



Impact of specific investments, governance mechanisms and behaviors on the performance of cooperative innovation projects

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Abstract

Inter-organizational collaborative innovation projects are increasingly cited as a “best practice” in R&D activities, this study seeks to understand the factors affecting performance of cooperative innovation projects from a new perspective: specific investments. Specific investments is important to the value creation for inter-organizational projects, however which can induce the “hold-up” problem, formal contracts and relational trust are two typical governance mechanisms employed to safeguard specific investments. This paper tests the effects of both mechanisms simultaneously using empirical studies focused on Chinese cooperative innovation projects, exploring the effects of specific investments, governance mechanisms and behaviors on cooperative innovation projects performance. The findings demonstrate that specific investments favor both, the formation of formal contracts and relational trust, and the effect of specific investments to performance is mainly influenced by relational trust. As such, this study contributes to governance theories in cooperative innovation projects management literature by empirically showing how specific investments affect cooperative innovation projects performance.

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1. Introduction

As organizations increasingly engage in joint innovation projects (Eriksson et al., 2016), many studies conclude that cooperative firms have, on average, higher overall performance levels than non-cooperative firms (Abramovsky and Simpson, 2011) since they are able to share investment costs and may take advantage of partners’ resources and capabilities. However, another strand of literature emphasizes that an important issue in project-based environments is the low performance in innovation (Winch, 1998). Others found that firms based on projects do not provide a context supportive of innovation, since they prioritize efficient management of projects (Keegan and Turner, 2002). More recently, Lhuillery and Pfister (2008)

find that 14% of R&D collaborating firms had to abandon or delay their innovation projects due to difficulties in their partnerships by the second French Community Innovation Survey. Thus the concern in this paper is to explore the factors influence the performance of cooperation with other organizations in technological innovation projects.

Based on Bosch-Sijtsema and Postma (2008) and Sandin et al. (2014), cooperative innovation projects (CIPs), or inter-organizational innovation projects, are specific projects designed to create a new idea, product, material, system, or manufacturing processes in cooperation with other firms (suppliers, customers, competitors and other firms) and public research organizations (such as, R&D institutes and universities). In a broad sense, the performance of cooperative innovation projects (PCIPs) is one of the topics of project governance. Although there is an ever-increasing discussion on governance in recent project research, the governance of inter-organizational innovation projects remains

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ambiguous. Few studies investigate innovation projects performed in cooperation with other firms in project-based industries (Gann and Salter, 2000). Transaction cost economics literature and corporate governance literature are two streams of literature prevalent in general governance literature (Ahola et al., 2014). From the perspective of transaction costs economics, this paper aims to study how firms involved in CIP partnerships protect specific asset investments through governance mechanisms (GMs), which include formal contracts (FCs) and relational trust (RT), and how these GMs deal with the opportunistic behaviors (OBs) and cooperative behaviors (CBs) to arrive at a satisfied PCIP.

At a time when organizational networks and collaborative innovation processes are proliferating in many economies (Calamel et al., 2012), a particular institutional environment may encourage or impede the building of relational ties between trading partners (North, 1990). On the one hand, China has functioned as a highly relational network of clans; on the other hand, China is rapidly changing towards a free market operation, providing a context appropriate for testing the impact of RT and FCs on transactions. Smyth and Morris (2007) argue that projects are context-specific and located in open-systems, this paper will test the effects of the specific investments (SIs) and two governance mechanisms to the performance of cooperative innovation projects within the Chinese context.

Based on a sample of 238 questionnaires that provided CIP data in Chinese high-tech enterprises, from the perspective of transaction cost economics, combined project governance and innovation management literatures, we hypothesize and test a proposed model that links specific investments and firm-level PCIPs, considering the role of governance mechanisms and partners' behaviors. The findings demonstrate that specific investments favor both of the formation of FCs and RT, and the effect of SIs to the performance of cooperative innovation projects is mainly influenced by RT in China. As such, this study contributes to project governance theories in CIP management literature by empirically showing how specific investments affect performance of cooperative innovation projects, filling in the gap of our understanding of the impact of SIs to PCIPs. The results provide considerable support for our model and yield important scholarly and managerial implications. The paper also contributes to a more comprehensive understanding of RT by introducing its roles in GMs, examining how such mechanisms influence PCIPs in the Chinese setting.

The rest of this paper is organized as follows. Section 2 proposes theoretical background and hypotheses and describes the model. Section 3 discusses the sample and the statistical methods. Section 4 presents and analyses the results. Section 5 concludes by comparing the results with related studies and stating the contributions and limitations of this study and identifying some future directions.

2. Theory and hypotheses

2.1. Theoretical background

Most of the cooperative innovation literature focuses on the topic of knowledge and learning, neglecting to consider the role

of SIs. SIs are assets that are uniquely dedicated to another firm (Williamson, 1979). These are dedicated assets that are transaction specific because their value in a given transaction is higher than in their next best use (Teece, 1986). SIs is a common feature of cooperative relationships and scholars working in the field have highlighted the importance of SIs as a means to establish and sustain cooperative relationships (Anderson and Narus, 1990; Lui et al., 2006; Morgan and Hunt, 1994). As pointed out by Tripsas et al. (1995), asset specificity is high in collaborative relationships. As a kind of organizational cooperation, the level of asset specificity is high in the partnership of CIPs. Calamel et al. (2012) conclude that collaboration is the product of a process of social construction by observation of the conduct of the collaboration projects, so we think that SIs is very important for social construction. Furthermore, Inemek and Matthyssens (2013) find that relation-specific investments, interfirm knowledge sharing routines and governance mechanisms may promote supplier innovativeness, however, the literature does not consider in an enough detail of their effects to the performance of cooperative innovation projects.

