How Does Inter-Organizational Relational Governance Propel Firms’ Open Innovation? A Conditional Process Analysis

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Abstract: To successfully implement open innovation, it is essential for firms to build close relationships with external innovators. Although many studies have suggested that relational governance, also known as social control, can effectively manage inter-organizational relationships, the role of relational governance on firms’ open innovation remains equivocal. Using a survey of 318 manufacturing firms from China, this study used a conditional process model to analyze the interplay of relational governance, open innovation, and firms’ innovation performance and examine the influence of environmental dynamism. The results demonstrate that relational governance has a positive impact on firms’ open innovation (both inbound and outbound) and innovation performance. We also found that open innovation mediates the association between relational governance and firms’ innovation performance. A high level of environmental dynamism enhances the indirect effect of relational governance on firms’ innovation performance through open innovation. These findings help clarify the interaction between relational governance and open innovation. They also deepen understanding of the value co-creation principle of open innovation.

Keywords: open innovation; relational governance; environmental dynamism; innovation performance

1. Introduction

Intense global competition and frequent technological change have encouraged a growing number of firms to shift their strategies from closed innovation to open innovation [1]. Open innovation is a novel innovation paradigm that relies on firms purposively managing knowledge flows across organizational boundaries to facilitate internal R&D or external technology commercialization [2]. Open innovation has become an important strategic approach to breaking through resource constraints and obtaining monetary or non-monetary benefits not only for leading companies such as GE, IBM, and Nokia but also for small and medium-sized firms [1,3–5]. Prior studies have demonstrated that having a broad set of partners improves firms’ open innovation [1,6,7]. However, recent research has suggested that open innovation may have a dark side; firms engaging with external innovators may suffer from exchange hazards such as knowledge leakage, conflict between the demands of control and openness, and opportunism [8–11]. These problems pose a substantial challenge to both academic researchers and managers who are dedicated to promoting open innovation practices.

Open innovation scholars who regard inter-organizational knowledge transfer as a crucial means of facilitating value co-creation recommend that firms reduce their control over internal knowledge [7,12,13]. Although open innovation has evolved as a novel inter-organizational collaboration paradigm, the co-creation of value by exchange parties still faces numerous barriers. Recent research has found that open innovation is prone to conflict between knowledge sharing and knowledge protection, which hinders value creation and value capture by exchange parties; knowledge sharing increases the risk of
knowledge leakage, whereas knowledge protection may hamper communication and collaboration between firms and external innovators [8,11,14]. In addition, some authors have argued that exchange hazards among exchange parties, such as opportunistic motives [11], information overload [15], conflicts over ownership of knowledge [10], not-connected-here, and not-invented-here [16], seriously weaken the efficiency of open innovation. Some early research has suggested that formal governance (e.g., contract, hierarchy, and platform) is a feasible approach to eliminating the barriers of open innovation [1,4]. However, because of uncertainty and individual bounded rationality, “it is impossible to design a complete contract or regulation that anticipates all possible events and clarifies the appropriate actions of each party” [17–19]. Therefore, formal governance is difficult to effectively control the behavior of exchange parties. As each party has opportunistic motives and will adopt various strategic actions to maximize their individual interests, open innovation will inevitably breed exchange hazards (e.g., refusal to cooperate, conflicts, violation, and high renegotiation costs) that constrain the sustainability and flexibility of the exchange relationship [20,21]. Some scholars have proposed that to avoid exchange hazards, relational governance can be used to improve communication and consensus among exchange parties, complementing formal governance [22–26]. However, the role of relational governance in firms’ open innovation has received scant attention from scholars and managers. The lack of research in this area limits our understanding of the function of relational governance. It remains unclear whether relational governance facilitates or inhibits firms’ open innovation. Relational governance aims at the development of reciprocity, joint actions, and embedded social relations, and it restrains exchange hazards through trust and shared norms [24]. To the best of our knowledge, the relational governance literature has mostly focused on marketing, supply chain management, and international business and has verified the positive impact of relational governance on knowledge acquisition [21,27], specific investments [28,29], and organizational learning [30,31], while paying scant attention to exchange hazards in firms’ open innovation. Although some scholars have suggested that building and maintaining a close partnership is essential to promote open innovation, relevant studies have been limited to conceptual and qualitative analysis, and their findings need to be further verified by management practices [11,32]. In addition, there have been many studies surrounding the manifestations of and reasons for exchange hazards in open innovation, but they have failed to discuss the impact of relational governance on firms’ open innovation and innovation performance, so a comprehensive perspective on the effectiveness of relational governance is lacking in the open innovation literature [10,15,33].

Moreover, studies of open innovation have not investigated the effect of environmental dynamism on the association between inter-organizational collaboration and firms’ innovation performance. In practice, open innovation is always disturbed by changes in technology and market demands, and exchange parties should quickly alter their expectations and strategic decisions as a result [34,35]. Environmental dynamism will not only produce uncertainty and exchange hazards but also increase the difficulty for firms to monitor or control the behaviors of external partners [36,37]. However, the literature has only briefly considered the important role of relational governance in avoiding the risks of open innovation from the perspective of inter-organizational collaboration, but it has failed to explore the contingency factors of relational governance [11,32,38]. Thus, we argue that the inclusion of environmental dynamism as a moderator variable may clarify the role of relational governance in open innovation.

In response to these research gaps and drawing upon the theory of relational exchange and innovation management, we used conditional process analysis to examine how inter-organizational relational governance affects firms’ open innovation. This study makes three key contributions to the literature. First, it provides a systematic theoretical framework for relational governance in open innovation. We found that relational governance not only can promote inbound and outbound open innovation but also has a positive impact on firms’ innovation performance. Second, we examined the mediating role of inbound and outbound open innovation in the association between relational governance and firms’
innovation performance at the level of inter-organizational collaboration, improving the understanding of the value co-creation principle in open innovation. Finally, our results reveal that environmental dynamism positively moderates the indirect effect of relational governance on firms' innovation performance via open innovation. These insights provide a more comprehensive understanding of the boundary conditions in the relationship between relational governance and open innovation.

