: unilateral, bilateral, minority equity alliances and EJVs (Das & Teng, 2001; de Man & Roijakkers, 2009). Many others have proposed and empirically tested two types of modes: contract-based alliances and EJVs (Gulati, 1995; Hagedoorn, 2002; Oxley & Sampson, 2004; Sampson, 2004). An EJV is an alliance governance mode that enables a new firm to share equity among partners in an attempt to, *inter alia*, control outcomes, restrain opportunistic behavior and share risk. A contract-based alliance is an alliance mode that describes tasks, goals, control mechanisms and the distribution of outcomes in contracts such as agreements for joint R&D, joint marketing, joint production, subcontracted R&D, licenses and consigned production agreements. These types of alliances are more flexible than EJVs because they require less asset investment than EJVs, which involve the establishment of a new firm. Contract-based alliances are generally preferred in high-tech industries both because of the importance of strategic flexibility in such industries (Hagedoorn, 2002) and because performance risk (such as R&D risk) is higher for high-tech industries than for medium- and low-tech industries. In the following section, we describe a number of alliance risks and propose hypotheses based on the risk-based perspective on alliance governance.

## HYPOTHESES

### Competitors alliance risk

There will be greater difficulty concerning the distribution of alliance outcomes and opportunistic behavior if firms ally with direct competitors (Das & Teng, 2001; Park & Ungson, 2001; Oxley & Sampson, 2004). Opportunistic behavior in interfirm alliances includes 'cheating, shirking, distorting information, misleading partners, providing substandard products/services, and appropriating partners' critical resources' (Das & Teng, 1998: 492). Park and Russo (1996) found that alliances with direct competitors are more likely to fail than are alliances with nondirect competitors because direct competitors operate in the same market, and building trust with allied competitors is problematic (Park & Ungson, 2001). The lack of trust and direct competition in the same market will threaten shared goals, communication and the exchange of knowledge, know-how and skills between direct rival partners. The risks of allying with direct competitors manifest in situations in which 'firms seek out the same limited resources or target the same markets or customers' (Gimeno, 2004: 821). If competitors are more effective at serving the market, the focal firm will lose position in that market.

Notable findings on the risks identified in allying with direct competitors, often called ‘competitive alliances’ (Park & Zhou, 2005), are ‘market share instability’ (Kogut, 1988), ‘loss of competitive advantage’ (Silverman & Baum, 2002; Gimeno, 2004), ‘leakage of firm-specific resources/capabilities and appropriation hazards’ (Park & Ungson, 2001; Park & Zhou, 2005) and ‘alliance failure’ (Park & Russo, 1996). However, allying with direct competitors also provides benefits and competitive advantages. In a study of high-tech manufacturing small and medium-sized enterprises in New Zealand, Chetty and Wilson (2003) found that allying with direct competitors leads to the acquisition of complementary resources and fosters internationalization. The benefits of allying with direct competitors are further addressed by Hamel, Doz, and Prahalad (1989), who found that Asian firms forming joint ventures with their rival Western partners gained access to new markets/technologies and fostered learning. However, the literature generally agrees that allying with direct competitors has a higher level of risk than allying with noncompetitors. Oxley and Sampson (2004) observed that the alliance governance mode is less likely to be protective (i.e., a contract-based alliance) when firms ally with direct competitors because there is excessive risk associated with being locked into a rigid type of governance mode such as an EJV. Based on the risk-based perspective on alliance governance, firms are more likely to form contract-based alliances as governance modes when allying with direct competitors because the level of risk is high (Das & Teng, 2001).

Hypothesis 1: If firms ally with direct competitors, risk will increase; thus, firms will prefer contract-based alliances to EJVs.