SIs has important value-creation properties, however, transaction cost economics claims that the SIs increase the hazards of opportunism (Heide and Stump, 1995). CIPs are characterized by equivocality (Sakka et al., 2016) and cultural complexity since members from academia, firms and research institutes work together (Sandin et al., 2014), the members of interorganizational innovation teams bring to bear different experiences, knowledge, and resources (Eriksson et al., 2016). All of those will increase the risk and opportunism, to reduce them, necessary GMs are useful, among the diversity of governance approaches (Müller et al., 2015), and FCs and RT are ranked as two vital GMs that can safeguard transactions and SIs (Das and Teng, 1998; Poppo and Zenger, 2002).

In transaction cost economics and relational exchange theory literatures, although the effectiveness of contracts and trust in governing inter-organizational and their effects on cooperation performances have been widely studied (e.g. Luo, 2002; Yang et al., 2011), there is limited empirical evidence as to how they affect PCIPs. From the perspective of transaction costs economics, both the frequency of interactions and the level of uncertainty are high (Tripsas et al., 1995) in the relationship. In addition, information asymmetries are also common in collaborative relationships, all of those will increase the transaction costs in inter-organizational projects. Compared with relationship performance, the outcome of CIPs is unpredictable, which indicate it is difficult to specify the terms and clauses in advance (Wang et al., 2011). Do those facts mean that trust is more important than contract in CIPs? Especially in China — a country rich with *guanxi*? This paper is to test the effect of them in the context of CIP settings.

Similar to transaction cost economics, agency theory relies on the assumption that human beings are self-interested and opportunistic in their behavior (Sundaramurthy and Lewis, 2003), Kadefors (2004) argues that contractual incentives and close monitoring of contractor performance may induce opportunism in client–contractor relationships in construction projects.

And in sociological theories, trust aligns with cooperation driven by loyalty to a partner due to ethics or bonds of friendship or kinship, rather than coercion or material self-interest; trust affects the partner's behaviors through intrinsic instead of extrinsic motivations (Nagin et al., 2002), which can safeguard proper behaviors in exchange relationships characterized by uncertainty and dependence (Doney and Cannon, 1997). Moreover, behaviors can influence performance.

Although some studies focus on the topics of specific investments (e.g., Ebers and Semrau, 2015) and innovation project performance (e.g. Arranz and de Arroyabe, 2012), studies on the relationship between specific investments and cooperative innovation project performance are scarce. Wagner and Bode (2014) study the links the level of a supplier's relationship-specific investments to its sharing of innovative ideas, similarly, Pinheiro et al. (2016) examines the role of social capital dimensions towards resource sharing within R&D cooperation projects. Based on the arguments of transaction cost economics and relational exchange theory, Lui et al. (2009) built a model to discuss two distinctive mechanisms linking the asset specificity and partnership performance of cooperative relationships. However, they test both mechanisms simultaneously on a sample of procurement relationships between Hong Kong trading firms and their Chinese suppliers, we will test the link of specific investments to the performance of cooperative innovation projects in Chinese CIPs.

We discuss their relation, testing the impact of SIs and GMs to PCIPs in Chinese CIP setting, which is project oriented and puts more emphasis on innovation. Our research framework and hypothesis are graphically depicted in Fig. 1 and the relationships are hypothesized in the following sections. In the framework, SIs is a key factor of the “push model” of PCIPs and the roles of GMs as well as different behaviors are also considered. By testing the theory under different contexts, we can know if context matters in the link of SIs and performance. What's more, as far as the relationship of GMs and behaviors is concerned, they just simply suppose that contract relates negatively to OBs and trust relates positively to CBs, neglecting the influences of FCs to CBs and RT to OBs. In addition, their model assumes that the link of GMs to performance is by behaviors, actually, GMs may affect performance directly, for example, Lu et al. (2015) find that contractual and relational governances are important to improve project performance, similarly, it is argued that a higher level of trust would improve

project performance (Kadefors, 2004). Our model also texts this in Chinese CIPs, thus our model expands the research scope and context of Lui et al. (2009).

2.2. Hypotheses

Asset specificity is centrally important to understand why contracts are essential for economic exchange (Williamson, 1979, 1985). SIs would expose an exchange party to the potential of opportunistic behaviors (OBs) by the other party (Ganesan, 1994). This hazard is present because SIs are of less value in alternative uses. Exchange partners have “hold-up” or “opportunism” incentives to expropriate returns from these specialized investments using ex-post bargaining or threats of termination (Klein et al., 1978). Under this circumstance, economic exchange requires FCs. Previous research has shown that asset specificity is positively related to FCs in a partnership (e.g. Poppo and Zenger, 2002). The prediction is that firms craft a more formal contract with their partners to safeguard their SIs in the partnership. We argue that the positive relationship is also true in CIPs, so we suggest:

H1. In CIPs, SIs relate positively to FCs.

