

1 **Investigating the Relationship between the Causes of Corruption and Corruption**

2 **Risks in the Public Construction Sector of China**

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4 **Abstract**

5 Understanding the causes of corruption is one of the key topics in the research of
6 corruption in construction because it addresses the fundamental issues of the
7 widespread corruption risks in the public construction sector. Through an empirical
8 survey, this study finds a positively correlated relationship between the causes of
9 corruption and corruption risks in the public construction sector of China. The data
10 were collected from industrial practitioners and academics that had public
11 construction project experiences in China, and thereafter analyzed by factor analysis
12 and partial least squares structural equation modeling. The results show that the
13 causes of corruption could be categorized into two constructs, namely, the flawed
14 regulation systems, and the lack of a positive industrial climate. The results also
15 indicate that the most influential item on the construct of the flawed regulation
16 systems is negative role models of leadership, followed by inadequate sanctions, the
17 lack of rigorous supervision, and multifarious authorizations. The most influential

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18 item on the construct of the lack of a positive industrial climate is interpersonal
19 connections, followed by close relationships among contract parties, complexity of
20 public construction projects, and poor standards of professional ethics. This study
21 contributes to knowledge by examining the relationship between the causes of
22 corruption and corruption risk using a quantitative method. Recommendations on the
23 prevention of corruption are also suggested based on results obtained in this study.

24 **Keywords**

25 Corruption Risk; Cause; Public Construction Sector; China

26 **Introduction**

27 Public construction sector is vulnerable to corruption risks, and is thus considered as
28 the most corrupt business sector (Harboon and Heinrich 2011). In this sector,
29 construction projects are unique and complex, it is difficult to benchmark project
30 performance against selected indicators (e.g. cost and time), and to make access to the
31 hidden and inflated additional expenditure. The construction sector is also fragmented
32 as a result of involving clients, designers, contractors, consultants, and suppliers,
33 which imposes difficulties in the tracing of payments and the diffusion of standards of
34 practice (Ahmad et al. 1995). In addition, public construction is a sector highly
35 affected and regulated by the government (Chan et al. 1999). These factors have
36 provided numerous opportunities and motives for the occurrence of corruption.

37 As a large developing country having a population of more than 1.3 billion,

38 China has experienced a process of rapid urbanization and made huge investments in
39 the public construction sector over the past two decades. The expenditure on public
40 infrastructure and construction projects in China jumped from CNY 2 trillion (USD
41 0.28 trillion) in 1995 to CNY 37.4 trillion in 2012 (USD 5.34 trillion) (National
42 Bureau of Statistics of China 2012), which has increased nearly 19 times. However,
43 these investments have caused a high risk in corruption. According to the National
44 Bureau of Corruption Prevention of China, between 2009 and 2011, 15,010 cases of
45 corruption were recorded in the public construction sector, more than 1167 public
46 officials above county level were alleged of corruption, and the corresponding amount
47 of corrupt money reached CNY 2,990 million (USD 490 million) (Xinhuanet 2011).
48 This fact indicates the country is facing a great corruption risk in the public
49 construction sector.

50 Understanding the causes of corruption in the public construction sector is
51 essential in preventing corruption risks. Although a growing number of researchers
52 attempted to conduct research on this topic (Tanzi 1998; Liu et al. 2004; Sohail and
53 Cavill 2008; Bowen et al. 2012), limited empirical studies are available on this issue.
54 Therefore, this paper focuses on the causes of corruption in the public construction
55 sector of China, and aims to examine the relationship between the causes of
56 corruption and corruption risks through an empirical survey.