### **Institutional risk**

Institutional prescription influences alliance partner selection (Hitt, Dacin, Levitas, Arregle, & Borza, 2000). Contractual governance attributes such as term specificity, contingency adaptability and mandatory contractual terms are contingent upon transactional characteristics (which affect expected opportunism, uncertainty and monitoring costs) and dimensions of the institutional environment, including the legal system and the amount of regulatory compliance (Luo, 2005). According to Bachmann and Inkpen, ‘Institutional structures (i.e., contexts) that can reduce the risk of misplaced trust may include, for example, legal regulations, professional codes of conduct that are or are not legally binding, corporate reputation, standards of employment contracts, and other formal and informal norms of behavior’ (2011: 285). In this paper, we define institutional context more narrowly as the degree to which legal and regulatory enforcement, rules or systems that impede unfair dealing between partners and influence alliance activities are settled in a region. Bachmann and Inkpen (2011) contended that the presence of institutional safeguards such as legal regulation promotes trust between partners during the formation of a joint venture. Joint ventures require mutual consent between the parties. EJVs arise whenever two or more partners bring given assets to an independent legal entity and pay for some or all of their contribution from the profits earned by the entity or when a firm acquires partial ownership of another firm (Hennart, 1988). Equity is a mechanism that causes allied parties to feel that they are treated fairly in the distribution of alliance outcomes. Equity is described as ‘a proportionate payoff based on one’s input, i.e., the more inputs, the more payoffs ... the need for equity, or the need to be treated fairly, can seriously affect the relationship between the partners’ (Das & Teng, 2001: 7). If firms felt that they were not being treated fairly, they would not exert their best efforts to achieve the alliance’s goals (Das & Rahman, 2010). EJVs require a supportive institutional context such as a strong legal system and government regulatory engagement (Kogut, 1988; Yiu & Makino, 2002).

Hypothesis 2: If there is weak institutional context that supports EJVs, risk will increase; thus, firms will prefer contract-based alliances to EJVs.

### International risk

In a comparative study of domestic and international buyer–seller relationships, Buvik and Andersen (2002) claimed that transaction costs are higher when dealing with foreign partners than with domestic partners because of the high risk and uncertainty in the foreign market. The authors further noted that it is more difficult to obtain reliable performance measures of interfirm alliances in international business contexts than in domestic contexts. An unfamiliar culture, the foreign system and the difficulty of measuring performance in international alliances increase uncertainty (Anderson & Gatignon, 1986; Wang, 2015). When transacting with domestic firms, such cultural and institutional constraints can be diminished. Specifically, firms find it difficult to write a contract and establish terms and conditions when transacting with international partners (Harrigan, 1988). Even firms with considerable international experience have less knowledge about product standard changes and market information in other countries than in their home country. Therefore, international alliances have higher risk than domestic alliances.

Hypothesis 3: International alliances have higher risk than domestic alliances; thus, firms will prefer contract-based alliances to EJV's.

### R&D risk

Russo (2004) defined R&D activities as the development and improvement of prototypes, processes, inventions and patents that are intended to diminish uncertainty in nature. R&D involves uncertainty, as its terminology implies. DiMasi (2001) found that the success rate of new investigational drug applications of New Chemical Entities<sup>4</sup> approved by the Food and Drug Administration was only 12.3% in the early 1990s, which implies high risk in R&D. Additionally, the average success rate of FP7<sup>5</sup> (the European Union's R&D promotion program) was only 22% (European Union Commission, 2013: 6). Many researchers have emphasized the high risk and uncertainty of pursuing R&D (Sampson, 2004; Chen, Shih, & Yang, 2009). Generally, higher risk exists in R&D alliances than in other types of conventional alliances such as marketing, production and brand alliances in general (Lavie & Rosenkopf, 2006). Das and Teng (2001) also argued that alliances that include R&D activities have higher risk than those that do not. In the presence of the high risk embedded in R&D collaboration, firms will seek greater flexibility (e.g., switching partners) to adapt to changing technology standards and government regulations.

Hypothesis 4: R&D alliances have higher risk than other types of alliances; thus, firms will prefer contract-based alliances to EJV's.

### Corporate risk

The literature has suggested the multidimensionality of corporate risk (Miller & Bromiley, 1990; Miller & Leiblein, 1996). Although corporate risk has a broad meaning, it is relatively common to regard corporate risk as risks to a corporation's financial condition (e.g., credit scores awarded by credit rating agencies) instead of risks to other aspects such as management, human resources and the firm's internal system (Merna & Al-Thani, 2005). Jo and Na defined corporate risk as 'a risk inherent in a firm's operations as a result of external or internal factors that can affect a firm's profitability'

<sup>4</sup> New Chemical Entities is a newly developed chemical compound that has not yet been tested in clinical trials (DiMasi, 2001).