Inter-organizational trust has been studied widely both in the social exchange literature (e.g., Zaheer and Venkatraman, 1995) and in the marketing literature (e.g., Anderson and Narus, 1990). Relational exchange theory considers that trust develops in a partnership when exchange partners act reliably and fairly, do not take advantage of each other, and are devoted to a mutual commitment (Poppo and Zenger, 2002). This is also a self-reinforcing process: as commitment in assets generates trust in a partner, trust in turn encourages a firm to invest more in specific assets (Narayandas and Rangan, 2004), so trust becomes an effective governance safeguard for those specific assets. Moreover, SIs are also a strategic tool that bonds partners together. With long-term bonding, partners are expected to behave in a trustworthy fashion (Ganesan, 1994; Lui et al., 2006). Likewise, Yu et al. (2006) also find a positive relationship between transaction-specific investments and trust. Thus,

H2. In CIPs, SIs relate positively to trust.

A contract is the legal bond that specifies the roles, routines, rights and obligations of partners with detailed and formal operational procedures (Arranz and de Arroyabe, 2012). As a transactional mechanism, FCs offer legal and institutional frameworks that guide task fulfillment and monitor the exchange between partners. Arranz and de Arroyabe (2012) argue that these aspects of FCs have a direct effect on the performance of the project. To the collaborative innovation context, the process of cooperative innovation includes knowledge acquisition and knowledge accessing (Grant and Baden-Fuller, 2004), thus the efficiency of knowledge transferred is important to PCIPs. Knowledge acquisition involves exchanging supplementary knowledge of a similar domain (Lane and Lubatkin, 1998), and FCs are appropriate for guarding an exchange when knowledge is more predictable, regular, and

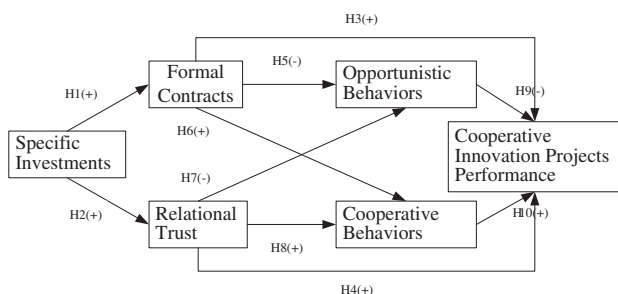


Fig. 1. Conceptual model.

explicit (Makhija and Ganesh, 1997). FCs specifying legally binding clause clearly and explicitly facilitate knowledge assimilation during the acquisition process (Lui et al., 2009). Thus, the costs and risks associated with knowledge exchange are reduced in CIPs. Lu et al. (2015) also find that higher level contractual governance plays an important role in improving construction project performance. Hence,

H3. In CIPs, FCs relate positively to PCIPs.

Several researchers have paid attention to interfirm trust and its benefits from theoretical and empirical perspectives (Das and Teng, 1998). The benefits from trust can be, for instance, reduction of transaction costs and increased information sharing. Jones and Lichtenstein (2008) consider that trust can help reduce transactional uncertainty which has the effect of decreasing coordination costs in inter-organizational projects. Trust based role structures in project environments have been shown to improve the ability to develop innovative solutions in reaction to problems and unforeseen circumstances (Bechky and Okhuysen, 2011; Meyerson et al., 1996; Okhuysen and Bechky, 2009) and a relationship based on trust would enable firms to improve their capabilities for innovativeness. Empirically, Hausman (2005) argues that channel relationships influence the innovativeness of small businesses primarily because innovation is a social process and innovative partners may influence a firm's innovation capability or innovativeness. Müller and Martinsuo's (2015) find that relational norms in the buyer–supplier relationship are positively associated with project success. Hausman and Stock (2003) consider that relationships in the supply chain may promote innovativeness because partners in the relationships influence innovative decisions made by others within the chain. Similarly, Maurer (2010) find that trust between project team members working on an inter-organizational project positively impacts the acquisition of external knowledge which, in turn, promotes product innovation. Thus, we propose that when a high level of trust is maintained between firms, knowledge, ideas and information can flow smoothly to help enhance PCIPs:

H4. In CIPs, RT relates positively to PCIPs.

Transaction costs economics argues that when formal contracts increase, partners will act less opportunistically. Opportunism is defined as self-interest seeking with guile (Williamson, 1985), which involves “lying, stealing, cheating, and calculated efforts to mislead, distort, disguise, obfuscate, or otherwise confuse.”, transaction costs economics further argues that FCs may reduce opportunism in several ways (Lui et al., 2009). First, because FCs state how different future situations will be handled, it provides formal rules and procedures to mitigate opportunistic behavior of the partners and reduces uncertainty about behaviors and outcomes (Lusch and Brown, 1996). Second, as FCs specify cheating occasions and related punishments in written form, it serves as a reference point to judge the extent of opportunism (Cavusgil et al., 2004). And third, as FCs clearly prescribe the nature of a transaction, partners can rely on this agreement to resolve conflicts arising from any disputes (Ring and Van de Ven, 1994). Empirical studies proclaim the effectiveness of FCs

in reducing opportunism. Dahlstrom and Nygaard (1999) find that formalization reduces opportunism in franchisees. Therefore,

H5. In CIPs, FCs relate negatively to OBs.

Because the application of FCs affect the expectations of each other in the CIPs, and cooperation by its very nature involves expectations and desires for relationship continuity. As signals of a structural and institutional framework, FCs secure both the transaction and the relationship in the long term, so the effect of FCs should enhance CBs by increasing perception of the probability of future interactions. Thus, we suggest:

H6. In CIPs, FCs relate positively to CBs.

