Bridging the cultural divide: Trust formation in university–industry research collaborations in the US, Japan, and South Korea

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A B S T R A C T

Academia and industry increasingly work together, but this is not always an easy endeavor. In this article we investigate how relational mechanisms facilitate trust formation in university–industry research collaborations (UICs) in three countries and contribute to the understanding of international similarities and differences in UICs by considering institutional factors, specifically, the strength and maturity of UICs in each country. Analyzing survey data of 618 recent UICs in the US, Japan, and South Korea, we identify the activities of innovation champions as a critical trust building mechanism between firms and universities that complements initial trust formation through tie strength, partner reputation, and contractual safeguards. We find that partner reputation and champion behavior are more important for trust formation in South Korea than in the US and Japan, indicating that in 'emerging UIC countries' where most firms and universities have little collaboration experience, reputation and the leadership by innovation champions are more important for trust formation in UICs than in 'advanced UIC countries' with strong and mature UIC networks. From a public policy perspective, our findings suggest that networks between firms and universities should be generally strengthened and collaboration partners should be provided with effective contractual safeguards to enhance trust formation in UICs.

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1. Introduction

University–industry research collaborations (UICs) are an increasingly important innovation mode (van de Vrande et al., 2009; Bianchi et al., 2011) that allows firms and universities to tap into complementary skills of each other and thus potentially help with saving cost and enhancing research outcomes. Innovating companies collaborate with universities not only to complement in-house R&D (Veugelers and Cassiman, 2005), but also to conduct groundbreaking research critical to innovation over the long run and to appropriate knowledge for private gain (Bruneel et al., 2010). At the same time, productive and well-established research relations with industry are important for those universities seeking to possess a vibrant and dynamic research enterprise and to supplement public research funding (Etzkowitz et al., 2008). But the channels and mechanisms through which these effects exercise their influence are much less understood (Mowery and Shane, 2002).

Despite their increasing openness to collaboration, companies and universities face major challenges when attempting to work together not least due to inherently different institutional cultures (Bjerregaard, 2010) and sometimes conflicting goals (Gilsing et al., 2011). Universities are driven by cultures that emphasize scientific performance unrelated to profit or market considerations (Dasgupta and David, 1994). The free and open communication of research results is essential to their goal of expanding and disseminating knowledge. For industry, in contrast, the protection of proprietary information is necessary to the ultimate goal of financial return. This general 'cultural divide' between academe and industry in terms of goals and working styles often results in great tension in UICs and causes many of them to perform below expectations (Burnside and Witkin, 2008; Bruneel et al., 2010). In addition, collaborative research exposes both sides to a certain degree of vulnerability to exploitation. Many academics view support and funding from industry as having strings attached that negatively influence their research. At the same time, many firms view universities' demand for exclusive ownership of intellectual property rights as an impediment for working with universities. For UICs to succeed, the counterparts must acknowledge and work with these fundamental differences and the cultivation of trust is vital for reducing them (Mora-Valentin et al., 2004).
A UIC here is defined as a project-based collaborative research relationship between universities and companies aiming at the generation or transfer of new products, technologies, or processes. Trust is defined as the intention to accept vulnerability based upon one party's positive expectations of the intentions or behavior of another party in situations that are interdependent or risky (Morgan and Hunt, 1994; Rousseau et al., 1998).

Whereas trust has been extensively studied in the context of innovation collaboration among industrial firms, how trust develops in UICs has received limited attention in only a small number of studies. Of these, Davenport et al. (1999) suggest that mutual respect and trust amongst partners is critical for collaboration success; Santoro and Saporito (2003) report that trust mediates the relationship between different characteristics of communication behavior and UIC outcomes, and Bruneel et al. (2010) find that trust between partners reduces collaboration barriers. Most of the extant UIC research, however, is focused on structural issues such as geographical proximity (Petruzzielli, 2011), firm size (Santoro and Chakrabarti, 2002), university linkages (George et al., 2002), firm structures and cultures or university intellectual property policies (Gopalakrishnan and Santoro, 2004), or the role of knowledge explicitness (Santoro and Bierly, 2006). Most strikingly, while trust is acknowledged as a factor for successful collaborations (Davenport et al., 1999; Barnes et al., 2002; Mora-Valentin et al., 2004), how it can be achieved between parties with fundamentally different modi operandi is neglected. Thus, we know little on how trust evolves in UICs.

At the same time, studies have long recognized the role of innovation champions in corporate settings (e.g., Chakrabarti, 1974; Howell and Higgins, 1990; Howell and Shea, 2006), but the question of their role in UICs remains mostly unexplored. Champions are broadly defined as individuals that are intensely interested and involved with the overall objectives and goals of the project and play a dominant role in many of the research-engineering interaction events, overcoming technical and organizational obstacles, and pulling the effort through its final achievement by the sheer force of their will and energy (Chakrabarti, 1974, p. 58). Anecdotal evidence suggests that the importance of the innovation champion is in selling and bridging a collaborative idea to both firm management and university and getting key stakeholders interested, so the firm will provide ongoing financial support, and in overcoming obstacles and persuading opponents to halt resistance. These champions become a bridge between the university and the firm and facilitate connection, communication, and coordination between the internal managers and scientists of both parties to create mutual trust.

It appears to be obvious that champions play a key role in trust formation in UICs, but how exactly they facilitate UICs and actually leverage successful outcomes is much less understood (Mowery and Shane, 2002) and anything but clear-cut, as research in the corporate domain suggests (Markham and Griffin, 1998).