<sup>5</sup> FP7 is the seventh framework program of the European Union for the funding of research and technological development in Europe (European Union Commission, 2013).

(2012: 441). We adopt this view and further argue that corporate risk includes the ownership structure. Corporations, such as government-owned corporations and listed companies, generally have less corporate risk (i.e., they are less financially unstable) than privately owned companies and subsidiary companies (Badertscher, Givoly, Katz, & Lee, 2015). Badertscher et al. (2015) analyzed ownership type and default risk based on 1,150 private and 29,193 public firms from 1987 to 2010 and found that private firms showed higher default risk than did public firms. If the corporate risk of alliance partners is high, the likelihood of bankruptcy and the unilateral termination of alliance contracts may increase, which will have a negative impact on the achievement of alliance goals. Firms will prefer more flexible alliance governance modes when alliance partners have high corporate risk that increases the alliance's risk (Das & Teng, 2001).

Hypothesis 5: If alliance partners' corporate risk is high, firms will prefer contract-based alliances to EJVs.

## METHODOLOGY

### Sample

We collected interfirm alliance data from Securities Data Company<sup>6</sup> for the most recent 5 years (2009–2014) for high-tech industries, including 3,228 alliances. Because most of the variables in this study are categorical, data frequencies are provided in Table 1. The table shows that the average number of alliance participants was 2.08 and that alliances with direct competitors account for 11.4% of the total alliances. Additionally, 98.6% of the alliances had no institutional safeguard (e.g., government approval, financial/legal advisory boards), and 26.5% were R&D alliances. The sample indicates that most alliances are formed in the information technology (IT) industry (2,053 cases) and the biotechnology (BT) industry (1,054 cases)<sup>7</sup>. Based on the Securities Data Company database, the IT and BT industries have the largest number of interfirm alliances in high-tech industries, accounting for 64 and 32% of our sample, respectively. This finding supports Hagedoorn (2002), who found that many newly established R&D alliances were primarily from the IT and BT industries. For example, the phenomenon of technology conversion has made IT a base technology that many industries adopt in their products to improve their interfaces with customers. Thus, it is not surprising to see that many strategic alliances are formed in the IT industry. In our sample, 2,694 alliances were formed by US firms, accounting for 83% of the total alliances. This result is also similar to the study of Hagedoorn (2006), who found that 70% of R&D alliances were formed by US firms. The status of the alliance contracts in our sample is as follows: there were 1,556 agreements signed that are now in the collaboration stage, with 1,603 cases pending and 68 cases in the negotiation stage.

### Measures

The present study considers five alliance risks: competitors alliance risk, institutional risk, international risk, R&D risk and corporate risk. Our approach to measuring these risks does not rely on measures of alliance participants' perceptions or a small number of case studies. Instead, we use information on the

<sup>6</sup> Securities Data Company data include interfirm alliances worldwide from external sources such as Securities Exchange Commission filings, market reports and industry and trade reports since 1970.

<sup>7</sup> The Organisation for Economic Co-Operation and Development (2011) classifies high-tech industries as aircraft and spacecraft; pharmaceuticals; office, accounting and computing machinery; radio, TV and communications equipment; and medical, precision and optical instruments. Our sample is based on the first two numbers of the standard industrial classification (SIC) digit codes, as follows: IT (30, 32, 33–36, 38–39, 48–50, 57, 73), BT (20–28, 51, 59, 80, 87), aerospace (37), precision (60, 62, 64, 67).