Cooperation is defined as coordinated actions taken by exchange parties to achieve mutually beneficial behavior in terms of flexibility, information exchange, and shared problem solving (Anderson and Narus, 1990). Relational exchange theory predicts that trust relates positively with CBs, which is because confidence in and reliance on the other partner promotes flexibility, solidarity, and information exchange between partners. Moreover, although behaving cooperatively exposes oneself to a partner and poses risks, these risks could be reduced when trust in the partner is high (Poppo and Zenger, 2002). The positive relationship between trust and CBs receives support empirically. Hewett and Bearden (2001) find that trust is positively related to CBs. They note that if the headquarters of a multinational is perceived as credible and concerned about the subsidiary's welfare, the subsidiary may be more likely to perceive objectives as mutually beneficial and may be more likely to cooperate. Morgan and Hunt (1994) also find that trust leads to cooperation, so we suggest:

H7. In CIPs, RT relates positively to CBs.

Trust is an integral part of relational exchange and has been termed a significant aspect of social capital (Fountain, 1998). As one of the typical mechanisms to control against opportunism from sociological perspectives (e.g., Uzzi, 1997), trust can facilitate detailed processes and achieve fewer transaction costs. CI involves mutual transfers of strategic information and sensitive technological knowledge, and trust plays a role of providing the assurance against potential opportunistic and hazardous behaviors from the partner (Gaur et al., 2011), Dyer and Singh (1998) also consider that trust of the focal firm in its business partners in general can act as a safeguarding mechanism and mitigate uncertainties associated with future displays of opportunism. So,

H8. In CIPs, RT relates negatively to OBs.

Transaction costs economics also predicts that OBs is negatively related to the performance of a cooperative relationship, since the success of a relationship and the competitive advantages rely on the joint efforts of the partners. If a party seeks its own unilateral gain and acts opportunistically by breaching the contract, withholding or distorting information, shirking obligations, or grafting joint earnings, the other party

will suffer. In addition, the suffered partner may cease to contribute valuable resources and information towards the exchange, and may hold back from the relationship avoiding to be exploited again (Luo, 2007). Under this circumstance, the partnership cannot generate the expected benefits or competitive advantage. Empirically, Luo (2007) analyzes a sample of foreign joint ventures and shows that opportunism pairs a joint venture's financial returns, sales growth, and overall performance. In light of this evidence, opportunism is expected to reduce partnership performance. In short, opportunism can increase transaction costs (Dahlstrom and Nygaard, 1999), and reduce satisfaction and firm performance. So,

H9. In CIPs, OBs relate negatively to PCIPs.

Relational exchange theory argues that CBs lead to better partnership performance. This outcome occurs because repeated instances of cooperation relate to the norm of reciprocity and self-enforced safeguards (Luo, 2002). Anderson and Narus (1990) further claim that when firms take similar or complementary coordinated actions in interdependent relationships, they are able to achieve mutually favorable outcomes. Dyer (1997) explains that, in addition to enjoying economies of scale and scope with an increasing volume of exchange, partners also have the substantial benefits of information sharing and the reduction of information asymmetry and potential for opportunism. This in turn minimizes transaction costs. Cooperation also offers a platform for interorganizational learning (Dyer and Singh, 1998), which relates to the success of cooperative innovation. Some empirical studies support the positive relationship between CBs and performance. For example, Luo (2002) demonstrates that cooperation positively drives international joint venture performance. Thus,

H10. In CIPs, CBs relate positively to PCIPs.

3. Research design

The empirical tests involve a sample of high-tech enterprises in China, and Chinese context can provide a useful alternative to extant research, which relies mostly on large enterprises from the United States and United Kingdom (Mukherjee et al., 2012). Questionnaires were addressed to CEOs, top management team and R&D management members as well as product managers. These enterprises received a questionnaire and an introductory letter explaining the purpose of the research and promising confidentiality. Each set of questionnaires contained three parts: a copy of the questionnaire, a guide to completing the questionnaire, and a return envelope. The survey asks respondents to answer the questions with respect to “an innovation partner that you have recently dealt with in inter-organizational projects,” which directed them to a particular partnership. After several rounds of communication during a period of six months, of the 472 mailed surveys, we received a total of 301 responses. After discarding 63 partially completed questionnaires, the final sample consisted of 238 questionnaires.

The measures of the constructs were generated from previous literature and interviews to this research context. To

further test the content and face validity of the measures, the researchers interviewed ten senior R&D managers and asked them to identify the relevance and clarity of the measures. Several ambiguities revealed in the draft were rectified based on their responses. The measurement items and validity test results are reported in Table 1.

Based on Suh and Kwon (2006) and modified to fit the specific context, SIs include four items. Borrowed from Lui et al. (2009) and Liu et al. (2009), FC is measured with four items. The measurement of RT comes from and modified based on Gaur et al. (2011) and Yang et al. (2011). Adopted from Rokkan et al. (2003), modified to fit the specific context, six items are used to measure OBs. CBs are measured with six items based on Pearce's (2001) scale. Finally, PCIPs was measured by four items based on Chen et al. (2009), using the subjective scale. Subjective measures are used commonly in research on private companies or business units of large corporations (Yang et al., 2012). Previous studies have found a strong correlation between subjective assessments and their objective counterparts (Pearce et al., 1987).