Previous work on UICs is focused mostly on the US (e.g., Santoro and Chakrabarti, 2002; George et al., 2002; Santoro and Bierly, 2006) and Europe (e.g., Barnes et al., 2002; Mora-Valentin et al., 2004; Bjerregaard, 2010). Notwithstanding the emergence of East Asian nations as leading sources of technological innovation, there is still limited knowledge about the formation and management of UICs outside the Western hemisphere, leaving us with a lack of understanding of the differences in such collaborations between countries. Yet as firms are gradually seeking more research collaborations with foreign universities, understanding country-level differences becomes increasingly important (Burnside and Witkin, 2008). The dissimilarities of institutional and cultural factors among countries and their consequences for trust formation (Fukuyama, 1995; Doney et al., 1998) likely relate to UICs as well. However, little is known about their relevance for trust formation in UICs.

In this study, we compare UICs in the US with those in two East Asian countries that differ in their economic developments and UIC histories – Japan and South Korea (hereafter, Korea). The purpose of this paper is to better understand trust formation in UICs as an important means to bridge the cultural divide between universities and industry in terms of different organizational settings and processes. Specifically, this research advances our understanding of UICs by (1) examining how trust develops in UICs in three different countries, (2) exploring how initial trust formation mechanisms are mediated by champion behavior; and (3) identifying whether different institutional settings between countries moderate the importance of trust formation mechanisms. The focus of this research is on companies that are researching and developing new products and technologies and that have initiated cooperation with a university to help undertake R&D.

In the following, we identify three mechanisms that underlie initial trust formation in UICs: the strength of ties between firms and universities, the reputation of university partners, and contractual safeguards. While these mechanisms may alleviate some of the initial concerns and contribute to trust, firms and universities have their own distinct processes of conducting research, which may easily conflict. Therefore, invested and committed individuals – champions – are needed to reconcile these differences during the collaboration process. Moreover, the relative importance of these processes may differ between countries due to institutional differences in the field of UICs.

2. Theory and hypotheses

The literature suggests several ways how initial trust between collaboration partners can be facilitated. The strength of ties is one mechanism that influences collaboration processes and outcomes. The power of tie strength is manifested in the benefits of reduced interaction uncertainty and exchange efficiency (Ring and Van de Ven, 1994). Stronger ties are associated with expectations of trust and reciprocity providing assurances that the exchange will be used to the mutual benefit of both parties (Uzzi, 1999).

The second mechanism underlying initial trust is the reputation of the partner. Collaboration partners may grant or develop initial trust that is not based on much experience with, or knowledge of, the other party. Rather, it is based on credentials reflecting expertise in a domain or on institutional cues that enable one party to trust another without direct knowledge (McKnight et al., 1998). Reputation is important in temporary project groups, where there is neither enough time nor opportunity for experience-based trust to emerge (Meyerson et al., 1996).

The third mechanism facilitating initial trust is related to contractual safeguards, which reduce behavioral uncertainty and allow people or organizations to work with previously unknown counterparts (Fukuyama, 1995). Through this social and legal mechanism, i.e. the expectation that the other party will make every effort to fulfill the arrangement, initial trust can be created on a calculative basis (Doney et al., 1998).

2.1. Establishing trust in UICs

Tie strength, generally characterized by the degree of closeness between actors and the stability of their relationship history (Granovetter, 1973), has been suggested to support trust formation (Tsai and Ghoshal, 1998), because stronger ties help overcoming tensions inherent to start-up cooperation. Partners with stronger ties have had more opportunities for exchange, and thus have a better basis to assess the predictability of the counterpart’s behavior compared to weak tie relationships (Krakhardt, 1992).
University and industry collaborators with stronger ties and a positive interaction history share an anchoring point for expectations about behavior that may decrease partner uncertainty (Santoro and McGill, 2005). Reduced uncertainty facilitates trust and initial interactions in subsequent projects and helps achieve positive collaboration outcomes (Petruszelli, 2011). This effect arises because previous exchanges allow predictions of future behavior on the base of past actions and insights into the partner’s intentions and competencies (Doney et al., 1998).

**Hypothesis 1.** Tie strength is positively related to trust in UICs.

Managers are likely to identify reputable universities and professors for research collaborations through their professional or personal networks. Reputation can be characterized as the outcome of a competitive signaling process on key characteristics or personal networks. Reputation can be characterized as the profressors for research collaborations through their professional (Santoro and McGill, 2005). Reduced uncertainty facilitates trust and initial interactions in subsequent projects and helps achieve positive collaboration outcomes (Petruszelli, 2011). This effect arises because previous exchanges allow predictions of future behavior on the base of past actions and insights into the partner’s intentions and competencies (Doney et al., 1998).

**Hypothesis 2.** Partner reputation is positively related to trust in UICs.

UI partners will negotiate contractual provisions at the beginning of the project to set the parameters for the collaboration and uncertain outcomes. Contractual safeguards facilitate exchange by reducing social uncertainty (Doney et al., 1998) and allow strangers with little or no interaction experience to work with one another (Fukuyama, 1995). Contractual safeguards are defined as agreements to better understand each other's roles, responsibilities, and performance obligations (Macneil, 1978). Specifically, university and industry collaborators agree upon expectations that need to be met and how to use outcomes in mutually acceptable and beneficial ways. This mechanism can flush out hidden assumptions and help the collaboration partners better appre hend expectations and obligations. At the same time, contractual safeguards can increase the expected benefits from an exchange and act against possible exchange losses (Macneil, 1978). Through this social and legal mechanism, the expectation that the other party will make every effort to fulfill the arrangement, trust can be created (Doney et al., 1998). As violations of such agreements risk reaping sanctions through social consequences or even legal action, these safeguards serve as a calculative mechanism for making behavior more predictable, reduce vulnerability, and facilitate trust formation and joint action (Fukuyama, 1995).