TABLE 1. FREQUENCIES (N = 3,228)

Variables	Type	Values	Cases	Percentage
Number of participants	Numerical	2	3,014	93.4
		3	179	5.5
		4	26	0.8
		5	8	0.2
		7	1	0.03
Industry type	Categorical	1 (IT)	2,053	63.6
		2 (BT)	1,054	32.7
		3 (Other)	121	3.7
Contract status	Categorical	1 (Signed)	1,555	48.2
		2 (Pending)	1,603	49.7
		3 (Negotiation)	70	2.2
Competitors alliance risk	Dichotomous	0 (Nondirect)	2,859	11.4
		1 (Direct)	369	88.6
Institutional risk (reverse) <sup>a</sup>	Dichotomous	0 (Yes)	45	1.4
		1 (No)	3,183	98.6
International risk	Dichotomous	0 (No)	3,189	1.2
		1 (Yes)	39	98.8
R&D risk	Dichotomous	0 (No)	2,372	73.5
		1 (Yes)	856	26.5
Corporate risk <sup>b</sup>	Ordinal	1 (Low)	1,034	32.0
		2 (Medium)	1,748	54.2
		3 (High)	446	13.8
Governance	Dichotomous	0 (Non-EJVs)	2,167	67.1
		1 (EJVs)	1,061	32.9

Note.

<sup>a</sup>Institutional risk was reverse coded to account for the practice of institutional safeguards such as government approval and the involvement of financial/legal entities in alliances (i.e., lower risk).

<sup>b</sup>Corporate risk is coded as follows: 1 = alliances formed by listed-listed, listed-government and government-government-owned firms; 2 = alliances formed where at least one of the partners is a private firm; 3 = alliances formed by only private firms.

BT = biotechnology; IT = information technology; R&D = research and development.

track records of alliances formed by high-tech firms across nations obtained from secondary sources (i.e., Securities Data Company). Using large-scale data from secondary sources can provide less-biased information (Huber & Power, 1985) and capture more objective and generally observable phenomena concerning the relationship between risk and alliance governance. The responses of an individual representing a firm to a given level of alliance risks can vary depending on personal experiences, cognitive biases and contextual, cultural and cross-national differences (Nooteboom, Berger, & Noorderhaven, 1997). Such differences can adversely affect the generalizability of results on how risks affect the choice of alliance governance mode, and thus we have sought to avoid such undesirable factors in this paper. Therefore, the alliance risk variables that we have selected (see the Hypotheses section) are general, and we do not compare individual perceptions of managers (which may differ between A and B); our chosen risk variables are, by definition, common to alliance partners. Therefore, apart from Das and Teng's (2001) framework, we do not exclusively include variables related to relational risks and only include common (i.e., noncognitive) risks associated with interfirm alliances. However, it should be noted that performance or strategic risks included in this study such as allying with direct competitors, international partners and R&D alliances also comprise some aspects of relational risks such as opportunism, inequity and trust.



### ***Dependent variable***

Most strategic alliance studies divide alliance governance modes into contract-based alliances (i.e., non-EJVs) and EJVs (Gulati, 1995; Sampson, 2004). We follow this convention and measure alliance governance modes utilizing a dummy variable that equals 1 if the alliance governance mode is an EJV and 0 if it is a contract-based alliance.

### ***Independent variables***

We consistently coded the variables such that a negative sign on the coefficient indicates support for our hypotheses. A negative sign implies a preference for selecting the alliance governance mode in contract-based alliances when the level of risk is high.

*Competitors alliance risk:* Risk is higher if firms ally with direct competitors. Participant firms in an alliance that share the same four-digit SIC code are regarded as direct competitors in this study (Cohen & Levinthal, 1989; Oxley & Sampson, 2004). In principal, firms with the same SIC code are competing in the same market. We created a dummy variable that is coded 1 for alliances formed with direct competitors and 0 for alliances that are not formed with direct competitors.

*Institutional risk* is measured by whether institutional safeguards, such as government regulatory approval and financial or legal advisors, play a role in the alliance contract. Institutional safeguards such as government approval and financial and legal advisors can promote fair dealing between alliance partners (Luo, 2005). This variable is reverse coded because the absence of institutional safeguards entails greater risk. Thus, we created a dummy variable that equals 0 if such an institutional safeguard exists and 1 if it does not (reverse coded).

*International risk* is measured by whether an alliance is cross-border. We created a dummy variable that is coded 0 for domestic alliances and 1 for international alliances. International alliances have higher risks and transaction costs than domestic alliances (Buvik & Andersen, 2002).

*R&D risk* is measured by whether the type of alliance is an R&D alliance. R&D alliances are generally riskier than other types of alliances, such as marketing, production, distribution and brand alliances (Odagiri, 2003; Lavie & Rosenkopf, 2006). We created a dummy variable that is coded 1 for R&D alliances and 0 otherwise.