The remainder of this paper is organized as follows. The conceptual model and hypotheses are presented in Section 2. We discuss the samples, data, and measures in Section 3. In Section 4, we test the hypotheses and provide our empirical results. Theoretical contributions, managerial implications, and future research directions are proposed in Section 5.

2. Theory and Hypotheses

Building on the literature, this study develops the conceptual model shown in Figure 1 to investigate the interplay of inter-organizational relational governance, open innovation, and firms’ innovation performance.

Figure 1. The conceptual model.

2.1. Relational Governance and Innovation Performance

Relational governance, also called social control, is a series of socialized mechanisms that guide and control individual behavior through social relations and shared norms [23, 25, 26, 39]. Compared with formal governance, relational governance relies on self-enforcement in informal relationships to curb opportunistic motivation and mitigate exchange hazards in a more flexible way. Trust and relational norms are two of the most important mechanisms in the literature on relational governance [20, 23, 25, 40].

Social exchange theory posits that trust is the foundation for building and maintaining close relationships [41–43]. In inter-organizational relationships, trust refers to an organization’s expectation that the other party will perform particular actions for joint gain, irrespective of whether the partner’s behavior can be monitored or controlled [25, 44, 45]. This composite definition of trust has been widely used in the literature and captures three main aspects of trust: fairness, predictability, and reliability [45–47]. Fairness suggests that the exchange partner will conduct negotiations and collaboration fairly and impartially. Predictability means that one party will behave in a predictable way without compromising the other party’s benefits. Reliability is the extent to which the organizations will fulfill their promises and obligations.

Trust is considered as an effective mechanism to enhance consensus and understanding between exchange partners and reduce collaborative risks caused by asymmetric information and uncertainty [41, 48]. Some studies have shown that mutual trust between organizations plays a positive role in firms’ sales revenue, new product development, and R&D efficiency [39, 46, 49]. For example, Li et al. [46] showed empirically that trust increases confidence and expectations between a firm and its partners, which not only inspires exchange partners to behave cooperatively but also enhances the firm’s sales revenue. Maurer [50] reported that trust can replace dogmatic supervision and control, reduce conflicts of interest, and enable firms and external partners to focus on the development of new products. Jensen et al. [49] found that the success rate of R&D projects is
significantly improved in a cooperative atmosphere with higher mutual trust. Bouncken et al. [39] suggested that building trust is an effective way for firms to better understand external needs and identify suitable partners, thereby improving the efficiency of technology commercialization. Corral de Zubielqui et al. [38] indicated that contracts may suppress inter-organizational knowledge sharing but that trust promotes knowledge transfer and technological innovation between firms and external partners. Therefore, we propose our first hypothesis:

**Hypothesis 1 (H1).** Inter-organizational trust relates positively to firms’ innovation performance.

Originating from relational exchange theory, relational norms are a series of behavioral expectations, underlying rules, and shared norms that each party in an inter-organizational relationship abides by to achieve collective goals [26,51]. More specifically, relational norms promote the formation of common vision and values, guiding exchange parties to build an interdependent partnership [52,53]. A number of empirical studies have shown that participation, solidarity, and information exchange are the key components of relational norms [20,51]. Participation encourages exchange parties to actively perform joint decision-making through mutual understanding and adjustment, avoiding the risk of cooperation arising from uncertainty, and improving exchange performance with a closer cooperative relationship. Solidarity facilitates the formation of bilateral behavioral expectations, creating behavioral rules for achieving collective or group goals, and plays a positive role in restraining self-interest seeking behaviors. Information exchange enables each party’s ideas and initiatives to be effectively shared and communicated and stimulates exchange partners to resolve problems and conflicts via joint consultation and discussion.

Compared with formal governance, relational norms significantly improve the cooperative satisfaction between firms and external partners and have a positive correlation with firms’ innovation performance [54]. Lechner et al. [55] found that relational norms enhance firms’ courage and belief in their ability to overcome difficulties and facilitate efficient product development and patent output through close cooperation. Arranz and de Arroyabe [30] showed empirically that when relational norms are established, external partners actively participate in firms’ technological innovation processes, improving the performance of joint R&D projects. Therefore, we predict the following hypothesis:

**Hypothesis 2 (H2).** Inter-organizational relational norms relate positively to firms’ innovation performance.

### 2.2. The Mediation Effect of Open Innovation

Open innovation implements value co-creation through inter-organizational knowledge transfer [13,56]. According to the different directions of knowledge transfer, open innovation can be decomposed into two strategic modes: inbound open innovation and outbound open innovation [57,58]. Inbound open innovation refers to external knowledge search and acquisition such that firms can absorb new ideas, technologies, and experience to facilitate internal R&D. Outbound open innovation involves firms outputting knowledge to external partners (e.g., patent licensing, technology transfer, and cooperative R&D) to obtain monetary or non-monetary benefits.

Relational governance affects firms’ inbound and outbound open innovation in three ways. First, inter-organizational trust is conducive to reducing the negative impact of uncertainty and asymmetric information on firms’ strategic decisions and facilitating knowledge transfer between firms and external partners in an atmosphere of reciprocity and fairness [27,31,59]. A high level of mutual trust also contributes to the development of a convenient communication channel for negotiation and adaptation, enabling the responsibilities and obligations of exchange parties to be clarified [48,60] and thereby mitigating the risk of knowledge leakage in open innovation. Second, relational norms based on a common belief improve understanding and consensus between firms and external partners in terms of goals, values, and joint actions; increase the degree of firms’ inbound and outbound openness; and enhance the efficiency and quality of knowledge transfer. Relational norms guide an individual’s bounded rationality and self-interest
seeking behavior toward concerns about common interests, reconciling the benefit conflict between individual and collective goals [40]. Third, under the joint effect of trust and relational norms, exchange parties’ strategic decisions will focus on the long-term interests that are beneficial to each party and stimulate the emergence of self-enforcement behaviors during collaboration [20,23]. Therefore, when relational governance exists, exchange parties hold a common belief and commitment to the partnership and thereby harmonize interests, curtail potential opportunistic behavior, and increase the degree of knowledge transfer and openness between firms and external partners. Accordingly, we predict the following hypotheses:

Hypothesis 3 (H3). Inter-organizational trust relates positively to firms’ (a) inbound and (b) outbound open innovation.