**Hypothesis 3.** Contractual safeguards are positively related to trust in UICs.

2.2. The mediating role of champion behavior for trust formation in UICs

Initially granted trust can easily break down due to conflicts and misunderstandings in the everyday exchanges between collaboration partners (Spekman et al., 1996). In addition, UICs are often met by ignorance or resistance within firms or academia (Santoro and Betts, 2002). Therefore, initial trust needs to be maintained and reinforced. In UICs, this reinforcement is achieved through the commitment and efforts of champions – individuals who take an inordinate interest in the success of the collaboration and can bridge the two different mindsets and operating philosophies (Chakrabarti and Santoro, 2004). These champions are key facilitators of UICs and get the project off the ground, overcome obstacles, solicit and maintain the ongoing financial and other commitment of both partners, and ‘fight fires’ should the collaboration encounter significant difficulties. Through their professional optimism and enthusiasm they elevate the confidence of the individuals involved in a UIC that partners can be trusted and high performance can be achieved (Howell and Shea, 2006).

UIC champions build their legitimacy and influence on the mechanisms that help create initial trust in the partner. Capitalizing on pre-existing ties between collaborating companies and universities enables champions to take a central position and persuade stakeholders to buy into the collaboration (Ibarra, 1993). A strong reputation serves as a signal of competence of the partner university and helps champions to actively sell the UIC to key stakeholders and overcome internal resistance. Contractual safeguards provide the general parameters within which champions interpret the arrangements and act to make the UIC work. They help champions getting buy in from management and separating intellectual property considerations from the more important task of a mutually productive relationship (Burnside and Witkin, 2008).

Supported by the initial trust bonus that comes with pre-existing ties, a strong reputation of the university partner, and contractual agreements, champions can more easily ensure that UIC partners adapt and redefine their working goals and plans according to changing needs and environments over the course of the collaboration, thus reinforcing trust in the partner (Inkpen and Tsang, 2005). Champion behavior helps creating shared values between partners and maintaining a trusted relationship.

Taken together, tie strength, partner reputation and contractual safeguards strengthen UIC champions’ legitimacy and increase their effectiveness in maintaining and further enhancing trust between company and university partners throughout the collaboration. Therefore, we expect champion behavior to mediate the initial relationships of tie strength, partner reputation, and contractual provisions with trust formation.

**Hypothesis 4.** Champion behavior mediates the positive relation between tie strength and trust in UICs.

**Hypothesis 5.** Champion behavior mediates the positive relation between partner reputation and trust in UICs.

**Hypothesis 6.** Champion behavior mediates the positive relation between contractual safeguards and trust in UICs.

2.3. Differences in trust formation between countries

UICs have evolved quite differently between the countries studied. In the US, strong research linkages between industry and universities have emerged since before World War II (Mowery and Rosenberg, 1993). UICs have taken on real significance since the Bayh–Dole Act in 1980, an amendment to US patent law, which granted universities and other non-profit organizations the right to own intellectual property rights from federally funded research (Etzkowitz, 1999). Collaborative research between universities and firms is also attributed to be a main driver for the development of high technology clusters such as Silicon Valley (Saxenian, 1994) or the biotechnology cluster in Massachusetts (Owen-Smith and Powell, 2004). As a result, US research intensive firms commonly engage in UICs.
In Japan, since their establishment in the 1880s national (imperial) universities have become intellectual cores of advanced knowledge on which Japanese industrialization considerably depended. Tight partnerships between academia and industry have played an important role in the Japanese innovation system since the late 19th century (Hane, 1999; Odagiri, 1999). Even during the 1960s and 1970s, when severe constraints limited such collaborations due to companies’ wartime support of the military government, firms and universities maintained informal relations (Hane, 1999; Hatakenaka, 2004). From the 1980s onwards public policies again promoted UICs, particularly since the enactment of the Science and Technology Basic Law in 1995. In 1998 technology licensing organizations were endorsed; the Japanese version of the Bayh–Dole Act was legislated in 1999; intellectual property centers were set up in 2003; and national universities were transformed into independent corporations in 2004 (Woolgar, 2007). As a result, the number of such collaborations has exploded since the late 1990s (Kato and Odagiri, 2012). The US and Japan as ‘advanced UIC countries’ thus appear to have arrived at a similar set of policies, ranging from funding programs to encourage UICs to the establishment of regulatory frameworks for intellectual property rights (Hatakenaka, 2004).

In Korea, in contrast, UICs were rare until quite recently. Most Korean firms were still catching up with their rivals from the most advanced countries until the 1990s and focused more on development and engineering capabilities than research skills. At the same time, universities mostly saw themselves as higher education institutions with limited resources for research (Kim, 1997). This situation drastically changed since the turn of the millennium. Korean firms now have reached the technological forefront and place high priority on strengthening their research capabilities. At the same time, universities have become much more research oriented and in 2003 technology transfer centers were widely established after the enactment of the ‘Law on Industrial Education and Industry–University Cooperation’, resulting in a steep increase of UICs in Korea. However, as these institutional changes mostly occurred over the last decade, Korean companies still struggle to manage UICs professionally and fully reap their potential benefits (Eom and Lee, 2010). We thus consider Korea, and countries in a similar UIC development stage, as ‘emerging UIC countries’.

Based on the historical evolution and current state of UICs, we expect several differences between the countries included in our study. First, strong ties and networks exist between industry and universities in the US and Japan that enable companies to draw effectively on well known partners when conducting UICs. In Korea, there is also a strong tendency to cultivate ties as a trust base in collaborations, but these ties are often more general in nature, such as those when company and university representatives come from the same geographic region or have attended the same school or university (Yee, 2000). Such general ties may not necessarily translate into a higher level of trust in research collaborations, as initial positive expectations may not be met once both sides experience working together (Bstieler and Hemmert, 2010). Due to this lack of UIC experience and professional ties in Korea, we expect that tie strength plays a larger role for trust formation in UICs in the US and Japan than in Korea.

Hypothesis 7. The relation between tie strength and trust in UICs is stronger in the US and Japan than in Korea.