57 **Theoretical Framework**

58 ***Causes of Corruption in Construction***

59 Sustained efforts have been made to investigate causes of corruption in the
60 construction sector. For instance, corruption is regarded as the result of an unethical
61 decision (Zarkada-Fraser and Skitmore 2000; Liu et al. 2004; Moodley et al. 2008). A
62 defective law system is also considered to provide opportunity for corruption in the
63 construction sector (Bologna and Del Nord 2000; Sha 2004). Ling and Tran (2012)
64 observed that an intimate relationship among contract parties could lead to corruption.
65 Bowen et al. (2012) stated that the negative role models of public officials and
66 absence of deterrents and sanctions are key causes of corruption in construction. Apart
67 from the causes mentioned above, Sohail and Cavill (2008) and Tabish and Jha (2011)
68 added that corruption often occurs in construction as a result of the deregulation in the
69 public construction sector, the excess competition of the construction market, and
70 inappropriate political interference in investment decision making. Tanzi (1998)
71 further examined causes of corruption at multiple levels and aspects, such as
72 regulations and authorizations, discretionary decisions, wage level of public servants,
73 penalty systems, institutional controls, transparency, as well as role models of
74 leadership. Based on the above reviews, causes of corruption could be grouped under
75 two categories, namely, the flawed regulation system (FRS), and the lack of a positive
76 industrial climate (LPIC).

77 The flawed regulation system (FRS) can be measured by multifarious

78 authorizations (FRS1), deficiencies in rules and laws (FRS2), the lack of rigorous
79 supervision (FRS3), inadequate sanctions (FRS4), as well as the negative role model
80 of leadership (FRS5).

81 Multifarious authorizations (FRS1) are required for those organizations and
82 professionals engaging in the construction sector. The establishment of these
83 authorizations provides a monopoly power to the government and affiliated officials,
84 and thus they can authorize or inspect the projects. In this case, some officials
85 possibly make use of this authorization power to extract bribes from those who need
86 the authorizations (Tanzi 1998; Rose-Ackerman 2008). Bologna and Del Nord (2000)
87 and Sha (2004) pointed out that deficiencies in rules and laws (FRS2) become a
88 hurdle to successful regulation on corrupt practices. Furthermore, these deficiencies
89 may motivate corrupt conducts. Tanzi (1998) opined that corruption should be
90 discouraged or discovered by honest and effective supervisors and auditors, and the
91 lack of rigorous supervision (FRS3) can facilitate corruption. Bowen et al. (2012)
92 conducted an online questionnaire survey in the construction sector of South Africa,
93 which showed that inadequate sanctions (FRS4) and the negative role models of
94 leadership (FRS5) are two main causes of corruption in the construction sector.

95 The lack of a positive industrial climate (LPIC) can be measured by five items:
96 the low wage level (LPIC1), poor standards of professional ethics (LPIC2), excessive
97 competition in the construction market (LPIC3), close relationships among contract
98 parties (LPIC4), and complexity of public construction projects (LPIC5).

99 Haque and Sahay (1996) revealed a statistically significant correlation between

100 the serious corruption situation and the low wage level (LPIC1). Numerous studies
101 disclosed the role of the poor standards of professional ethics (LPIC2) as a root cause
102 of corruption in the construction sector (Zarkada-Fraser 2000; Zarkada-Fraser and
103 Skitmore 2000; Liu et al. 2004; Moodley et al. 2008; Bowen et al. 2012). Sohail and
104 Cavill (2008) and Tabish and Jha (2011) stated that corruption may be caused by
105 misconducts of contractors those try to secure contracts from clients in the excessively
106 competitive market (LPIC3). Ning and Ling (2013) reported that although the close
107 relationships among contract parties (LPIC4) is often regarded as a critical success
108 factor of public construction projects, the relationships may also trigger corruption
109 instead of partnership-based collaboration (Sohail and Cavill 2008; Ling and Tran
110 2012). Sohail and Cavill (2008) further stated that the negative impact of the
111 complexity of public construction projects (LPIC5), for example, the information
112 asymmetry, may lead to corruption.