Hypothesis 4 (H4). Inter-organizational relational norms relate positively to firms’ (a) inbound and (b) outbound open innovation.

Open innovation has a positive impact on firms’ innovation performance via enhanced inter-organizational value co-creation [7,13]. Previous studies have examined the positive impact of inbound and outbound open innovation on firms’ sales revenue, new product development, and technological innovation [61,62]. In the case of inbound open innovation, acquiring and utilizing valuable external ideas and technologies is an advantageous approach to value creation, saving the time and investment required for internal R&D and increasing the speed of new product development [34,61]. Given that most firms do not possess all of the necessary resources to carry out internal R&D alone, inbound open innovation can also produce a synergistic effect, stimulate firms and external partners to share complementary resources, and help firms break through their own capacity and resource constraints to accelerate technological innovation [1,37,63]. Compared with competitors who focus on closed innovation, firms that actively search and acquire external knowledge can continuously create new knowledge combinations to improve their innovativeness, thereby achieving better innovation performance when competing in product or service markets [64]. External technology commercialization is an important function of outbound open innovation, which not only provides a business model for firms to develop the business value of internal knowledge but also enables them to better understand changes in technology and market demand [1,56]. In the process of outbound open innovation, firms can obtain economic benefits directly by selling underexploited knowledge (e.g., ideas, technologies, and patents) to external parties or realize value capture indirectly through cooperative R&D [34,62,63]. Opening part of the knowledge base to the outside can maximize firms’ profitability and help them assess which kinds of internal knowledge have commercial potential [65,66]. In addition, firms’ technological innovation advantages may be demonstrated by outbound open innovation, enabling them to occupy a favorable position in establishing industry standards and obtain monopoly profits from future technological output [34,67]. Therefore, we propose the following hypothesis:

Hypothesis 5 (H5). Firms’ (a) inbound and (b) outbound open innovation relate positively to innovation performance.

Relational governance encourages knowledge transfer between exchange parties and provides opportunities for firms to improve their innovation performance. First, relational governance expands firms’ external knowledge source by stimulating external parties to share or sell core technologies willingly in inbound open innovation. When firms face formidable internal R&D challenges, trust and relational norms can reduce the transaction costs of establishing and maintaining cooperative relationships when acquiring external knowledge, protecting firms from the threat of external knowledge suppliers’ pricing discrimination and self-interest seeking behaviors [59,60]. Second, some firms may express concern about knowledge leakage in outbound open innovation. In this context, relational governance can provide a safeguard for firms’ core technology to be used normatively and appropriately by external partners. For outbound open innovation, trust is conducive to exchange parties fully discussing the adverse consequences of opportunistic behaviors in
inter-organizational knowledge transfer and guides firms and external partners to properly use each other’s core technologies by designing specific cooperation procedures and benefit distribution clauses [40,68]. Finally, relational norms help establish common goals, decrease the negative impact of asymmetric information and uncertainty on knowledge transfer, and facilitate firms’ value capture in outbound open innovation. Therefore, relational governance inspires firms to actively perform open innovation and enhance their innovation performance via inbound and outbound knowledge transfer. Accordingly, we predict the following:

**Hypothesis 6 (H6).** Inbound open innovation mediates the associations between (a) inter-organizational trust and firms’ innovation performance and (b) inter-organizational relational norms and firms’ innovation performance.

**Hypothesis 7 (H7).** Outbound open innovation mediates the associations between (a) inter-organizational trust and firms’ innovation performance and (b) inter-organizational relational norms and firms’ innovation performance.

### 2.3. The Moderating Effect of Environmental Dynamism

To successfully implement open innovation, exchange parties should not only establish a close partnership but also pay attention to the impact of environmental dynamism on collaboration. Environmental dynamism refers to “the rate of change and the level of unpredictability of the environment” [69,70]. In a highly dynamic environment, consumer behaviors and preferences will change rapidly, firms’ products and services may be eliminated by new market demand at any time. Therefore, if firms want to improve their innovation performance, they need to acquire external ideas, experience, and knowledge through inbound open innovation to quickly respond to unexpected changes in the dynamic environment and develop new products and services to satisfy latent market demand [71]. Furthermore, in a rapidly changing market competition, the commercial value of technology will depreciate with the emergence of new market demand [37]. Firms should actively implement outbound open innovation and convert idle or underused technology into monetary or non-monetary benefits to improve their innovation performance [36]. On the contrary, when the level of environmental dynamism is low, the changes in market demand and consumer preferences are relatively stable, firms will reduce cooperation with external innovators [72,73], then decreasing the positive effect of open innovation on innovation performance. In summary, the higher the degree of environmental dynamism, the more positive the association between firms’ open innovation and innovation performance. Hence, we propose the following:

**Hypothesis 8 (H8).** Environmental dynamism positively moderates the associations between (a) inbound open innovation and innovation performance and (b) outbound open innovation and innovation performance.

Based on these hypotheses, we argue that the mediating effect of open innovation may be affected by environmental dynamism. Specifically, the relationship between inter-organizational relational governance and firms’ innovation performance will be more fully mediated by open innovation when there is greater environmental dynamism. In contrast, the indirect impact of inter-organizational relational governance on firms’ innovation performance through open innovation will be reduced when environmental dynamism is lower. Accordingly, we propose our final hypothesis:

**Hypothesis 9 (H9).** Environmental dynamism positively moderates the mediating effect of (a) inbound and (b) outbound open innovation between inter-organizational relational governance and firms’ innovation performance.