*Corporate risk* is measured by three types of ownership, depending on the level of corporate risk. We created an ordinal variable whereby, first, allied listed–listed, listed–public (government-owned firms) and public–public firms are coded as 1. Allied listed–private firms are coded as 2, and allied private firms are coded 3. Allied private firms have the highest level of corporate risk because their financial statements are not required to be reported to the public (Badertscher et al., 2015). Thus, officially, no stockholders are concerned about the firm's financial condition.

### ***Control variables***

In addition to controlling for other factors that are presumably associated with the risk–governance relationship, we included control variables such as industry type, status of alliance contract and the number of alliance participants that are not captured by the independent variables. A categorical variable for industry type is included in the testing models to control for any sectoral differences in the practice of alliance governance types (Hagedoorn, 1993). We coded IT as 1, BT as 2 and other high-tech industries, such as aerospace, precision and others, as 3. Additionally, we included alliance contract status; if the contract has been signed, then this variable is coded as 1; if the contract is in the pending stage, then it is coded as 2; and if the contract is in the negotiation stage, then it is coded as 3. Generally, EJVs require a longer period of time to settle more detailed clauses, terms and conditions for establishing a new enterprise than that required for contract-based alliances. Based on the large-scale data set used in this study, the negotiation and pending stages require a longer period of time to finalize alliance goals, requirements, tasks and other contractual terms, which could influence alliance

governance. Finally, we controlled for the number of participants in the alliance in an attempt to control for the size and scope of the alliance. An increase in the number of alliance participants could lead to a rise in the scope of tasks and size of investment such as human, physical and capital investment. The previous literature suggests that when more firms participate in an alliance, the difficulty of monitoring, coordinating and preventing conflicts between partners can increase, which could affect alliance risk (Gulati, 1995; Milgate, 2000; Oxley & Sampson, 2004). As noted by Doz and Hamel (1998), a larger number of alliance participants could entail complexity in alliance design and governance.

## RESULTS

Table 2 presents the means, standard deviations and correlations of the variables. The correlation matrix shows some significant correlations between the independent variables. There is a strong positive relationship between industry type (categorical variable) and R&D alliance (i.e., the dichotomous variable), implying a higher likelihood of forming R&D alliances in the precision, aerospace and BT industries than in the IT industry (Cramer's  $V = 0.657$ ). We checked the variance inflation factors for evidence of multicollinearity. Variance inflation factors ranged from 1.01 to 1.38 and fell well below the cut-off value of 10, indicating no multicollinearity issues (Hair, Anderson, Tatham, & Black, 1995). Therefore, no multicollinearity problems exist.

Table 3 presents the results of the hypothesis testing from the binomial logistic regression analysis. Because our dependent variable is binary, we employed a binomial logistic regression. The base model, which includes only the control variables, and the main prediction models, which include all of the variables, were tested. The  $\chi^2$  values are significant, indicating that both models are robust. Hypothesis 1 argues that allying with direct competitors will increase risk, and it is likely that contract-based alliances will be selected as the alliance governance mode in such cases. The coefficient of this variable was negative and significant, thus supporting Hypothesis 1 ( $\beta = -0.259, p < .05$ ). Hypothesis 2 suggests that a high level of institutional risk will lead to contract-based alliances as the alliance governance mode. The coefficient of this variable exhibited significant negative values, thus supporting Hypothesis 2. When a high level of institutional risk exists, firms perceive greater risk, and contract-based alliances are preferred ( $\beta = -2.021, p < .01$ ). Hypothesis 3 predicts a negative relationship between international alliances and protective alliance governance (i.e., EJVs). The results demonstrate that the coefficient is significantly negative ( $\beta = -1.132, p < .05$ ). This result indicates that international alliances will likely choose contract-based forms as their alliance governance mode. Therefore, Hypothesis 3 is supported. The coefficient of R&D risk is significant and negative ( $\beta = -0.528, p < .05$ ). This result suggests that R&D alliances are more likely to be contract-based alliances than EJVs. Thus, Hypothesis 4 is supported. Hypothesis 5 argues that higher corporate risk increases performance risk; thus, firms will prefer contract-based alliances as the governance mode, suggesting a significant and negative value. However, we found that the coefficient of corporate risk is not significant ( $\beta = -0.011, p = n.s$ ); thus, Hypothesis 5 is not supported.