In addition, to control for other factors that may influence PCIPs, we include two control variables such as firm size and firm age. Firm size might have an effect on the performance because larger firms generally have more resources to devote to innovative activities, enhancing their innovation capability and performance (e.g., McEvily and Marcus, 2005; Yam et al., 2011). Firm size is measured by the number of employees. Firm age may also influence the performance, and previous investigations have indicated that older firms have accumulated the experience and knowledge needed to facilitate innovation generation and engage more frequently in innovative activities than younger firms (e.g., Li et al., 2010). Firm age is measured by the number of years that the firm has been active in the sector.

4. Empirical results

4.1. Validation of instrument

Before conducting hypothesis testing, a thorough measurement analysis was carried out on the instrument to reduce measurement error (Churchill, 1979). The analysis included assessments of the scale reliability, convergent validity, discriminant validity, and unidimensionality of the research constructs. Cronbach's alpha was used to assess the scale reliability of each construct in the research model. Cronbach's alpha for every factor (shown in Table 2) was greater than the suggested threshold value of 0.7 for an acceptable level of reliability (Kline, 1998). The analysis includes confirmatory factor analysis to examine the unidimensionality and convergent validity of the constructs. The fit indexes indicated that the model fit the data well (χ^2 (268) = 451.24; RMSEA = .054; GFI = .94; AGFI = .93; NFI = .92; CFI = .97). All items loaded on their respective constructs, and all loadings were significant at the 0.001 level. This supports the dimensionality of the constructs. These results indicated unidimensionality among the research constructs.

Table 1
Items and constructs.

Constructs	Items
Specific investments (SIs)	1. We and our partner have made significant investments in resources dedicated to the relationship for the cooperation.
	2. We and our partner's operating processes have been tailored to meet the requirements of cooperation.
	3. We and our partner have involved substantial commitments of time and money for the cooperation.
	4. If the cooperative product innovation relationship over, it will be a big loss to us.
Formal contracts (FCs)	1. Our relationship with the partner is governed primarily by written contracts and agreements.
	2. We have formal agreements that detail the obligations and rights of both parties.
	3. Over time we have developed ways of doing things with the partner that never need to be expressed contractually or formally (reverse coded).
	4. We do not have specific, well-detailed agreements with the partner (reverse coded).
Relational trust (RT)	1. In contact with business partners we never had the feeling of being misled.
	2. We feel comfortable to let the other party make decisions.
	3. We can effectively do things for each other.
	4. We are confident that the interests will be ensured because both are thought to belong to "one family".
Opportunistic behaviors (OBs)	1. The partner has always provided us a completely truthful picture of their abilities.
	2. The partner sometimes promises to do things without actually doing them later.
	3. The partner does not always act in accordance with our contracts.
	4. The partner sometimes tries to violate informal agreements between two parties to maximize their own benefit.
	5. The partner will try to take advantage of "holes" in our contract to further their own interests.
	6. The partner seems to feel that it is all right to use my proprietary technology and know-how for their own internal projects without my permission.
Cooperative behaviors (CBs)	1. Flexibility in response to requests for changes is a characteristic of our relationship.
	2. When an unexpected situation arises, the partners would rather work out a new deal than hold each other to the original terms.
	3. Exchange of information in our relationship takes place frequently, informally, and openly.
	4. The partners keep one another informed of changes and events that might affect them.
	5. In most aspects of our relationship the parties are jointly responsible for getting things done.
	6. Problems that arise in the co-innovation relationship are treated as joint rather than individual responsibilities.
Performance of co-innovation projects (PCIPs)	1. We make considerable profit from new products by the cooperation.
	2. We can improve our product quality by the cooperation.
	3. We can develop new technology and knowledge by the cooperation.
	4. We can accelerate the commercialization pace of the new products by the cooperation.

Table 2
Measurement properties.

Construct	Items	Standardized loading	Cronbach's alpha	SE (standard error)	CR (composite reliability)	AVE (average variance extracted)
SIs	1	0.87	0.89	0.09	0.89	0.68
	2	0.67		0.10		
	3	0.81		0.17		
	4	0.92		–		
FCs	1	0.68	0.77	0.08	0.77	0.63
	2	0.89		0.08		
	3	0.79		0.08		
	4	0.84		–		
RT	1	0.79	0.82	0.14	0.87	0.71
	2	0.81		0.12		
	3	0.87		0.08		
	4	0.90		–		
OBs	1	0.70	0.94	0.23	0.93	0.70
	2	0.75		0.21		
	3	0.82		0.18		
	4	0.92		0.15		
	5	0.90		0.16		
	6	0.89		–		
CBs	1	0.78	0.85	0.12	0.86	0.75
	2	0.83		0.08		
	3	0.89		0.15		
	4	0.80		0.09		
	5	0.76		0.24		
	6	0.87		–		
PCIPs	1	0.89	0.87	0.19	0.90	0.69
	2	0.88		0.23		
	3	0.80		0.36		
	4	0.76		0.39		

The results in Table 2 indicate further support for the convergent validity of the measures. Each factor loading is greater than twice the standard error (Anderson and Gerbing, 1988), which implies that each loading is significant at $p = .01$. The composite reliability values, which assess the internal consistency of a measure and usually calculated in conjunction with structural equation modeling (Peterson and Kim, 2013), vary from .74 to .94. These findings offer robust support for the convergent validity of the items in each scale.