### 3. Methodology

#### 3.1. Sample and Data

We selected manufacturing firms in the Pearl River Delta region of China (including nine cities such as Guangzhou, Shenzhen, and Foshan) for our empirical setting. China is
the second-largest economy in the world and has become a global manufacturing center. The most advanced manufacturing industry clusters in China are located in the Pearl River Delta region, where many firms are actively participating in open innovation and are highly reliant on the cultivation of close relationships with external innovators to strengthen their competitive advantages. This provides an ideal context to examine the hypotheses we propose in this study.

As suggested by Gerbing and Anderson [74], we developed a survey instrument. In-depth interviews were conducted with senior managers from 20 firms before the formal survey began. We asked the interviewees to evaluate the accuracy, readability, structure, and completeness of the items and revised the survey instrument based on their feedback. For the formal survey, 900 questionnaires were sent to manufacturing firms in the registration list of national high-tech zones and industrial parks in the Pearl River Delta region of China selected by a random sampling method. The questionnaire was filled out by senior managers familiar with the firms’ technological innovation processes (e.g., CEO, R&D manager, or supply chain manager). As this study focuses on inter-organizational relational governance in open innovation, we used one item to ask the respondents how often they have implemented open innovation in the past three years on a 5-point Likert scale (1 = “never”, 5 = “frequently”). We excluded questionnaires from respondents whose firms had not often adopted open innovation in the past three years, and finally obtained 318 usable questionnaires, for a response rate of 35.33%.

The demographic profile of the sample is shown in Table 1 (N = 318). In terms of size, 27.67% of the firms ranged from 500 to 1000 employees. Firms that had been operating in related industries for 10 to 20 years accounted for the largest proportion, reaching 37.42%. Concerning ownership, 59.12% of the firms were private enterprises. In terms of industry, 76.10% of the firms were in high-tech industries such as electronic information, advanced manufacturing and automation, biotechnology and medicine, and new materials; 23.90% of the firms were in traditional manufacturing industries such as petrochemicals, food, and clothing.

Table 1. Characteristics of the sample (N = 318).

| Category        | Item        | Number | Percentage |
|-----------------|-------------|--------|------------|
| **Firm size**   | <100        | 38     | 11.95%     |
|                 | 100–300     | 77     | 24.21%     |
|                 | 301–500     | 72     | 22.64%     |
|                 | 501–1000    | 88     | 27.67%     |
|                 | >1000       | 43     | 13.52%     |
| **Firm age**    | <5          | 36     | 11.32%     |
|                 | 5–10        | 90     | 28.30%     |
|                 | 11–20       | 119    | 37.42%     |
|                 | 21–30       | 52     | 16.35%     |
|                 | >30         | 21     | 6.60%      |
| **Industry**    | High-tech industry | 242 | 76.10%     |
|                 | Traditional industry | 76  | 23.90%     |
| **Ownership**  | State-owned enterprises | 19  | 5.97%      |
|                 | Private enterprises | 188 | 59.12%     |
|                 | Foreign-funded enterprises | 41  | 12.89%     |
|                 | Joint venture enterprises | 70  | 22.01%     |

We examined non-response bias in the responding versus nonresponding firms from the sampling frame in terms of key firm characteristics (e.g., size, age, industry, and ownership) and found no significant differences between the two groups, indicating that non-response bias was not an issue in this sample.
3.2. Measures

All items in this study were adapted from the literature and measured on a 5-point Likert scale, ranging from 1 = “strongly disagree” to 5 = “strongly agree” (see Appendix A).

3.2.1. Dependent Variable

Despite the publication of numerous studies on firms’ innovation performance, there is no consensus on the measurement of this construct. In the literature, two common approaches are used to measure firms’ innovation performance: using objective items to evaluate firms’ financial profitability, such as the profitability of sales, return on investment, and return on assets, and using subjective items to measure firms’ sales, innovation efficiency, and new product development speed by manager self-assessment [57,75–77]. Because some key financial indicators involve trade secrets, many firms do not voluntarily report their profitability, so it is usually difficult to collect real financial data with objective items. Therefore, some scholars have suggested using managers’ self-assessments instead of objective items. Moreover, Geringer and Hebert [76] found a significant correlation between subjective and objective items for measuring firms’ innovation performance. Based on the work of Chen et al. [77] and Huang et al. [37], we used five manager self-assessment items to measure firms’ innovation performance: the number of new products, the speed of new product development, the success rate of R&D projects, the number of patent applications, and the sales of new products. The respondents were asked to assess their firm’s performance compared with peer competitors over the past three years on 5-point Likert scales.

3.2.2. Independent Variable

A five-item scale for trust was adapted from Zaheer et al. [45], Poppo et al. [47], and Zhang and Zhou [27]. This scale captured the extent to which firms believed their partners’ behavior was reliable, predictable, and fair. A four-item scale was adapted from Liu et al. [20] and Arranz and de Arroyabe [30] to measure relational norms via degree of participation, solidarity, and information exchange between exchange parties. The measure of open innovation was adapted from Hung and Chou [34], Lichtenthaler [56], and Sisodiya et al. [64] to assess the level of inbound and outbound knowledge transfer between firms and external partners. On the basis of Jansen et al. [70], a five-item scale was used to measure environmental dynamism (the rate of change and the instability of the external environment).

3.2.3. Controls

In line with Chen et al. [77], Hung and Chou [34], and Zhang and Zhou [27], we controlled several variables that significantly influence firms’ open innovation, including firm size, industry type, and firm age. Specifically, industry type was measured on a two-item scale with 0 = traditional industry and 1 = high-tech industry. Firm size was assessed by the number of employees, using five items from 1 = less than 100 to 5 = more than 1000. Firm age was measured on a five-item scale from 1 = less than 5 years old to 5 = more than 30 years old.