113 ***Corruption Risks***

114 Several studies have been conducted to identify corruption risks in the construction
115 sector. Sohail and Cavill (2008) examined multiple examples of corruption
116 vulnerabilities and related stakeholders in the construction project cycle and the
117 infrastructure service delivery. De Jong et al. (2009) enumerated main forms of
118 corruption in the engineering/construction industry, including kickbacks and bribery,
119 front companies, bid rigging and collusion, fraud, and conflict of interest. Alutu (2007)
120 and Alutu and Udhawuve (2009) listed and prioritized unethical conducts in the

121 engineering/construction industry in Nigeria based on data gathered from two
122 questionnaire surveys. Vee and Skitmore (2003) and Bowen et al. (2007a; 2007b)
123 adopted the same questionnaire instrument to investigate unethical practices in the
124 Australian and South African construction sectors, which reinforced the finding of de
125 Jong et al. (2009) that main unethical practices in the two countries are collusion,
126 bribery, negligence, fraud, dishonesty and unfair practices. Thereafter, Bowen et al.
127 (2012) examined 42 corrupt acts in the South African construction industry and
128 further categorized them into two groups, namely, appointment and tender
129 irregularities, as well as contract administration and closeout irregularities. In addition,
130 Tabish and Jha (2011) collected 61 irregularities to reveal corruption in the
131 procurement of public construction projects in India, and grouped them under five
132 categories, namely, transparency, professional standards, fairness, contract monitoring
133 and regulation, and procedural accountability irregularities. The above reviews have
134 revealed the increasing attention on corruption issues in construction around the world,
135 particularly those from the developing countries, such as Nigeria, South Africa, and
136 India.

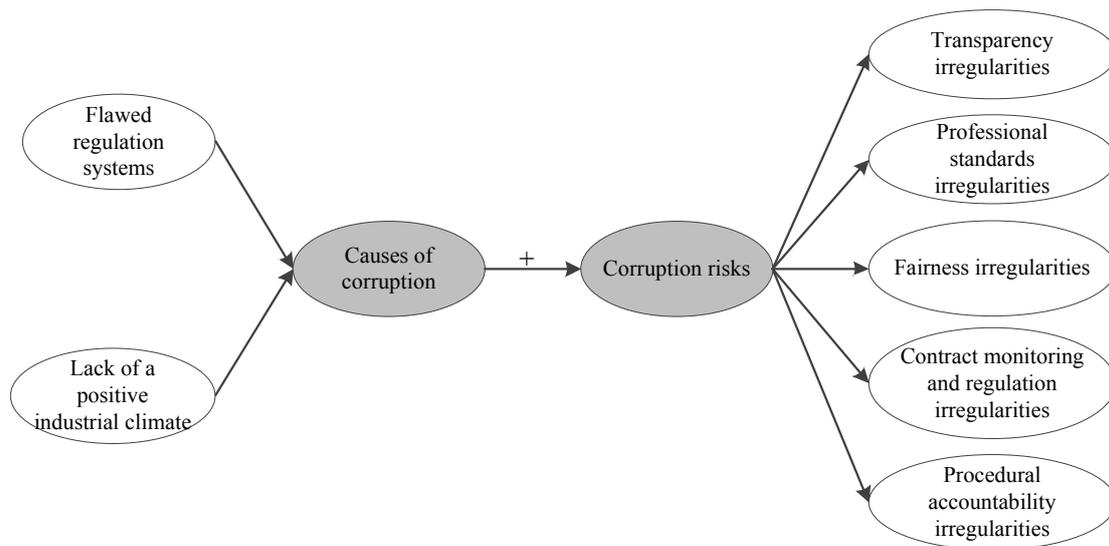
137 The framework of corruption risks adopted in this study is developed according
138 to Tabish and Jha (2011) because the irregularities summarized in their study good
139 indicators to measure corruption risks. In addition, adopting the framework of
140 Tabish and Jha (2011) has three advantages compared with developing a new
141 framework. First, their framework identified 61 detailed irregularities in the public
142 procurement of India, and such irregularities have already been recognized by the

143 industry at large. Second, the published work of Tabish and Jha (2011) included
144 findings derived from their framework, thereby proving the worthiness of such
145 framework in academic study. Third, China and India are similar in terms of rapid
146 urbanization and public construction projects. However, there are two issues in
147 adopting the framework of Tabish and Jha (2011) directly to this study. First, Tabish
148 and Jha (2011) mainly focuses on irregularities in the project procurement phase,
149 whereas the scope of this study extends to the entire life circle of a project. Second,
150 there is objective difference in construction practice between India and China due to
151 the different societal and economic system. Therefore, a series of structured
152 interviews were conducted afterwards to refine the irregularities of Tabish and Jha
153 (2011) and to supplement measurement items beyond the project procurement phase.
154 The measurement items of causes of corruption were also refined and supplemented
155 in the interviews.