To assess the discriminant validity, a series of two-factor models, recommended by Bagozzi et al. (1991) were estimated in which individual factor correlations, one at a time, were restricted to unity by using AMOS. The fit of the restricted models was compared with that of the original model. In total, we performed 22 models — 44 pairs of comparisons. The chi-square change ($\Delta\chi^2$) in each model, constrained and unconstrained, were significant, $\Delta\chi^2 > 3.84$, which suggests that constructs demonstrate discriminant validity.

4.2. Hypothesis testing

The reliable and valid scales support the development of composite factor scores for the variables from the principal component analysis. Table 3 presents the descriptive statistics and correlations. The formal test of multicollinearity used the variance inflation factor statistic; the highest value was too low for any multicollinearity concerns.

For the test of the theoretical model, the results of the SEM analysis come from AMOS. The overall fit statistics indicate an adequate fit of the model to data ($\chi^2 = 458.36$, $df = 279$, $\chi^2/df = 1.64$, $p < 0.001$; $RMSEA = 0.05$; $CFI = 0.97$; $GFI = 0.92$; $TLI = 0.96$).

The study examines individual hypotheses (Table 4), consistent with our predictions, the results indicate that the relationship between SIs and FCs and that between SIs and RT were significant, in support of H1 and H2. Contrary to our predictions, the results indicate that the relationship between FCs and PCIPs and that between FCs and OBs and CBs were insignificant, so the findings do not support H3, H5 or H6. In addition, the hypothesized relationship between RT and PCIPs was positive and significant, in support of H4. On the other hand, the hypothesized relationship between RT and OBs and

Table 4
Results of hypothesis testing.

Hypothesis	Path	Path value	Significant	Result (Supported or not)
H1(+)	SIs → FCs	0.23	***	Yes
H2(+)	SIs → RT	0.37	***	Yes
H3(+)	FCs → PCIPs	0.08	0.32	No
H4(+)	RT → PCIPs	0.44	***	Yes
H5(−)	FCs → OBs	0.09	0.41	No
H6(+)	FCs → CBs	−0.12	0.23	No
H7(−)	RT → OBs	−0.43	***	Yes
H8(+)	RT → CBs	0.47	***	Yes
H9(−)	OBs → PCIPs	−0.35	***	Yes
H10(+)	CBs → PCIPs	0.41	***	Yes

*** $p < 0.001$.

that between OBs and PCIPs were negative and significant, in support of H7 and H9. Consistent with relational exchange theory, trust had a significant and positive effect on CBs in support of H8. Finally, CBs had a significant and positive effect on PCIPs, supporting H10.

Regression analysis is conducted to test the influence of control variables, and the results show that both of firm size and firm age are not significant ($p > .1$). The findings are similar with several studies such as Wan et al. (2003), they reveal that firm size has no direct influence on innovation performance. Different from prior research (e.g., Li et al., 2010), we did not find that firm age had a differentiating effect on innovativeness.

4.3. Discussion of the results

The result shows that SIs are in favor of the formation of FCs, which seems to contradict Lui et al. (2009), they find that the relationship between asset specificity and FCs is insignificant, and we noticed that the validation of FCs had a Cronbach alpha of 0.57. Our result indicates that FC is important to induce SIs. Simple and straightforward contracts are treated as the basis or as a way to initiate CIPs in China. Firms have to rely much more on contracts to control their partners because they are not familiar with each other (Luo, 2002). Hence, FCs may be useful in the early stage of partnership (Wang et al., 2011).

Table 3
Descriptive statistics and person correlation matrix.

Constructs	Mean	Variance	1	2	3	4	5	6	7	8
1. PCIPs	3.17	0.63	–							
2. SIs	3.12	0.70	0.24**	–						
3. FCs	2.93	0.87	0.14	−0.07	–					
4. RT	3.30	0.72	0.52**	0.44**	−0.08	–				
5. OBs	2.84	0.85	−0.21	−0.22**	−0.14**	−0.45**	–			
6. CBs	3.61	0.58	0.57**	0.50**	0.41**	0.47**	−0.22**	–		
7. FS	725.28	634.71	0.12	0.18	0.16*	0.21**	−0.13	0.19*	–	
8. FA	22.79	14.23	−0.05	0.06	0.03	0.07	−0.04	0.05	0.312**	–

* Correlation significant at the .05 level (two-tailed).

** Correlation significant at the .01 level (two-tailed).

The study finds that the relationship between FCs and PCIPs is not significant. It is generally believed that FCs are conducive to protect the property and core technology as well as knowledge of the partners, however the effect is weakened by innovation characters and Chinese context. Firstly, as mentioned before, the level of technology and market uncertainty as well as the equivocality in CIPs is high, innovation projects demand more creative ideas, and the output is unpredictable, for example there is no guarantee that a novel product sought from a cooperative innovation project will be delivered. As a result, it is difficult to specify the terms and clauses in advance. Some studies also argue that formal controls may not be suitable in high uncertainty and equivocality projects because they impose constraints on the professionals involved and limit their freedom and innovation capacity (e.g. Hope and Fraser, 2003).

Secondly, as the information asymmetries and environment are changing quickly, it becomes almost impossible to either specify the contingencies in advance or to monitor the execution of the contracts (Lusch and Brown, 1996; Poppo and Zenger, 2002), especially for cooperative innovation projects. In this case, project managers may depend on other mechanism or tools, for example, project managers deal with unclear user needs by using tools other than formal controls, such as prototyping, sign-offs or encouraging informal and rapid communications among future users and system designers (Sakka et al., 2016).