3.3. Reliability, Validity, and Common Method Variance

Confirmatory factor analysis was used to test the reliability and validity of the measures. As shown in Table A1, the model fit was acceptable (χ²/df = 1.178, CFI = 0.986, GFI = 0.920, IFI = 0.986, TLI = 0.984, RMSEA = 0.024). Cronbach’s α values for all of the constructs exceeded 0.8, and the composite reliability (CR) was higher than the benchmark of 0.70, confirming adequate measurement reliability. Table A1 also demonstrates that each item’s standardized factor loading was higher than 0.70, and the average variance extracted (AVE) values for all of the constructs exceeded the 0.50 threshold, thus indicating adequate convergent validity and reliability. As shown in Table 2, the square roots of the AVE for each construct were higher than the construct’s correlation coefficients with other factors,
indicating acceptable discriminant validity. We also examined the variance inflation factor (VIF) of each variable. The results showed that the variables’ VIFs ranged from 1.01 to 1.32, so multicollinearity was not a major concern.

Table 2. Descriptive statistics and correlations (N = 318).

|       | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. Industry | N/A   |       |       |       |       |       |       |       |       |
| 2. Firm size | −0.005 | N/A   |       |       |       |       |       |       |       |
| 3. Firm age  | 0.058  | 0.032 | N/A   |       |       |       |       |       |       |
| 4. Trust     | −0.086 | −0.002| −0.007| 0.742 |       |       |       |       |       |
| 5. Relational norms | −0.107 | −0.011| 0.068 | 0.201**| 0.796 |       |       |       |       |
| 6. Inbound open innovation | −0.121* | −0.056| −0.092| 0.321**| 0.254**| 0.792 |       |       |       |
| 7. Outbound open innovation | −0.141* | −0.059| −0.065| 0.380**| 0.307**| 0.340**| 0.766 |       |       |
| 8. Environmental dynamism | −0.020 | 0.059 | −0.134*| 0.183**| 0.222**| 0.238**| 0.283**| 0.754 |       |
| 9. Innovation performance | −0.055 | 0.086 | 0.054 | 0.310**| 0.335**| 0.320**| 0.331**| 0.356**| 0.768 |
|       | Mean  |       |       |       |       |       |       |       |       |
|       | 0.530 | 3.070 | 2.790 | 3.127 | 3.231 | 3.354 | 3.286 | 3.117 | 3.375 |
|       | SD    | 1.240 | 1.059 | 0.706 | 0.890 | 0.777 | 0.747 | 0.853 | 0.781 |

Note: The results in bold are the square root of the AVE; *p < 0.05, **p < 0.01.

Following Podsakoff et al. [78], we used the Harman single-factor test to examine potential common method variance (CMV). The results showed that the first factor explains 28.017% of the total variance, which is lower than the benchmark of 40%. In addition, in accordance with Malhotra et al. [79], we compared the key fit indexes of the single-factor model with the six-factor model (trust, relational norms, inbound open innovation, outbound open innovation, environmental dynamism, and innovation performance) using confirmatory factor analysis. The results indicated that the fit of the six-factor model (see Table 2) was significantly better than that of the single-factor model ($\chi^2/df = 8.077$, CFI = 0.421, GFI = 0.502, IFI = 0.424, TLI = 0.376, RMSEA = 0.149). These results indicated that CMV was not a serious concern in this study.

4. Analyses and Results

Following Baron and Kenny [80], we used a causal steps approach to test our hypotheses. The results are presented in Tables 3 and 4. In Table 3, Models 1, 5, and 7 are the basic models that included only the control variables. The results of Model 2 showed that inter-organizational trust ($b = 0.279$, $p < 0.001$) and relational norms ($b = 0.247$, $p < 0.001$) had significant positive effects on firms’ innovation performance, supporting both H1 and H2. The results of Model 6 showed that inter-organizational trust ($b = 0.302$, $p < 0.001$) and relational norms ($b = 0.172$, $p < 0.001$) had significant positive effects on firms’ inbound open innovation. Therefore, H3 was supported. Model 8 indicated that inter-organizational trust and relational norms were positively correlated with firms’ outbound open innovation, with regression coefficients of 0.344 ($p < 0.001$) and 0.199 ($p < 0.001$), respectively. Thus, H4 was supported. Model 3 showed that inbound ($b = 0.247$, $p < 0.001$) and outbound ($b = 0.272$, $p < 0.001$) open innovation had significant positive effects on firms’ innovation performance. Therefore, H5 was supported. The results of Model 4 demonstrated that when the mediation variables were added to Model 2, inbound and outbound open innovation had a positive impact on innovation performance ($b = 0.178$, $p < 0.001$; $b = 0.169$; $p < 0.01$, respectively); the regression coefficients of the explanatory variables (trust and relational norms) remained statistically significant but were smaller than those of Model 2 ($b = 0.168$, $p < 0.01$; $b = 0.183$, $p < 0.001$, respectively), indicating that open innovation partially mediated the association between inter-organizational relational governance and firms’ innovation performance. These results provided support for H6 and H7.
Table 3. Results of mediating effect analysis.