The remaining coefficient estimates in Table 3 are the control variables: industry type, contract status and the number of participants. The coefficient of industry type is significant and positive ( $\beta = 0.241, p < .01$ ). This result indicates that the IT industry is more likely to prefer contract-based alliances than do the BT, aerospace, precision and other high-tech industries included in this study. As most of our sample data are from the IT and BT industries (96%), we ran a separate binomial regression analysis including only the IT and BT industries. We found that IT industries are less likely to prefer EJVs as their form of alliance governance than are the BT industries ( $\beta = -0.357, p < .01$ ). Second, the coefficient of contract status is significant and positive ( $\beta = 0.767, p < .01$ ). For contracts that are in the negotiation and pending stages, EJVs are likely to be chosen for the alliance

**TABLE 2. DESCRIPTIVE STATISTICS AND CORRELATIONS (N = 3,228)**

Variables	Mean	SD	Minimum	Maximum	1	2	3	4	5	6	7	8
1. Industry Type	1.40	0.56	1	3	–							
2. Contract status	1.54	0.54	1	3	0.068**	–						
3. Number of participants	2.08	0.33	2	7	0.006	0.020	–					
4. Competitors alliance risk	0.11	0.32	0	1	0.032	0.042	0.009	–				
5. Institutional risk (reverse)	0.98	0.12	0	1	0.032	0.002	–0.011	0.024	–			
6. International risk	0.01	0.11	0	1	0.040	0.035	–0.027	0.006	0.013	–		
7. R&D risk	0.27	0.44	0	1	0.657**	0.051*	0.004	0.028	0.018	0.011	–	
8. Corporate risk	1.82	0.65	1	3	0.036	0.021	–0.029	0.034	0.028	0.015	0.056**	–
9. Governance	0.33	0.47	0	1	0.135*	0.187**	0.143**	0.020	0.114**	0.047**	0.080**	0.036

Note. Associations between categorical variables are calculated using Cramer’s V.

R&D = research and development.

\* $p < 0.05$ , \*\* $p < 0.01$

TABLE 3. LOGISTIC REGRESSION RESULTS FOR RISK AND ALLIANCE GOVERNANCE

Variables	Logit (governance = equity joint ventures)	
	Model 1	Model 2
Competitors alliance risk		-0.259 (0.127)*
Institutional risk (reverse)		-2.021 (0.369)***
International risk		-1.132 (0.489)*
R&D risk		-0.528 (0.106)*
Corporate risk		-0.011 (0.060)
Industry type	0.045 (0.068)	0.241 (0.080)***
Contract status	0.752 (0.072)***	0.767 (0.073)***
Number of participants	0.916 (0.124)***	0.914 (0.125)***
Constant	-3.873 (0.307)***	-1.984 (0.487)***
N	3,228	3,228
$\chi^2$	175.889***	253.052***
% Correct	68.7%	69.7%
Degrees of freedom	3	8
-2 log likelihood	3,912.3	3,835.2
Cox and Snell pseudo $R^2$	0.053	0.075

Note. Values in parentheses represent the SE of each estimate.

R&D = research and development.

governance mode. The last control variable is the number of participants in the alliance. We found that if there are more alliance participants, firms are likely to choose EJVs as their form of alliance governance. Further evidence is found in our sample data that EJVs consist of more partners (average: 2.15 partners) than do contract-based alliances (average: 2.05).