Second, building trust across organizational boundaries is generally challenging in Korea’s ‘low trust’ culture (Fukuyama, 1995; Huff and Kelly, 2003) and the relatively weaker UIC networks in Korea imply that Korean firms adopt other means to reduce uncertainty and establish initial trust in UICs than their counterparts in the US and Japan. More specifically, Koreans tend to rely to a particularly high extent on transference-based trust that is built on credentials or expertise in one domain as a proxy for the reputation of partners (Kim, 2008). The country’s hierarchical culture (Lee et al., 2000) further amplifies the importance of reputation for trust formation, as much attention is given to organizational rankings, resulting in a trust bonus given to highly reputed organizations.

Third, collaboration partners in East Asian latecomer economies, such as Korea, tend to rely strongly on contractual safeguards as an initial base for building trust when interacting with unknown parties (Huff and Kelly, 2003). In lieu of an exchange history, collaboration partners are perceived as outsiders. As a consequence, the initial terms of exchange are usually oriented toward the short term and are well specified. Contractual safeguards are therefore highly important for establishing initial trust on a calculative base.

In sum, we anticipate that partner reputation and contractual safeguards play a larger role for trust formation in Korea than in the US and Japan.

Hypothesis 8. The relation between partner reputation and trust in UICs is stronger in Korea than in the US and Japan.

Hypothesis 9. The relation between contractual safeguards and trust in UICs is stronger in Korea than in the US and Japan.

Differences among countries are also expected regarding the importance of champion behavior for trust in UICs. The management of Korean firms is very hierarchical and emphasizes subordination and top-down decision-making (Lee et al., 2000). The initiation and implementation of challenging non-routine projects, such as UICs, thus depends strongly on the initiative and leadership of respected and influential individuals in Korean organizations, much more so than in Japan where organizations tend to rely more strongly on collective leadership or in the US where organizational cultures are less hierarchical. In Korea, champions are thus particularly crucial to secure internal support for UICs. Moreover, psychological barriers between groups and organizations are higher in Korea than in Japan or the US (Huff and Kelly, 2003). Individuals strongly distinguish between ‘in-groups’ who tend to be trusted and ‘out-groups’ with whom trust has yet to be established. However, once these inter-group barriers are overcome and mutual trust is developed, knowledge is freely shared (Yang, 2006). As a result, the initiative of knowledgeable and respected individuals to promote the UIC, to overcome obstacles, and to get the support and involvement of the right people is more crucial in Korea than in the other two countries. Taken together, we expect champion behavior to be more important for trust formation in UICs in Korea than in the US and Japan.

Hypothesis 10. The relation between champion behavior and trust in UICs is stronger in Korea than in the US and Japan.

3. The empirical study

3.1. Data collection and sample

We collected data on UICs in the biotechnology, microelectronics, and software industries in the US, Japan, and Korea. The industry selection was guided by the expectation that UICs are frequent in these three fields in general (Meyer-Krahmer and Schmoch, 1998). Our country choice was based on various considerations. First, UICs play an important role for the knowledge sourcing of firms in all three countries. Second, the general cultural environments regarding trust formation processes are quite different among the three countries (Fukuyama, 1995). Third, the specific conditions and
developmental paths for UICs also vary between the countries. Thus, our country selection allows us to examine the potential influence of general cultural differences (by comparing the two East Asian countries with the US) as well as institutional differences related to UICs (by comparing the US and Japan with Korea).

In all countries, the samples were drawn from company directories issued by industry associations or commercially available databases. In Korea, the sample was drawn from the ‘Directory of Microelectronic and Information Companies’, the ‘Directory of Bioventure Companies’, and a list of companies participating in UICs obtained from the Korea Association of Industry, Academy and Research Institute. In Japan, the sample was drawn from the company database of Tokyo Shoko Research and the directory of the Japan Bioindustry Association. In the US, the sample was drawn from the LexisNexis Business database and the directory of the Biotechnology Industry Association.

In the sampled firms we contacted a preliminary informant, usually the director of R&D, marketing, new product development, or new business development to help identify the most recently completed UIC project within the last three years which constitutes the unit of analysis for this study. Then a key informant within each firm – the person considered most qualified by the preliminary informant to respond to the survey for the identified UIC project, mostly a project manager – was identified and their cooperation solicited.

The data were collected via a structured questionnaire within the same time period in all three countries. We employed a number of measures to establish measurement equivalence of the constructs as suggested by Hult et al. (2008): The initial English language version was translated into Japanese and Korean and then translated back into English by a different person to secure identity of the contents. We pre-tested the survey with managers from the sample firms, resulting in minor adaptations. The questionnaire tapped into the perceptions of the informants regarding environmental factors, organizational arrangements, behavioral processes, and the amount of trust achieved in the relationship with the university partner and its representatives.

Characteristics of sample firms are reported in Table 1. In total, the median firm size in our sample amounts to 26 employees, with some variation among the three countries. More than 90% of the total sample (as well as more than 90% of the firm population in each country) are small- and medium-sized companies with less than 300 employees, illustrating the important role smaller firms play in UICs.

### 3.2. Measures

Most of the survey items are measured on 7-point Likert scales or semantic differentials. Details on the measures are summarized in Appendix A. All scales have satisfactory reliabilities for the pooled samples as well as in each country with all Cronbach’s alphas greater than 0.68 and mostly greater than 0.80.

#### 3.2.1. Dependent variable

Trust is operationalized with five variables adapted from Ganesan (1994) which address perceptions about the partner’s honesty, reliability, and benevolence.