| Variables               | Innovation Performance | Inbound Open Innovation | Outbound Open Innovation |
|-------------------------|------------------------|-------------------------|--------------------------|
|                         | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 | Model 8 |
| Industry                | −0.090 | (0.088) | 0.011   | 0.034   | −0.181* | −0.111 | −0.206* | −0.125 |
| Firm size               | 0.053   | 0.056   | 0.071*  | 0.067*  | −0.034 | −0.032 | −0.035 | −0.033 |
| Firm age                | 0.040   | 0.025   | 0.066   | 0.046   | −0.061 | −0.071 | −0.039 | −0.051 |
| Trust                   | 0.273***| (0.058) | 0.166** | 0.203***| 0.344***|
| Relational norms        | 0.247***| (0.046) | 0.183***| 0.172***| 0.199***|
| Inbound open innovation | 0.206***| (0.046) | 0.194***| 0.218***|
| Outbound open innovation| 0.208***| (0.048) | 0.181***| 0.218***|
| R²                      | 0.013   | 0.183   | 0.179   | 0.239   | 0.025  | 0.158  | 0.062  | 0.216  |
| Adjusted R²             | 0.004   | 0.170   | 0.166   | 0.222   | 0.015  | 0.145  | 0.017  | 0.203  |
| ∆R²                    | 0.013   | 0.169   | 0.166   | 0.056   | 0.025  | 0.134  | 0.026  | 0.189  |
| F-statistic             | 1.419   | 13.960***| 13.604***| 13.885***| 2.652* | 11.749***| 2.837* | 17.173***|

Note: Unstandardized coefficients are reported; standard errors are in parentheses; *p < 0.05, **p < 0.01, ***p < 0.001.

Table 4. Results of the moderating effect analysis.

| Variables               | Innovation Performance | Model 9 | Model 10 |
|-------------------------|------------------------|---------|----------|
| Industry                | −0.090 | (0.088) | −0.015   |
| Firm size               | 0.053  | 0.057  | 0.061*   |
| Firm age                | 0.040  | 0.087* | 0.086*   |
| Inbound open innovation | 0.206***| (0.054) | 0.194***|
| Outbound open innovation| 0.208***| (0.057) | 0.181***|
| Environmental dynamism  | 0.239***| (0.048) | 0.218***|
| Inbound open innovation × Environmental dynamism | 0.152* | (0.061) | 0.123* |
| Outbound open innovation × Environmental dynamism | 0.013 | (0.059) | 0.275 |
| R²                      | 0.004  | 0.224  | 0.257    |
| Adjusted R²             | 0.013  | 0.226  | 0.037    |
| ∆R²                    | 1.419  | 16.248***| 14.673***|

Note: Unstandardized coefficients are reported; standard errors are in parentheses; *p < 0.05, **p < 0.01, ***p < 0.001.

The moderating effect of environmental dynamism was shown by the results in Table 4. The results of Model 10 showed that the interaction between open innovation and environmental dynamism had a positive impact on firms' innovation performance (b = 0.152, p < 0.05; b = 0.123, p < 0.05, respectively), implying that environmental dynamism positively moderated the association between open innovation and innovation performance. Therefore, H8 was supported.

Based on the conditional process analysis recommended by Hayes [81], we examined whether the mediating effect of open innovation was moderated by environmental dynamism. The results of the conditional process analysis based on the bias-corrected bootstrap with 5000 resamples are presented in Table 5. For the “trust → inbound open innovation → innovation performance” path, when the degree of environmental dynamism was low, the mediating effect of inbound open innovation did not remain statistically significant (b = 0.014; 95% CI = [−0.045, 0.071]); when the degree of environmental dynamism was middling or high, inter-organizational trust had an indirect impact on firms’ innovation performance through inbound open innovation (b = 0.069 and 0.125; 95% CI = [0.028, 0.118]...
and [0.059, 0.203], respectively). For the “relational norms → inbound open innovation → innovation performance” path, when the degree of environmental dynamism was low, the mediating effect of inbound open innovation did not remain statistically significant (b = 0.001; 95% CI = [−0.040, 0.037]); when the degree of environmental dynamism was middling or high, inter-organizational relational norms had an indirect impact on firms’ innovation performance through inbound open innovation (b = 0.044 and 0.088; 95% CI = [0.017, 0.078] and [0.041, 0.146], respectively). These results showed that as the degree of environmental dynamism increased, the mediating effect of inbound open innovation between relational governance and firms’ innovation performance became greater. Similarly, for the “trust → outbound open innovation → innovation performance” and “relational norms → outbound open innovation → innovation performance” paths, the indexes of moderated mediation were both positive and the confidence intervals did not contain zero (b = 0.062 and 0.046; 95% CI = [0.020, 0.112] and [0.017, 0.079], respectively), indicating that environmental dynamism positively moderated the mediating effect of outbound open innovation. Therefore, H9 was supported.

Table 5. Conditional process analysis.

| Path | Conditional Indirect Effect of Open Innovation | Index of Moderated Mediation |
|------|-----------------------------------------------|------------------------------|
|      | Condition | Effect | SE | 95% CI       | INDEX | SE | 95% CI       |
| TR→IOI→IP | Low (−1 SD) | 0.014 | 0.029 | [−0.045, 0.071] | 0.065 | 0.028 | [0.017, 0.125] |
|        | Middle (0 SD) | 0.069 | 0.023 | [0.028, 0.118] |       |     |              |
|        | High (+1 SD) | 0.125 | 0.037 | [0.059, 0.203] |       |     |              |
| TR→OOI→IP | Low (−1 SD) | 0.019 | 0.033 | [−0.048, 0.084] | 0.062 | 0.023 | [0.020, 0.112] |
|        | Middle (0 SD) | 0.072 | 0.024 | [0.027, 0.124] |       |     |              |
|        | High (+1 SD) | 0.125 | 0.029 | [0.073, 0.189] |       |     |              |
| RN→IOI→IP | Low (−1 SD) | 0.001 | 0.019 | [−0.040, 0.037] | 0.051 | 0.020 | [0.018, 0.097] |
|        | Middle (0 SD) | 0.044 | 0.016 | [0.017, 0.078] |       |     |              |
|        | High (+1 SD) | 0.088 | 0.027 | [0.041, 0.146] |       |     |              |
| RN→OOI→IP | Low (−1 SD) | 0.007 | 0.021 | [−0.034, 0.047] | 0.046 | 0.016 | [0.017, 0.079] |
|        | Middle (0 SD) | 0.046 | 0.015 | [0.019, 0.078] |       |     |              |
|        | High (+1 SD) | 0.086 | 0.020 | [0.049, 0.127] |       |     |              |

Note: Bootstrap resamples = 5000; SD = standard deviation, SE = standard error, CI = confidence interval, TR = trust, RN = relational norms, IOI = inbound open innovation, OOI = outbound open innovation, IP = innovation performance.