Thirdly, the transaction costs are high in cooperative innovation projects, including ex-ante transaction costs and ex-post transaction costs (Tripsas et al., 1995), thus reaching and enforcing an agreement to cooperate may be difficult. Fourthly, the FC is limited for the Chinese context. Peng and Heath (1996) suggest that the institutional constraints in transition economies may limit the use of FC governance and thus redirect the growth of a firm from expansion and acquisition to a network-based strategy. Lastly, complete contracts are technologically infeasible, and it is too costly even impossible for the parties to write detailed long-term contracts (Grossman and Hart, 1986; Hart and Moore, 1990). All of those reasons make the effect of FCs on PCIPs not significant.

One of the most important findings is that our study pitted contracts and relationships against each other and found that, in Chinese context, trust is more important than contracts to PCIPs. This result is similar with several studies, for example, Lee and Cavusgil (2006) argue that the relational governance, as opposed to the contractual governance, is more effective in alliance performance; Liu et al. (2009) conclude the same result in relationship performance, this paper confirms this in a new context: Chinese CIPs. As the outcome of the CIPs is uncertain, the cooperation process is complex, Maurer (2010) argues that trust grants access to valuable knowledge of outside project partners. It facilitates the acquisition of novel ideas and insights which lay the ground for further product innovation. This is one of the reasons of the result, other explanations are as following.

We discuss the reasons for the effect of FCs on the performance of cooperative innovation projects is not significant in the study, which can be summarized into two aspects: one is

the nature of CIP activities and the other is the Chinese context. The reasons why the effects of FCs on PCIPs are not significant are discussed above, which may indicate that trust is especially important in China. The high uncertainty and transaction costs, as well as information asymmetries, all of those make trust more important than contracts in CIPs. As for Chinese context, some researches endorse the importance of RT and *guanxi* (literally, interpersonal relationships or connections), Zhuang et al. (2008) find that interpersonal *guanxi* helps determine whether firms gain influence in channel exchange relationships. We empirically demonstrate that trust is more important than contracts to PCIPs in Chinese high-tech enterprises. In Chinese culture, trust is based on good *guanxi*, which is the lifeblood of business in China (Shou et al., 2011). *Guanxi* is utilitarian in developing friendship to share resources in business communities (Su and Littlefield, 2001), which consists of personal ties or social bonds and is described as the informal connection that is essential to gain approval for or access to key resources in China. Although Guthrie (1998) argues that the significance and importance of using *guanxi* or the social network is declining in China, however, we argue that the nature of CIPs and Chinese culture make trust is still more important than contracts to PCIPs.

This study also finds that the negative effect of FCs to OBs is not significant, while RT is beneficial for CBs in Chinese CIPs. The conclusion is also similar with Yang et al. (2011), they differentiate the relations into strong tie from weak tie and find that trust reduces OBs in both the strong and the weak tie samples, however they find formal control insignificantly reduces OBs in the strong tie. And influenced by business and institutional tradition, even at sometimes formal and predetermined procedures often were viewed as a sign of distrust by Chinese partners. In addition, Chinese culture perceives open conflicts as indicators of interpersonal hostility, so solving conflicts by contracts has been viewed as an obstacle to pre-existing trust relationship enhancement (Tjosvold et al., 2006). All of those lead to the insignificant negative effect of FCs to OBs.

Finally, we further study the relationships between FCs and CBs and the relationships between RT and OBs. The results show that RT is conducive to reducing the OBs; however the positive effect of FCs to CBs is not significant in Chinese CIPs. And the conclusion of trust reducing OBs is consistent with most previous studies pertaining to trust and opportunism. Yang et al. (2011) find in the weak tie, formal control combined with trust significantly reinforces the long-term orientation, while in the strong tie, the effect of FCs decreasing long-term orientation is not significant. Similarly, Cao and Lumineau (2015) indicate that contracts, trust, and relational norms jointly improve satisfaction and relationship performance and jointly reduce opportunism. However in China, sometimes more contracts can increase distrust of partner, and the distrust can induce non-cooperative behaviors, thus FCs may not increase CBs.

5. Conclusions

In the past two decades, there has been a sustained interest in both practices and studies on interorganizational innovation

projects (Eriksson et al., 2016). Despite the increasing reliance on projects as an organization mode, few studies have investigated how SIs are managed in cooperative innovation projects. As Smyth and Morris (2007) point out that project management can be observed in its multidisciplinary nature and the way it draws upon a range of social (and natural) sciences, based on transaction costs economics and relational exchange theory, as well as project governance and innovation management literature, we extend prior literature by focusing on SIs in the less studied CIP setting. From the perspective of internal organization, we discuss two distinctive mechanisms linking SIs and performance in the process of cooperative innovation projects. Transaction costs economics and relational exchange theory consider that FCs and RT are two GMs for specific investments, and they can affect the behaviors of the partners, thus affecting the PCIPs.