#### 3.2.2. Independent variables

The strength measures the closeness and stability of the relationship with the university partner and its representatives prior to the focal UIC. This three-item construct was inspired by Granovetter (1973). Partner reputation is a newly developed construct and operationalized with three items regarding the university partner’s research competence, scientific standing, and field-related knowledge prior to the UIC. Contractual safeguards are measured with a three item scale adapted from Lusch and Brown (1996) assessing the extent to which the partners agreed on performance obligations, project schedules, and data protection at the beginning of the UIC. Champion behavior during the UIC project is assessed with four items adapted from Howell et al. (2005) on the extent to which the person most engaged in the UIC promoted its advantages, overcame obstacles, showed perseverance and got the right people involved in the project.

#### 3.2.3. Control variables

Previous research suggests that geographical proximity facilitates face-to-face interaction (Petruzzelli, 2011), thereby supporting trust formation. Proximity is included as the inverse term of the geographical distance between collaboration partners measured on a six point scale ranging from ‘less than 10 km’ to ‘500 km or more’. Prior collaboration experience can influence the extent to which partners trust each other (Gulati, 1995).

### Table 1

<table>
<thead>
<tr>
<th>Characteristics of sample firms.</th>
<th>Korea (n=295)</th>
<th>Japan (n=195)</th>
<th>US (n=128)</th>
<th>Total sample (n=618)</th>
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<tbody>
<tr>
<td>Number of employees</td>
<td>15 (134.68)</td>
<td>48 (137.95)</td>
<td>53 (26,714.39)</td>
<td>26 (12,670.62)</td>
</tr>
<tr>
<td>R&amp;D workforce (full time.equivalents)</td>
<td>5 (49.54)</td>
<td>6 (238.46)</td>
<td>13 (1091.91)</td>
<td>6 (526.21)</td>
</tr>
<tr>
<td>Age of firm (in years)</td>
<td>9 (7.19)</td>
<td>25 (20.40)</td>
<td>13 (34.95)</td>
<td>11 (22.00)</td>
</tr>
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</table>

Note: Median (standard deviation).
Therefore, we control for previous UICs by including a single-item Likert-scale regarding previous UIC project experience with the university partner, ranging from ‘none’ to ‘a lot’. Moreover, the nature of work pursued in a UIC may influence outcomes (Sauermann and Stephan, 2013). Thus, we include a dummy variable for basic research projects. We also control for the project length of UICs measured by the reported number of years. Furthermore, trust in UICs may be enhanced by government subsidies, as regulatory arrangements, set timelines and reporting needs in publicly supported projects may restrain opportunistic behavior, and foster discipline by participants. Thus, we control for public subsidies, as measured by the percentage of the total project budget covered. Market and technology uncertainty surrounding the UIC project may also affect trust formation. Market uncertainty measures with three items how dynamic, emerging, and unpredictable the targeted market for the project outcome was, with a Cronbach’s alpha of 0.69. Technological uncertainty measures with three items how rapidly the technology changed, how unpredictable the technological development was, and how radical the technological advancements were. The scale’s Cronbach’s alpha is 0.67. We also include firm size, measured by the natural logarithm of the number of employees, and dummies for each industry as further control variables with the biotechnology industry as baseline. Finally, we include dummy variables for Japan and the US, taking Korea as the baseline.

An exploratory factor analysis of the pooled data related to the main, mediating, and outcome variables results in a five factor solution explaining 72.7% of the total variance; all factor loadings > 0.70 and no cross loadings > 0.16; the means of the loadings for each factor > 0.80; an overall mean of communalities > 0.72, and communalities not varying over a wide range (see Appendix A).

A confirmatory factor analysis of the same variables for the pooled sample indicates a good fit and supports the convergent validity for a five factor model ($\chi^2=265.3$; goodness of fit index (GFI) = 0.95; Tucker Lewis index (TLI) = 0.97; comparative fit index (CFI) = 0.98; root mean square error of approximation (RMSEA) = 0.043). Furthermore, we conducted a multi-group analysis regarding the factor loadings across the three countries by using a constrained and an unconstrained model. The unconstrained multi-group model has a good overall fit ($\chi^2=643.8$; GFI = 0.90; TLI = 0.95; CFI = 0.96; RMSEA = 0.032) that compares favorably with a multi-group single factor solution ($\chi^2=3501.0$; GFI = 0.56; TLI = 0.50; CFI = 0.51; RMSEA = 0.105). When all factor loadings are set equal across the countries, the fit of the constrained model does not decrease significantly compared with the unconstrained model ($\Delta \chi^2/df=1.33; p > 0.10$), indicating metric invariance of our constructs across countries (Anderson and Gerbing, 1988).

To control for common method variance, we employ a number of methodological and statistical remedies, as suggested by Podsakoff et al. (2003). To prevent a social desirability bias by respondents, normative expressions, such as the word ‘trust’, are avoided. To minimize the application of implicit theories by informants, the questionnaire is timely split into two parts, with the first part containing questions on independent variables and mediator and the second part containing items related to the dependent variable. The second part was sent out several weeks after the informants returned the first part of the survey. Finally, we conducted a marker test with the respondents’ assessment regarding the ‘success of UICs’ (in general) as a proxy for social desirability. When controlling for this variable, the correlations between the main variables do not change notably, suggesting that common method variance may not be a serious problem.