156 **Hypothesis Development**

157 Based on the theoretical framework indicated earlier, an initial conceptual model was
158 hypothesized to examine the relationship between the causes of corruption and
159 corruption risks as shown in Figure 1. In the proposed model, causes of corruption are
160 considered to be a two dimensional and second-order construct comprising the flawed
161 regulation systems and the lack of a positive industrial climate. Corruption risks are
162 deemed as a five dimensional and second-order construct consisting of transparency,
163 professional standards, fairness, contract monitoring and regulation, and procedural

164 accountability irregularities. The second-order construct approach is recommended by
 165 Wetzels et al. (2009), as it maximizes the interpretability of both measurement and the
 166 hierarchical models. In the proposed model, the hypothesis that causes of corruption
 167 are positively correlated with corruption risks in public construction projects, is to be
 168 tested.



169
 170 Figure 1 The initial conceptual model and research hypothesis

171 **Research Methods**

172 This study first established a conceptual model that defines the causes of corruption
 173 and corruption risks. Then structured interviews were used to refine the model to
 174 account for the specific conditions in China. Based on this model, a questionnaire
 175 survey was administered. On the basis of data collected from the questionnaire survey,
 176 factor analysis (FA) was conducted to validate the results from structured interviews.
 177 Partial least squares structural equation modeling (PLS-SEM) was used to test the
 178 conceptual model proposed in this study. Results obtained from the different methods

179 can triangulate and complement each other, thus yielding stronger and more reliable
180 findings (Hon et al. 2012).

181 To refine the proposed measurement items of causes of corruption and corruption
182 risks in China, a series of structured face-to-face interviews were conducted between
183 July and August 2013. Fourteen experienced industrial experts and academics were
184 invited and participated in the interviews. Each interviewee was requested to provide
185 his endorsement on the proposed measurement items, by using a five point rating
186 system of “1-strongly disagree”, “2-disagree”, “3-neutral”, “4-agree”, and “5-strongly
187 agree”. Interviewees were also encouraged to supplement the measurement items that
188 were not recorded in the interviews. Only measurement items receiving the support of
189 most interviewees were considered as key measurement items and added in the
190 theoretical framework. As mentioned earlier, this additional procedure is necessary
191 because the framework of Tabish and Jha (2011) mainly focuses on the measurement
192 items in project procurement phase other than the entire life circle of a project. In
193 addition, mean score of each measurement item was calculated and a threshold of 2.5
194 was established as a cut criterion as recommended by Hsueh et al. (2009). To ensure
195 the reliability and quality of interviews, all the interviewees involved had at least ten
196 years of experience in public construction projects in China and senior positions in
197 their organizations. Additionally, the selection of 14 interviewees with various
198 professional backgrounds and geographic locations increased the heterogeneity of the
199 interviewees and thus improved the validity of interviews. Table 1 shows the
200 backgrounds of interviewees.

201 **(Please insert Table 1 here.)**

202 A structured questionnaire was developed based on the measurement items
203 consolidated in the structured interviews. The target population included industrial
204 practitioners (e.g. clients, contractors, designers, and consultants), governmental
205 officials, and academics involved in public construction projects in China. To
206 maximize the number of potential survey respondents, a number of government
207 agencies, research institutions, and companies within the construction industry were
208 contacted. In the end, eight institutions accepted the invitations and agreed to facilitate
209 the survey. They are all active players in the public sector in China. Each of them
210 represents a huge number of governmental officials or industry professionals or
211 researchers from a broad range of the entire sector. These institutions are:

- 212 1. Research Institute of Complex Engineering & Management, Tongji University;
- 213 2. Shanghai Construction Consultants Association;
- 214 3. Shanghai Xian Dai Architectural Design (Group) Co., Ltd.;
- 215 4. School of Civil Engineering and Transportation, South China University of
216 Technology;
- 217 5. College of Civil Engineering, Shenzhen University;
- 218 6. Construction Commission of Zhengzhou Municipality;
- 219 7. Zhengzhou Metro Group Co., Ltd.;
- 220 8. China Construction Eighth Engineering Division.