## DISCUSSION

This paper offers the first large-scale empirical study of the *risk factors* that influence the choice of alliance governance mode in high-tech industries. We began our quest to discover why high-tech firms choose contract-based alliances more than EJVs as their preferred alliance governance mode. We tested this question by employing a risk-based perspective on alliance governance. Table 4 summarizes the empirical findings of this study. Consistent with Oxley and Sampson (2004), we found that in cases of alliances with direct competitors, EJVs provide an insufficient safeguard for protecting valuable knowledge, skills and know-how. We obtained evidence that institutional structures such as governmental, legal and financial arrangements promote equity investment in alliances, as institution-based trust between partners is strengthened (Bachmann & Inkpen, 2011). This study found that international alliances are less likely to be EJVs. The difficulty of knowledge sharing and communication and the impediments associated with cultural and geographical distance can be regarded as disfavoring EJVs as a governance mode in international alliances. For R&D alliances, we found that contract-based alliances are preferred, similar to the findings of Narula and Hagedoorn (1999). Pisano, Russo, and Teece (1988) suggested that when an alliance involves pure R&D activities, alliance partners can effectively protect their tacit knowledge, skills and know-how through the adequate use of contractual arrangements. We found evidence that R&D alliances are less likely to adopt EJVs as the form of alliance governance. However, we did not find evidence that a high level of corporate risk (in this study, ownership structure) leads to EJVs being preferred as the alliance governance mode. We based our argument concerning corporate risk on the study of Badertscher et al. (2015); however, their

TABLE 4. SUMMARY OF HYPOTHESES AND EMPIRICAL RESULTS

<i>Hypotheses</i>	<i>Empirical results</i>
Hypothesis 1: If firms ally with direct competitors, risk will increase; thus, firms will prefer contract-based alliances to EJV's	Supported
Hypothesis 2: If there is weak institutional context that supports EJV's, risk will increase; thus, firms will prefer contract-based alliances to EJV's	Supported
Hypothesis 3: International alliances have higher risk than domestic alliances; thus, firms will prefer contract-based alliances to EJV's	Supported
Hypothesis 4: R&D alliances have higher risk than other types of alliances; thus, firms will prefer contract-based alliances to EJV's	Supported
Hypothesis 5: If alliance partners' corporate risk is high, firms will prefer contract-based alliances to EJV's	Not supported

EJV's = equity joint ventures; R&D = research and development.

comparison of public debt defaults is limited to the ownership structure. As further noted by Badertscher et al., other factors affect the cost of debt, such as 'the degree of regulation,' 'the level of litigation risk' and 'the structure of management compensation' (2015: 6). We also suggest that factors other than ownership structure affect the risk of corporate (financial) instability. In summary, we found support for 4 of the 5 Hypotheses proposed in this study. We claim that these results strongly support adopting a risk-based perspective in predicting the appropriate alliance governance mode in high-tech industries characterized by unstable and turbulent business environments.

We found that more R&D-intensive industries, such as aerospace and BT, prefer more protective alliance governance modes such as EJV's than do less R&D-intensive industries (e.g., IT industries)<sup>8</sup>. We also found that contracts in the negotiation and pending stages are likely to be EJV's. This may be because EJV's require longer periods of negotiation, not only for the terms and conditions but also because of the long list of written contracts required in such arrangements. As the sample data are for the most recent 5 years, this explanation may prove to be plausible.

Although the literature suggests that alliance risks increase when more partners participate in an alliance due to the complexity of establishing tasks and goals and the difficulty of monitoring and coordinating across partners (Gulati, 1995; Oxley & Sampson, 2004), EJV's require significant amounts of financial, physical, technical and managerial assets to be invested in newly established firms and the risk of such investments to be shared. Therefore, more participants, including firms, banks and investors, are usually involved in EJV's than in contract-based alliances.

## CONCLUSION

Few studies have considered risk-based perspectives on alliance governance. The extant literature predominantly concerns transaction costs, resource complementarity and social networks, focusing primarily on positive aspects of alliance formation. While the benefits gained from strategic alliances affect the choice of alliance governance mode, the related potential negatives, that is, risks, have considerable influence on the governance decision. In this paper, we have contributed to broadening

<sup>8</sup> According to Organisation for Economic Co-Operation and Development's (2011) technology intensity classification based on R&D intensities, of those considered in this study, the industry ranking of average R&D intensities from 1991 to 1999 is as follows: aircraft/spacecraft industries (13.3%), pharmaceuticals (10.5%), radio/TV and communications (8.0%) and electrical machinery (3.9%).