To fully investigate the moderating effect of environmental dynamism, we used the Johnson–Neyman approach suggested by Preacher et al. [82] and plotted the results in Figures 2 and 3. As shown in Figure 2a,b, the results revealed that inter-organizational relational governance (trust and relational norms) demonstrated stronger indirect effects on firms’ innovation performance when environmental dynamism was higher than 2.67 or 2.74. The results, found in Figure 3a,b, suggested that trust and relational norms demonstrated stronger indirect effects on firms’ innovation performance when environmental dynamism was higher than 2.75 or 2.78. Thus, H9 was further supported.

Figure 2. The moderating effect of environmental dynamism on (a) “trust→inbound open innovation→innovation performance” and (b) “relational norms→inbound open innovation→innovation performance.”
5. Discussion

5.1. Theoretical Contributions

In recent years, open innovation has become a critical strategic orientation chosen by many firms to shape competitive advantages [2–4]. However, the different motives, goals, and organizational routines of firms and external partners inevitably induce exchange hazards such as knowledge leakage, conflicts of interest, and opportunism, which become major obstacles restricting firms’ open innovation [8–10]. Although some scholars have emphasized the role of relational governance in restraining exchange hazards, the interaction between relational governance and open innovation is still unclear [11,32]. This study answers the calls in the literature and verifies the positive correlation between relational governance and open innovation by testing the effects of inter-organizational trust and relational norms on firms’ innovation activities and performance. We expand the literature on open innovation and relational exchange theory and provide new evidence for how firms can effectively implement open innovation. Specifically, this study makes three major contributions to the literature.

First, our findings enrich the open innovation literature by building a systematic theoretical framework for investigating the interplay of relational governance, open innovation, and firms’ innovation performance. Although some scholars have paid attention to the risks and conflicts experienced by firms and external partners in open innovation, related research only briefly discusses the role of relational governance between exchange parties in establishing a stable collaborative relationship. The interaction between relational governance and open innovation has not been tested empirically [11,32]. Following Chesbrough [2], Hung and Chou [34], and Cassiman and Valentini [57], this study decomposes firms’ open innovation into two strategic models comprising inbound and outbound open innovation from the perspective of inter-organizational knowledge transfer and examines the positive impact of relational governance on firms’ open innovation and innovation performance. Our findings reveal the mediating role of open innovation in the association between inter-organizational relational governance and firms’ innovation performance. We conclude that inter-organizational relational governance increases mutual understanding and consensus among exchange parties and encourages firms and external partners to actively participate in open innovation practices, thereby significantly improving firms’ innovation performance. Therefore, our findings not only offer theoretical insights into open innovation literature by identifying the internal “black box” between relational governance and open innovation but also contribute to a better understanding of the value co-creation principle of open innovation.

Second, this study explored the issue of relational governance in the context of open innovation practices, providing new theoretical insights for relational exchange theory. Relational governance has long been a topic of considerable ongoing debate in relational exchange theory, but related research has mainly focused on marketing, supply chain
management, international business, and other areas [21,27,28,31]. Studies have considered how to design effective governance mechanisms to reduce transaction costs and opportunistic risks, but few have focused on the potential impact of relational governance on open innovation [29,40]. Following a number of important works on relational exchange theory [23,25,26,39], we argue that trust and relational norms are the two major mechanisms of relational governance and examine the positive effect of relational governance on promoting firms’ open innovation at the level of inter-organizational collaboration. We found that relational governance can not only be used to investigate issues in marketing and supply chain management but also to solve the risks and conflicts in firms’ open innovation. Accordingly, this study enriches understanding of the role of relational governance in the context of open innovation practices, thereby creating marginal contributions to relational exchange theory.

Third, the innovation management literature has called for additional analyses of the ways in which firms’ innovation activities depend on the external environment [34,35,70]. A high level of environmental dynamism increases risks and uncertainties and poses challenges to firms’ innovation capabilities and value capture [35,70]. To sustain a competitive advantage in a dynamic environment, firms should adapt to changes in technology and market demand and actively acquire and exploit external knowledge to seize market opportunities [34,74]. However, few studies have attempted to investigate the impact of environmental dynamism on firms’ open innovation. By using conditional process analysis, we reveal that environmental dynamism not only positively moderates the association between open innovation and firms’ innovation performance but also enhances the mediating role of open innovation between inter-organizational relational governance and firms’ innovation performance. Hence, our findings contribute to the innovation management literature by examining the moderating effects of environmental dynamism.

5.2. Managerial Implications

Our study has several strategic implications for managers of open innovation practices. Our findings suggest that relational governance can promote knowledge acquisition and external knowledge commercialization, thus helping firms to improve innovation performance. Therefore, selecting suitable external partners and building close relationships are the priority decision-making issues for managers when implementing open innovation. Managers should continually search for new ideas, technologies, and market opportunities in the external environment and understand how to use formal and informal mechanisms to establish extensive partnerships with universities, research institutions, suppliers, users, and even competitors to attract key innovators embedded in their firms’ innovation networks. Priority should be given to establishing partnerships with organizations that have a similar business philosophy, knowledge base, and organizational culture, and full discussions based on negotiation and mutual trust should clarify rights and responsibilities to curb the opportunistic motives of all parties at an early stage of a partnership. In the collaborative process, managers should also pay attention to maintaining information exchange with external partners and undertake joint actions and planning to reduce transaction risks induced by information asymmetry between exchange parties. In addition, to increase the likelihood of their firm obtaining monetary or strategic benefits, managers should strengthen internal incentive mechanisms and the organizational culture, encourage employees and departments to communicate and collaborate with external innovators, and adopt an enterprising and open attitude to open innovation.