221 The questionnaire was disseminated through three channels between September
222 and October 2013. First, an online version of the questionnaire was developed and

223 disseminated to professionals and academics within the above supporting institutions.
224 Second, hard copies were also distributed in an industrial forum held in Shanghai.
225 Selected qualified attendants of this meeting were invited to participate in this survey.
226 Third, field surveys were conducted in three public construction projects in Shanghai,
227 Jinan (the capital city of Shandong Province), and Zhengzhou (the capital city of
228 Henan Province), respectively. The three survey approaches adopted in this study
229 enhance the validity of the survey results. Lastly, one hundred and eighty eight valid
230 replies were received. Among them, eighty seven replies were collected from the
231 online survey, twenty replies were collected from the industrial forum, and eighty one
232 replies were collected from the field surveys. Table 2 shows the backgrounds of
233 respondents.

234 **(Please insert Table 2 here.)**

235 **Tools for Data Analysis**

236 ***Factor Analysis***

237 Factor Analysis (FA) is a statistical technique widely adopted to identify a small
238 number of individual factors that represent some sets of interrelated variables (Choi et
239 al. 2011). FA using Statistical Package for the Social Sciences 17.0, was adopted to
240 condense and summarize the measurement items proposed in this study. Principal
241 Component Analysis was conducted to identify the underlying grouped factors for its
242 simplicity and distinctive capacity of data-reduction (Chan et al. 2010). To obtain

243 grouped factors for a clearer image, factor extraction with Promax Rotation and
244 Kaiser Normalization was conducted as recommended by Conway and Huffcutt
245 (2003). The appropriateness of using FA technique was evaluated by using
246 Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity. According to Norusis
247 (2008) and Choi et al. (2011), a KMO value should be higher than the threshold of 0.5.
248 Bartlett's Test for Sphericity was also performed to present correlations among
249 variables (Chan et al. 2010; Xu et al. 2010).

250 ***Partial Least Squares Structural Equation Modeling***

251 PLS-SEM was adopted to test the conceptual model. PLS-SEM is a technique using a
252 combination of principal components analysis, path analysis, and regression to
253 simultaneously evaluate theory and data (Aibinu and Al-Lawati 2010). PLS-SEM
254 estimates parameters for links between measurement items and their corresponding
255 constructs and links among different constructs (Mohamed 2002). In addition,
256 PLS-SEM has minimum demands for sample size, but it can handle nonnormal data
257 sets (Reinartz et al. 2009; Ringle et al. 2012). Therefore, PLS-SEM was adopted in
258 this study.

259 Results of PLS-SEM include a set of measurement models and a structural model.
260 In this study, four indicators were examined to evaluate the measurement models,
261 namely, (1) internal consistency reliability; (2) indicator reliability; (3) convergent
262 validity; and (4) discriminating validity (Hair et al. 2011; Ning and Ling 2013; Zhao
263 et al. 2013). Composite Reliability (CR) was used to assess the internal consistency

264 reliability, which should be larger than 0.7 (Hair et al. 2011). Loadings of
265 measurement items on the corresponding construct were adopted to assess the
266 indicator reliability, which should be at least larger than 0.4 (Hair et al. 2011; Ning
267 and Ling 2013). Average Variance Extracted (AVE) was used to evaluate the
268 convergent validity, which should be larger than 0.5 (Hair et al. 2011). With regard to
269 discriminating validity, the AVE value of each construct should be larger than the
270 construct's highest squared correlation with any other latent construct or, a
271 measurement item's loading should be larger than all of its cross loadings (Cenfetelli
272 and Bassellier 2009; Hair et al. 2011; Ning 2013; Zhao et al. 2013). Regarding the
273 evaluation of the structural model, the significance of path coefficients was adopted
274 with the aid of Bootstrapping (Hair et al. 2011; Ning and Ling 2013; Zhao et al.
275 2013).