the understanding of what alliance governance modes are preferred based on risk perspectives. In the Introduction section, we noted that firms face two opposing potentials: opportunity and risk. This is prevalent in the high-tech industry environment, which faces rapidly changing technology and markets, and while the payoffs from seizing opportunities in these industries are greater, they also feature higher risks than do traditional industries. The central tenet behind TCE suggests that more protective and hierarchical forms of alliance governance such as EJVs are preferred in a highly uncertain and risky environment, which is undoubtedly observed in high-tech industries. As Williamson noted, 'transactions, which differ in their attributes, are aligned with governance structures, which differ in their cost and competence, so as to effect a transaction cost economizing result' (1991: 79), implying that the selection of an effective governance mode is a core aspect of TCE. However, incongruous with the tenets of TCE, more contract-based alliances than EJVs are formed in high-tech industries.

Organizational studies have devoted considerable attention to TCE to understand the choice of organizational governance modes such as hierarchies, markets and hybrids (David & Han, 2004). In the previous studies on TCE, there are two that may embed some degree of outdated and limited explanatory power for the TCE–alliance governance relationship in contemporary high-tech business. First, many TCE studies appear to focus on traditional industries, which provide desirable empirical settings for TCE variables to be applied. For example, pursuing economies of scope and/or scale based on asset specificities and minimizing uncertainties are widely employed strategies in those industries (Chandler, 1990). Therefore, TCE perspectives are better suited to traditional industries than to high-tech industries. However, we believe that asset specificity still affects the alliance governance decision in high-tech industries, where considerable asset investments are required, as in pharmaceuticals and aerospace. In fact, a meta-analysis of TCE also supports this notion that asset specificity has greater explanatory power than does uncertainty for the organizational governance choice (David & Han, 2004). Second, Williamson advanced an important conceptualization of TCE theory in his 1975 book 'Markets and Hierarchies' and a series of related works published mostly from the 1970s to the 1990s, when there was less uncertainty in the technology and market. The applicability of TCE logic based on 'uncertainty' to the organizational governance decision may be outdated in the current era of rapidly changing markets and technology, particularly in high-tech sectors. Based on our findings and arguments, we argue that TCE and risk-based perspectives provide complementary rationales for alliance governance decisions, depending on industrial sectors.

We suggest delving into identifying the mechanisms whereby crucial alliance governance factors such as opportunities, risks and bargaining power interact to influence a final selection decision, which will certainly advance our understanding of the choice of alliance governance mode. Because alliance governance choice is an outcome of managerial decisions, firm managers must simultaneously consider those three factors in their decision-making process. However, the interaction of these factors is not easily captured given the complexity and heterogeneity of and differences in individual cognition, situations and competence involved in the dyadic relationships frequently found in alliances. Although some researchers have measured relative bargaining power using firm size (Bosse & Alvarez, 2010), return on assets (Kim & Choi, 2014), total assets (Lerner & Merges, 1998) and ownership (Fagre & Wells, 1982) as proxies, these are imperfect measures. To summarize, although the importance of understanding the interaction among three factors such as opportunity, risk and bargaining power is crucial in alliance governance choice, the alliance governance literature, specifically empirical studies, has largely neglected these crucial points.

### **Limitations and directions for future study**

This study does not measure the risk factors that are embedded in relational contexts. Variables that are primarily associated with relational risks such as opportunistic behavior, inequity and trust are indeed

cognitive, and it is difficult to measure them with secondary objective data. Future research based on primary data such as surveys could complement our study. Second, we mainly adopted the alliance risk factors from Das and Teng's (2001) study. However, there are other types of risks, such as cultural differences, partner misfit (Yoon, Lee, & Song, 2015), agency risk (Hsieh, Rodrigues, & Child, 2010), and technological obsolescence (Colombo, 2003), and these risks may have different effects. We suggest including more alliance risks in future research to investigate how they affect alliance governance modes in different industrial sectors. We only considered two types of alliance governance mode, EJVs and contract-based alliances. This limits the applicability of our findings to better-scrutinized types of alliance governance modes such as bilateral/unilateral contract alliances and minority/equity alliances. Future studies could benefit from the inclusion of more specific types of alliance governance modes. Finally, our sample is drawn primarily from the IT and BT industries, high-tech sectors, which hinders the applicability of our findings to other industries.

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