3.3. Results

Table 2 shows the descriptive statistics and bivariate correlations of the pooled sample. Table 3 provides the descriptive

<table>
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<th>Variables</th>
<th>1</th>
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<th>14</th>
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<tbody>
<tr>
<td>SD</td>
<td>1.60</td>
<td>1.58</td>
<td>0.36</td>
<td>1.80</td>
<td>3.50</td>
<td>1.30</td>
<td>1.30</td>
<td>1.30</td>
<td>1.21</td>
<td>1.47</td>
<td>3.11</td>
<td>0.41</td>
<td>0.49</td>
<td>0.47</td>
<td>0.46</td>
<td>0.46</td>
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<td>Note: n=618</td>
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Table 2: Bivariate correlations, means and standard deviations of variables.
Table 3
Means and standard deviations of main variables by country.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Korea (n = 295)</th>
<th>Japan (n = 195)</th>
<th>US (n = 128)</th>
<th>F(p)</th>
<th>One way ANOVA differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tie strength</td>
<td>4.95 (1.48)</td>
<td>5.30 (1.55)</td>
<td>5.15 (1.33)</td>
<td>1.11</td>
<td>Not significant</td>
</tr>
<tr>
<td>Partner reputation</td>
<td>4.91 (1.26)</td>
<td>5.27 (1.38)</td>
<td>6.13 (0.86)</td>
<td>43.50***</td>
<td>J &gt; K***, US &gt; K***, US &gt; J***</td>
</tr>
<tr>
<td>Contractual safeguards</td>
<td>5.26 (1.28)</td>
<td>5.12 (1.41)</td>
<td>5.32 (1.17)</td>
<td>0.99</td>
<td>Not significant</td>
</tr>
<tr>
<td>Champion behavior</td>
<td>5.01 (1.21)</td>
<td>4.66 (1.43)</td>
<td>5.61 (1.03)</td>
<td>22.90***</td>
<td>K &gt; J***, US &gt; K***, US &gt; J***</td>
</tr>
<tr>
<td>Trust</td>
<td>5.11 (1.21)</td>
<td>5.53 (1.22)</td>
<td>5.17 (1.13)</td>
<td>7.35***</td>
<td>J &gt; K***, J &gt; US***</td>
</tr>
</tbody>
</table>

Note: Means (standard deviations); difference between countries.

** p < 0.01.
*** p < 0.001.

Table 4
Regression analysis for trust formation.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
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<td>Controls</td>
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<td>Geographic proximity</td>
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<td>−.01</td>
<td>.00</td>
<td>−.02</td>
<td>−.01</td>
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<td>−.08*</td>
<td>−.06</td>
<td>−.05</td>
<td>−.04</td>
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<td>−.05</td>
<td>−.03</td>
<td>−.05</td>
<td>−.03</td>
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<td>Project length</td>
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<td>−.05</td>
<td>−.04</td>
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<td>.08*</td>
<td>.04</td>
<td>.07*</td>
<td>.04</td>
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<td>Market uncertainty</td>
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<td>−.06</td>
<td>−.04</td>
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<td>−.04</td>
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<tr>
<td>Technological uncertainty</td>
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<td>−.02</td>
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<td>.01</td>
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<td>Industry (microelectronics)</td>
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<td>Country (Japan)</td>
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<td>.21***</td>
<td>.24***</td>
<td>.18***</td>
<td>.23***</td>
</tr>
<tr>
<td>Country (US)</td>
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<td>−.07</td>
<td>.03</td>
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<tr>
<td>Basic effects</td>
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<td>.19***</td>
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<td>Partner reputation</td>
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<td>.15***</td>
<td>.19***</td>
<td>.14***</td>
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<td>Contractual safeguards</td>
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<td>.12***</td>
<td>.20***</td>
<td>.12***</td>
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<td></td>
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<td></td>
<td></td>
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<td>.34***</td>
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<td>Country moderating effects</td>
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<td>Japan × Tie strength</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US × Tie strength</td>
<td>−.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Japan × Partner reputation</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US × Partner reputation</td>
<td>−.13***</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Japan × Contractual safeguards</td>
<td>−.01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US × Contractual safeguards</td>
<td>−.01</td>
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<td></td>
<td></td>
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<tr>
<td>Japan × Champion behavior</td>
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<td>US × Champion behavior</td>
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<td>R²</td>
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<td>.37</td>
<td>.31</td>
<td>.37</td>
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<tr>
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<td>.07***</td>
<td>.02*</td>
<td>.01*</td>
<td></td>
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<tr>
<td>F-value</td>
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<td>16.57***</td>
<td>20.63***</td>
<td>12.71***</td>
<td>19.83***</td>
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</tbody>
</table>

Note: n = 618.
* p < 0.05.
** p < 0.01.
*** p < 0.001.

We test Hypotheses 1–10 with hierarchical multiple regression analysis. We check for multi-collinearity and calculate the variance inflation factors and find none of the factors exceeds a value of 2.8, indicating a limited potential for collinearity. In the first step, the effects of the control variables on trust are estimated (Model 1 in Table 4). Five controls variables have significant effects. Previous UICs, public subsidies and the country dummy for Japan are...
positively and basic research projects and market uncertainty are negatively related with trust formation.

In Model 2, the independent variables are entered into the regression. All three variables, i.e. tie strength, partner reputation, and contractual safeguards are positively related to trust, supporting Hypotheses 1–3.

To test for the hypothesized mediation effect of champion behavior, we add this variable in Model 3 and examine four conditions suggested by Baron and Kenny (1986): First, all independent variables (tie strength, partner reputation, contractual safeguards) are significantly associated with the mediator (see Fig. 1). We calculated these statistical associations by regressing the three independent variables on champion behavior while including all control variables in the equations. Second, all independent variables are significantly related with trust (Model 2). Third, the mediator is significantly associated with trust (Model 3). Fourth, when champion behavior is added, all associations of the independent variables with trust are partially mediated (Model 3). Sobel tests reveal that all three mediation effects are significant ($p < 0.001$), lending support to Hypotheses 4–6. The summary path diagram (Fig. 1) shows the direct and indirect effects of the variables on trust.

In Model 4, we examine the moderating effects of the institutional differences between countries by including the interaction terms of the independent variables with each country dummy. The results indicate that the effect of partner reputation on trust is significantly stronger in Korea than in Japan or the US, but we find no significant cross-country differences for tie strength and contractual safeguards. These results lend support to Hypothesis 8, but not to Hypotheses 7 and 9.