276 **Results**

277 ***Structured Interview***

278 Table 3 shows interview results of measurement items of causes of corruption
279 provided by the interviewees. The measurement item low wage level (LPIC1) was
280 dropped from the measurement list with an evaluation score below 2.5. This result
281 indicated that interviewees refused to consider low wage level (LPIC1) as a key cause
282 of corruption in construction, which is also in line with the statistical bulletin that the
283 average wage in the construction sector ranks sixth in the whole 19 sectors in China
284 (National Bureau of Statistics of China 2012). An additional measurement item,

285 interpersonal connections (LPIC6), was suggested by interviewees to measure the
286 construct of the lack of a positive industrial climate (LPIC) (Table 5). Interviewees
287 stated that interpersonal connections (LPIC6), such as relatives, friends, and
288 colleagues may push officials who could have been incorrupt to perform corrupt
289 practices.

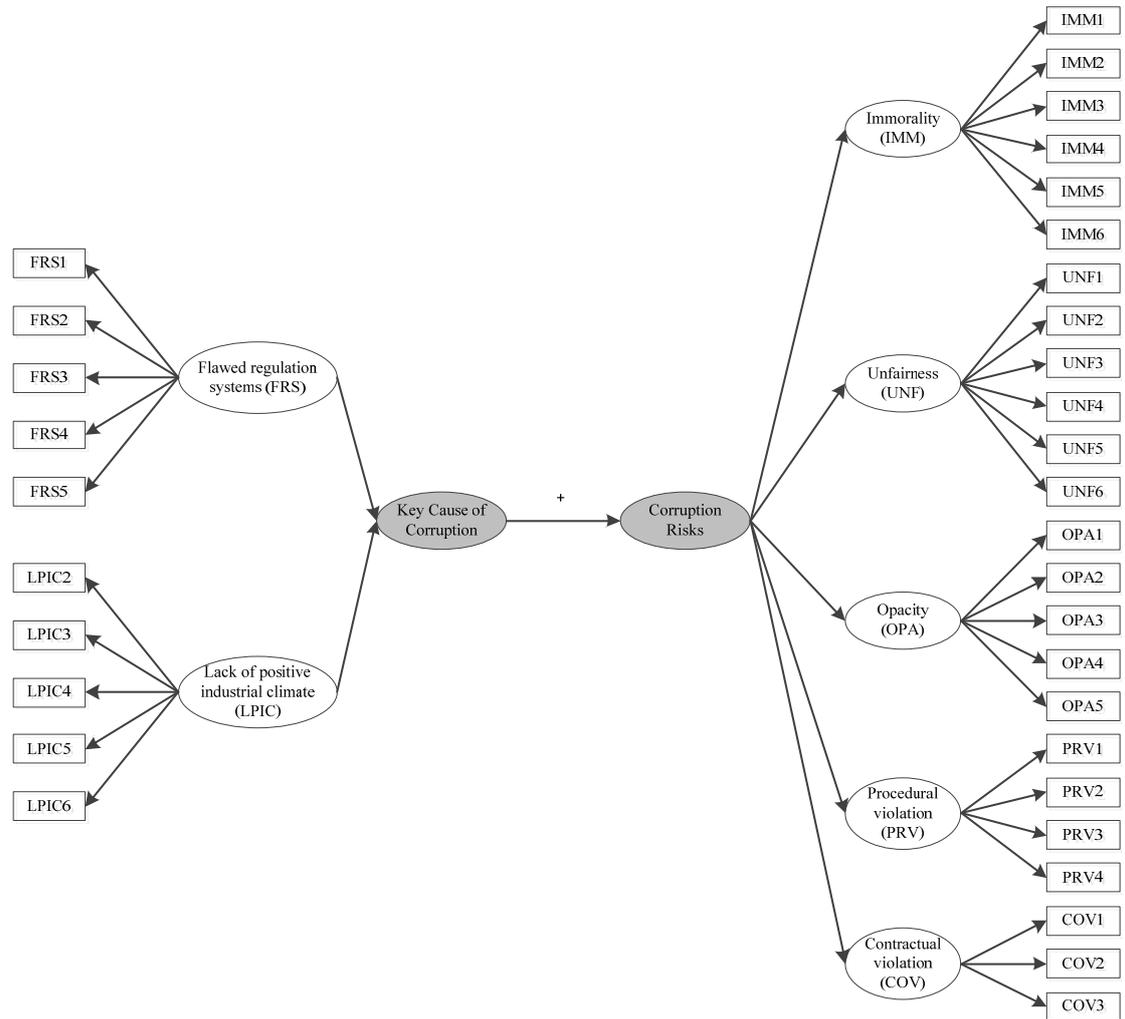
290 Table 4 shows the irregularities of Tabish and Jha (2011) receiving assessment
291 scores above 2.5 points. The 19 measurement items of corruption risks were
292 confirmed by interviewees in the context of China. Interviewees stated that some
293 proposed measurement items used in the interviews were irregularities that may not
294 be resulted by corruption, which should not be considered as measurement items for
295 corruption risks. Therefore, a trim from 61 irregularities to 19 measurement items of
296 corruption risks was obtained in terms of interview feedback. In addition, five
297 additional measurement items suggested by the interviewees were added in the
298 framework. As shown in Table 4, the five items were affiliated with three constructs
299 of professional standards, fairness, and transparency irregularities, respectively.
300 Particularly, two of them (IMM5 and IMM6) refer to the measurement items of
301 corruption risks in project construction phase. Thus the supplementation improves the
302 completeness of proposed framework. Additionally, Interviewee I, Interviewee L,
303 Interviewee M, and Interviewee N recommended to rename transparency, professional
304 standards, fairness, contract monitoring and regulation, and procedural accountability
305 irregularities as opacity, immorality, unfairness, contractual violation, and procedural
306 violation, respectively in the design of questionnaire which can provide a better