This study contributes to a better understanding of the performance of cooperative innovation projects in Chinese context. Like national culture theory (e.g. Zaheer and Zaheer, 2006), institutional theory has gained widespread adoption as a means to explain companies' behaviors across countries (Wu et al., 2008). For example, *guanxi* (literally, interpersonal relationships or connections) is the lifeblood of business in China (Shou et al., 2011). Cai et al. (2010) also notice that the various effects of diverse institutional factors on management practices in cross-country contexts, and argue that it is also important to recognize that the effects of institutional forces may vary significantly within a single country, depending on the firms' location, industry type and so forth. Although Lui et al. (2009) study a sample of procurement relationships between Hong Kong trading firms and their Chinese suppliers. Hong Kong, officially the Hong Kong Special Administrative Region of the People's Republic of China, maintains a separate political and economic system from China. As a developed area, the ideas and behaviors of Hong Kong firms are different from the Chinese mainland. We test the links between specific investments and PCIPs based on the sample of cooperative innovation projects in Chinese mainland and find that *guanxi* is really critical for the cooperation, which will be addressed later.

Whereas there are some studies focusing on the SIs and the GMs (e.g. Lui et al., 2009; Yang et al., 2011), prior literature neglects the effect of them on the PCIPs. Zwikael and Smyrk (2014) argue that project governance models have lagged behind developments in the project management literature. This paper fills in this gap by providing a clearer model of how firms involved in cooperative innovation projects protect the specific investments through FCs and trust based GMs, and how these mechanisms impact PCIPs. By doing so, our study contributes to project governance theories in cooperative innovation projects in three ways.

First, we examine how transaction-specific investment influence formal and relational GMs in cooperative innovation projects. Second, in addition to influence the performance of cooperative innovation projects indirectly by behaviors, we believe that GMs can directly affect the PCIPs. Thus, we uncover the distinct, complex effect of FCs and RT on PCIPs. And we argue that FCs can also affect CBs and at the same time RT can also affect OBs, so

we test the effect and their influence on PCIPs. What's more, we also examine the effects of FCs on CBs and the effects of RT on OBs. Third, this study helps illuminate the research setting of CIPs in the transitional economy of China. The relationship of FCs and trust, and their effect on relational performance, thus clearly warrant further analysis to enrich our understanding of the complex working mechanisms associated with CIPs governance. Although the importance of trust in inter-organizational projects is widely acknowledged (Maurer, 2010), this study find that trust is more important than contracts to PCIPs in Chinese context.

As a growing area of interest for both researchers and professional, the question of how to build and manage collaboration in inter-organizational project opens up new and promising avenues for applied research (Calamel et al., 2012). This study, based on Chinese cooperative innovation projects, brings a qualitative understanding on the impact of SIs to PCIPs, having several important implications. On a micro managerial level, firstly, projects managers should focus on how to foster trust and CBs with SIs in the process of CIPs. The potential benefits of SIs are considerable. As argued by Dyer (1996), transaction-SIs may be highly effective tools in speeding up the development of new products and increasing their quality. However, investing in specific assets in a business partnership is risky for managers, since it makes them vulnerable to the partner's OBs. Our study suggests that managers should focus on how to foster trust and CBs with SIs in the process of CIPs because these relate more strongly to performance. Secondly, managers should pay attention to cultivate relational trust in China. A transitional economy implies a business environment with incomplete laws and ever changing regulations; and *guanxi* play an important role in China. Managers may engage in a social process of communication, both of formal and informal communication (Kamuriwo and Baden-Fuller, 2016) to achieve trust between partners, and communication may also reduce the negative effects of information asymmetry in alliances (e.g. Schreiner et al., 2009).

On a macro level, this study has potential implications for foreign firms entering China for the first time and conducting CIP agreements with Chinese firms. To them, the most important thing is to recognize the importance of trust in Chinese culture. Although Chinese market economy is increasingly mature and the rules of law are increasingly perfect, the development of institutional environment of contractual law and dispute resolution in China is still slow and inadequate. The results indicate that RT is important to PCIPs in China. Trust in America is built on social and legal systems, while in China it is built on personal relationships. A *guanxi* relationship is necessarily, a trusting one that depends on the trust worthiness of the *guanxi* partners. To safeguard against *guanxi* risk, Chinese people use *guanxi* only with trustworthy partners (Shou et al., 2011), so foreign firms should spend some time to cultivate and establish a good *guanxi* with Chinese partners, which can smooth their CIPs process and gain success in the cooperation.

This study contains some limitations that suggest some directions for further research. First, we adopt a subjective

evaluation measurement for PCIPs, because the enterprises often have strong commercial awareness of self-protection, the financial data is difficult to obtain. Second, the samples come from Chinese high-tech manufacturing enterprises, which also make the conclusions more applicable in this industry, therefore it needs further inspection for the conclusion in other industry, such as service industry.

Lastly, the findings show that specific investments is in favor of formal contracts and relational trust formation, conversely whether the FCs and RT affect specific investments or not is worth of study. Yu et al. (2006) find that both formal governance and relational governance mechanisms affect suppliers' tendencies to make specialized investments, which shows the relationships among them maybe complex and reciprocal, accordingly, it may be useful to examine the interactions of them in future study. Additional research might include policy study, as trust is so important in Chinese CIP context, it is valuable to investigate how trust is inculcated and if the third parties are necessary to transfer *guanxi* or not, and the role of the government in enforcing contracting laws. Moreover, there are two dimensions of trustworthiness (Shazi et al., 2015), ability and benevolence, and it can be classified into two types: calculative trust and relational trust (Poppo et al., 2016), the further study may empirically assess the roles of them in CIP relationship.

Conflict of interest

The authors declared that they have no conflicts of interest to this work.

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