Finally, Model 5 shows both interaction terms of champion behavior with the country dummies as significant, suggesting that champion behavior is more important for trust formation in Korea compared to Japan and the US and supporting Hypothesis 10.

3.4. Discussion

This study reveals important insights regarding trust formation in UICs. First, there are some general differences among the three countries regarding several key variables. The perceived stronger partner reputation in the US could be due to the stronger research capabilities of US universities than their Japanese and Korean counterparts (Pavitt, 2001). The stronger perception of exercised champion behavior in the US than in the two Asian countries can be related to the more individualistic culture in the US (Hofstede et al., 2010), which expects individual managers to get the job done as ‘execution champion’. The higher amount of trust in the university partner in Japan than in the US and Korea is in line with a study on inter-firm collaborations in the automotive industry in these countries (Dyer and Chu, 2000) and matches Fukuyama’s (1995) classification of Japan as a ‘high trust’ country, Korea as a ‘low trust’ country, and the US as a formerly ‘high trust’ country, where inter-organizational trust has diminished in recent decades.

Second, tie strength, partner reputation, and contractual safeguards are related to trust in UICs across the countries studied. This result is in line with studies on alliances between firms (Larson, 1992; Gulati, 1995; Lee and Cavusgil, 2006) and indicates that initial inter-organizational trust is created in various ways (Doney et al., 1998). These include that past behavior is a good predictor of future behavior, that positive word-of-mouth contributes to an initial trust bonus, and that the legal and normative power of contractual safeguards can be used to build trust into a partner university.

Beyond the role each individual mechanism plays for trust formation, there is an ongoing debate on whether contractual and relational mechanisms work as complements or substitutes in enhancing outcomes in inter-firm collaborations (Poppo and Zenger, 2002; Wuyts and Geyskens, 2005; Ryall and Sampson, 2009). Therefore, in a post-hoc analysis we additionally examine potential interaction effects of each pair of independent variables on trust in the UIC context. We find the interaction term of tie strength and contractual safeguards to be negatively related with trust ($\beta = -0.09; p < 0.05$); whereas the interaction terms of tie strength and partner reputation and of contractual safeguards and partner reputation are unrelated to trust ($\beta = 0.04; p > 0.05$ and $\beta = 0.06; p > 0.05$). These post-hoc results suggest in tendency a substitution effect between tie strength and contractual safeguards on trust in UICs. This finding is in contrast to some recent studies on innovation collaboration between firms that found contracts and relational mechanisms to be complements (Aryges et al., 2007; Ryall and Sampson, 2009). A possible explanation for these different findings is that whereas in inter-firm collaborations concerns about exchange hazards may induce partners to combine various mechanisms in order to minimize the potential for opportunistic behavior, the focus in UICs lies instead in overcoming the cultural divide between firms and universities and achieving a good relationship quality. For establishing trust between UIC partners, the combined use of strong ties and contractual safeguards may not be instrumental, as the extensive application of contractual safeguards may undermine goodwill trust based on strong ties.

Third, in keeping with previous research on the central role of champions (Santoro and Betts, 2002), we find that the initial trust building mechanisms are mediated by champion behavior during the collaboration. Given the importance of champion behavior, three questions are of interest: (1) Who are these champions? (2) Does their functional background or organizational standing facilitate their behavior? (3) Are there between-country differences regarding the relevance of these attributes for trust formation?

To answer these questions, we conducted another post-hoc analysis on the champions’ functional background and hierarchical status. 50.7% were researchers or engineers and the remaining 49.3% were administrators or managers. 63.9% held executive and 36.1% non-executive positions. In line with Markham (2000), we observed much variety in the functional backgrounds and hierarchical status of innovation champions.

We tested for a potential direct effect of the champions’ function or status on trust formation as well as for the influence of these attributes on the association between champion behavior and trust. None of these attributes or interactions were significantly associated with trust. We also regressed trust on the interactions of the champion attributes with country dummies, and did not find any significant effects. These results suggest that the effectiveness of champion behavior in UICs is not limited to a specific background or hierarchical status. While research in
corporate settings often finds that the hierarchical position and professional knowledge of champions are key drivers for their effectiveness (Hauschildt and Kirchmann, 2001; Roure, 2001), our findings indicate that it is their leadership which primarily matters for trust formation in UICs.

Fourth, partner reputation and champion behavior influence trust in UICs more strongly in Korea than in the US or Japan. The stronger relation between partner reputation and trust suggests that Korean firms rely to a higher extent than their counterparts in the US or Japan on reputational information on university partners, most likely because of a lack of ties with academia. The stronger association of champion behavior with trust in Korea indicates that the activities of innovation champions are particularly important for developing trust when the ‘cultural divide’ between industry and academia is distinct and barriers between firms and universities are high.

The unexpected cross-country invariance regarding the association of tie strength with trust could be rooted in differences between business cultures, which counteract the institutional differences regarding UICs. The generally high reliance of Koreans on social ties in economic and professional activities (Yee, 2000) may also apply to the field of UICs. While Korean firms have weaker professional networks with universities and academia than companies in the US and Japan, they make more intensive use of the ties they do have in developing trust with university partners; that is, they rely on these weaker ties to build trust with their university partners as much as US or Japanese managers.

The absence of differences among the countries regarding the importance of contractual safeguards could be related to the substitutive relationship between tie strength and contractual safeguards we have found in a post-hoc analysis and which is discussed above. As firms in all three countries rely to a similar extent on tie strength when establishing trust with universities, the utilization of contractual safeguards as an alternative way of trust formation may also have been applied to a similar extent between the three countries.

Finally, we find no significant association between many control variables and trust. Notably, geographic proximity and trust are unrelated. This result contrasts with Petruzelli’s (2011) study which found a positive link between geographic proximity and the value of UIC outcomes. One possible explanation could be recent advances in communication technology which may have diminished the relevance of physical face-to-face meetings for effective collaboration between companies and universities.