307 expression in the Chinese context. Thus, the initial proposed conceptual model was
 308 refined as shown in Figure 2.

309 (Please insert Table 3 here.)

310 (Please insert Table 4 here.)

311 (Please insert Table 5 here.)



312

313

314 Figure 2 Refined proposed conceptual model

315 ***Factor Analysis***

316 Table 3 shows FA results of measurement items of causes of corruption. Two
317 constructs encapsulating eleven measurement items were generated. The KMO value
318 is 0.789, which is considered to be acceptable to utilize FA (Norusis 2008). The total
319 variance explained is 54.160%. The Bartlett's Test of Sphericity produced an
320 approximate $\chi^2 = 486.044$ (d. f. = 55, p = 0.000), indicating the correlations among
321 measurement items were high (Dziuban and Shirkey 1974). Hair et al. (2010) stated
322 that the loading of each measurement item on its corresponding construct should not
323 be lower than 0.5. Therefore, FRS2 and LPIC3 were dropped from the list of
324 measurement items.

325 Table 4 shows FA results of measurement items of corruption risks. Five
326 constructs encapsulating twenty-four measurement items were generated. The KMO
327 value is 0.863, which is considered to be acceptable (Norusis 2008). The total
328 variance explained is 61.623%. The Bartlett's Test of Sphericity produced an
329 approximate $\chi^2 = 1308.051$ (d. f. = 276, p = 0.000), indicating that the correlations
330 among measurement items were high (Dziuban and Shirkey 1974). The IMM2, UNF3,
331 OPA2, PRV4, and COV3 were excluded from the list of measurement items because
332 their factor loadings were lower than 0.5 (Hair et al. 2010).