Our results show that a highly dynamic environment can enhance the mediating role of open innovation in the association between inter-organizational relational governance and firms’ innovation performance. In practice, managers need to be acutely aware of changes in the external environment and share and discuss the latest ideas, technologies, and market demands with external partners in a timely manner so that the parties can jointly resist the challenges of environmental dynamism. Firms’ open innovation relies on a variety of specific investments that require managers to focus on how to reach a consensus
on common goals and benefits with external partners. Managers should establish benefit coordination mechanisms with external partners to stimulate knowledge sharing and innovation resource input by improving resource coupling and interest binding between exchange parties. They must also balance the possible conflicts between the strategic goals of firms and their external partners, promote the formation of common vision with effective communication and negotiation mechanisms, and adapt to changes in the external environment with strategic flexibility.

5.3. Limitations and Future Research Directions

This study has several limitations, which offer directions for future research. First, the results of the empirical analysis may be both country- and industry-specific because the data were collected from a sample consisting of manufacturing firms in the Pearl River Delta region of China. Hence, the generalizability of the results is limited. It would be both important and fruitful for future research to validate the robustness of our findings in other geographical contexts or a broader range of industrial sectors. In addition, we used managers’ self-assessments to measure firms’ innovation performance, ignoring the heterogeneous phenomenon of performance measurement. Therefore, future research could explore a multidimensional approach (e.g., the combination of subjective and objective items) to test our hypotheses and conceptual model.

Second, this study confirms the positive effect of inter-organizational relational governance on firms’ innovation performance and reveals the mediating role of open innovation from the perspective of firms. As the data are from the firms, we do not have insight into the perceptions of the firms’ external partners. To enhance the reliability of our measures, a future study could collect matched dyadic data from both firms and their external partners. Additionally, the cross-sectional design of this study cannot fully depict the dynamic process of open innovation practices. A longitudinal study is necessary to address this limitation.

Finally, our findings confirm that environmental dynamism positively moderates the indirect effect of inter-organizational relational governance on firms’ innovation performance through open innovation. In practice, firms’ open innovation may also be affected by other factors, such as knowledge ambiguity, appropriability regimes, and environmental competitiveness. It would be valuable for future research to examine the potential moderating effects of these factors and further clarify the boundary conditions of the relationship between inter-organizational relational governance and open innovation.

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Appendix A

Table A1. Construct reliability and validity.

| Variable | Factor Loading |
|----------|----------------|
| Trust [Zaheer et al. [45], Poppo et al. [47], Zhang and Zhou [27]], Cronbach’s α = 0.859, CR = 0.860, AVE = 0.550 | 0.734 |
| 1. External partners negotiate fairly with us. | 0.724 |
| 2. External partners will not encroach on our interests. | 0.752 |
| 3. External partners always keep their promises. | 0.764 |
| 4. We are not hesitant to cooperate with external partners despite unclear specifications. | 0.727 |
| 5. External partners are trustworthy. | 0.732 |
| Relational norms [Li et al. [39], Arranz and de Arroyabe [39]], Cronbach’s α = 0.873, CR = 0.873, AVE = 0.633 | 0.762 |
| 1. We exchange useful information with external partners. | 0.762 |
| 2. Ideas or suggestions can be communicated easily and efficiently in cooperation. | 0.818 |
| 3. Disagreements or conflicts can be resolved in negotiation. | 0.770 |
| 4. We actively make joint decisions with external partners through mutual understanding. | 0.831 |
| Inbound open innovation [Hung and Chou [34], Sisodiya et al. [64]], Cronbach’s α = 0.893, CR = 0.894, AVE = 0.627 | 0.770 |
| 1. We regularly obtain useful knowledge from external innovators. | 0.802 |
| 2. To promote value creation, we often search for external ideas and technologies. | 0.802 |
| 3. We have established an effective system to acquire external knowledge. | 0.781 |
| 4. We actively cooperate with external innovators to obtain advanced experience and technology. | 0.803 |
| 5. Our R&D relies on establishing extensive partnerships with external innovators. | 0.802 |
| Outbound open innovation [Hung and Chou [34], Lichtenhaler [56]], Cronbach’s α = 0.876, CR = 0.876, AVE = 0.587 | 0.790 |
| 1. We actively export knowledge to external innovators. | 0.790 |
| 2. We usually sell technologies and patents to external innovators. | 0.746 |
| 3. To develop the commercial value of internal knowledge, we have set up a dedicated department. | 0.784 |
| 4. We hope that external innovators will purchase and use our technologies and patents. | 0.774 |
| 5. We often cooperate with external innovators to co-exploit technology. | 0.734 |
| Innovation performance [Chen et al. [73], Huang et al. [37]], Cronbach’s α = 0.878, CR = 0.878, AVE = 0.590 | 0.770 |
| 1. We have developed more new products than our competitors have. | 0.770 |
| 2. We develop new products faster than our competitors do. | 0.756 |
| 3. The proportion of new product sales in total sales is higher than that of competitors. | 0.775 |
| 4. The success rate of innovative projects is better than that of our competitors. | 0.770 |
| 5. The number of patent applications is higher than that of our competitors. | 0.770 |
| Environmental dynamism [Jansen et al. [76]], Cronbach’s α = 0.868, CR = 0.869, AVE = 0.570 | 0.770 |
| 1. The environment of our market is changing rapidly. | 0.738 |
| 2. New demands for products and services are constantly emerging in the market. | 0.806 |
| 3. In our market, changes are taking place continuously. | 0.711 |
| 4. In the past year, great changes have taken place in our market. | 0.744 |
| 5. The number of products and services in our market changes rapidly and frequently. | 0.769 |

Model fit indices

χ² = 426.376, χ²/df = 1.178, p = 0.011, CFI = 0.986, GFI = 0.920, IFI = 0.986, TLI = 0.984, RMSEA = 0.024

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