In sum, our results indicate that the association of certain factors (tie strength, contractual safeguards) with trust is equally strong between the three countries, whereas that of others (partner reputation, champion behavior) is not. Our study is based on three countries and generalizations to other countries have to be considered with caution, but the findings suggest that some trust formation mechanisms are more universal than others.

At the same time, notable differences are related to the country specific environments within which UICs take place. In Korea, industry and academe have weaker links with each other and face a larger cultural divide than their counterparts in Japan and the US. As a consequence, partner reputation and champion behavior play a larger role for developing trust in UICs in Korea. At the same time, notwithstanding the reported cultural differences between the US and Japan (Hofstede et al., 2010), we did not find significant differences regarding trust formation mechanisms between Japan and the US.

4. Conclusion: contributions, limitations, research directions and implications

This study contributes in various ways to the literature on UICs. We validate tie strength, partner reputation, and contractual safeguards as initial trust formation mechanisms, and champion behavior as a crucial factor for maintaining and reinforcing trust between firms and universities during a collaboration. Another contribution relates to institutional factors that appear to be more relevant for the effectiveness of trust formation mechanisms than general cultural differences. Specifically, the results of our study suggest that in ‘emerging UIC countries’, including Korea and other newly industrialized Asian countries, and despite vibrant universities and globally competitive firms, partner reputation and champion behavior are essential for building trust between UIC partners, due to a relatively short history of research collaboration between the two types of organizations. Companies in ‘emerging UIC countries’ appear to rely strongly on the reputation of partner universities for building initial trust and on the leadership of innovation champions to overcome resistance and obstacles during a UIC for reinforcing this trust. Comparatively, these two mechanisms are less important for UIC trust formation in the US, Japan, and possibly other ‘advanced UIC countries’ with strong and mature university–industry research networks such as the UK or Germany. UIC partners in these countries may rely less on partner reputation due to their stronger direct exposure to universities, and there is also less resistance to UICs in companies, thus diminishing the role of a champion. Finally, notwithstanding the cross-country differences regarding the importance of champion behavior for trust formation, we find the effectiveness of champions to be generally unrelated to their professional background or hierarchical status, indicating that it is primarily their leadership which matters for trust formation in UICs.

At the same time, our study has a number of limitations. Our empirical observations are built on information obtained from the company’s perspective. Given the reciprocal nature of trust, it would have been valuable to take into account the perceptions from respondents of both collaboration partners. Due to the reluctance of respondents to share the identities of their university partners, it was not feasible to collect dyadic data. Instead, we worked on collecting large samples of responses across countries and on maximizing the quality of responses.

A single key informant was used for most measures. Given the interest in capturing the perceptions toward UICs the key informants were actively involved in, the use of self-report seemed justified for this kind of research. As we employed various methodological and statistical checks, the potential of a common method variance appears to be limited, though its existence cannot be strictly ruled out.

The study is cross-sectional, thereby limited in capturing the relational dynamics of UICs. Another potential concern is that of reverse causality between antecedent and dependent variables. The cross-sectional nature of the data does not allow us to assess potentially competing explanations, but this restriction does not invalidate the inherent causal nature of our conceptualization (Whetten, 1989). We emphasized the temporal sequencing of the antecedent, mediator, and outcome variables in the questionnaire and took great care in their formulation and measurement. Therefore, we conclude that whereas reverse causality cannot be strictly ruled out; its potential may be limited.

Given these limitations and the partially unexpected results of our study, additional research on UICs considering regions outside the Western hemisphere, in particular in emerging economies, would further advance our understanding of this field. Longitudinal studies and research based on dyadic data appear to be suitable to validate our findings and gain further insights, particularly as regards the between-country variance or invariance of factors that determine trust formation and performance of UICs. Furthermore, future studies could more explicitly consider institutional or cultural background factors in order to disentangle their specific influence on trust formation, as these factors sometimes
appear to have countervailing effects on the relevance of certain trust formation processes.

For UIC partners, our findings suggest that there are various ways to establish trust in such relationships, including capitalizing on pre-existing ties, seeking out reputable partners, and negotiating mutually beneficial contractual outcome provisions. Managers should leverage previous experience with university partners, information obtained from third parties, and legal and social norms within society as a whole to build trusting UICs. Moreover, companies should give the management of UICs into the hands of managers who are strongly motivated to collaborate with universities and lead the UIC to overcome internal resistance in order to strengthen trust with university partners, regardless of their professional background or hierarchical status.

At the same time, when companies and universities are relatively inexperienced with such collaborations, certain behaviors appear to be particularly important for building trust in UICs in ‘emerging UIC countries’. In these countries, the university partner’s reputation appears to be specifically important for building initial trust, and champion behavior to be critical for maintaining it during the collaboration. Therefore, companies and universities engaging in UICs in these countries should give particular attention to these mechanisms. Even if they do not have strong direct ties, they may collaborate with partners which are highly reputed and reinforce initial trust by relying on the leadership of innovation champions in promoting UICs, overcoming obstacles and resistance, and getting the right individuals involved.

From a public policy perspective, our findings suggest that policymakers both in ‘emerging’ and ‘advanced UIC countries’ should support firms and universities in building mutual trust by strengthening the mechanisms which generally help bridging the cultural divide and establishing trusted relationships. They should enhance the strengthening of university–industry networks by creating suitable exchange forums, such as university–industry roundtables, which allow academics and corporate managers to build ties which can help with trust formation in future UICs. Furthermore, university technology transfer offices should be advised to help creating trust between collaborating firms and universities by crafting contractual agreements which reassure partners that their interests will be sufficiently protected in UICs.

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Appendix A

See Appendix Table A1.

References