333 ***Evaluation of Measurement Models***

334 Tables 6, 7 and 8 show the evaluation results of measurement models. Table 6 shows
335 that (1) all loadings are larger than 0.6 with t-values larger than 2.58, indicating the

336 acceptable indicator reliability (Hair et al. 2011; Ling et al. 2013; Ning and Ling
337 2013); (2) the values of CR are over 0.7, suggesting a satisfactory level of reliability
338 of internal indicators with each construct (Hair et al. 2011; Ning 2013); (3) the values
339 of AVE are higher than 0.5, showing a satisfactory level of convergent validity of the
340 constructs (Hair et al. 2011; Ning 2013). Table 7 shows that each construct's AVE is
341 higher than its squared correlation with any other construct. Table 8 indicates that
342 each measurement item has the highest loading on the corresponding construct. They
343 indicate the high discriminate validity of the constructs (Hair et al. 2011; Ling et al.
344 2013; Ning 2013). The results of measurement model evaluation suggest that each
345 construct has internal consistency reliability.

346 **(Please insert Table 6 here.)**

347 **(Please insert Table 7 here.)**

348 **(Please insert Table 8 here.)**

349 ***Evaluation of Hierarchical Models***

350 Table 9 shows that all path coefficients for the hierarchical models are significant
351 (t-value >2.56). Values of CR are also over 0.7, suggesting a satisfactory level of
352 reliability of first-order constructs with the corresponding second-order construct
353 (Bagozzi and Yi 1988; Ling et al. 2013).

354 **(Please insert Table 9 here.)**

355 ***Evaluation of Structural Model***

356 The path coefficient between causes of corruption and corruption risks has a t-value

357 higher than 2.58, indicating its statistical significance at the 0.01 level (Henseler et al.
358 2009). The hypothesis that causes of corruption are positively correlated with
359 corruption risks is supported in the hypothesized sign. Figure 3 shows the testing
360 results of the conceptual model.

361 **(Please insert Figure 3 here.)**

362 **Discussion**

363 According to the PLS-SEM results, all the statistical parameters were found to be
364 acceptable, which validated the hypothesis developed in the study (Hair et al. 2011).
365 The PLS-SEM results suggested that the causes of corruption have a positive
366 correlation with corruption risks in public construction projects in China. The results
367 also showed that flawed regulation systems (FRS) and the lack of a positive industrial
368 climate (LPIC) had significant correlations with the second-order construct the causes
369 of corruption. The flawed regulation systems (FRS) emerged as the most principal set
370 of causes of corruption with a path coefficient of 0.605. The lack of a positive
371 industrial climate (LPIC) emerged as the second most principal set of causes of
372 corruption with a path coefficient of 0.560.

373 ***The Flawed Regulation Systems***

374 The negative role model of leadership (FRS5) had the highest factor loading (0.830)
375 on the flawed regulation systems (FRS). Leadership plays a vital role in the culture of
376 an organization, particularly for an ethically-oriented culture (Sims 1992; 2000;

377 Schein 2006). A positive leadership can facilitate the achievement of a mission via fair
378 and honest actions (Tabish and Jha 2012). However, the negative role models of
379 leadership can lead to corruption. The leaders may engage in acts of corruption
380 themselves or, they overlook such acts performed by their friends, relatives, or
381 colleagues. Under such circumstance, their subordinates will not behave differently
382 (Tanzi 1998). According to Li et al. (2013), an evident phenomenon has been found
383 that, in most corruption cases referring to the public construction sector in China, acts
384 of corruption are conducted by a collective consisting of some leaders and their
385 subordinates. In a recent survey conducted in South Africa, Bowen et al. (2012) also
386 reported that corrupt practices of organizational leaders could produce negative role
387 models to their subordinates, which would be followed by the subordinates.

388 The inadequate sanctions (FRS4) had the second high factor loading (0.737) on
389 the flawed regulation systems (FRS). Theoretically, a tough sanction on corruptors
390 who get caught can help curb corruption (Tanzi 1998; Zarkada-Fraser 2000). However,
391 in China, the public opine that very few people are sanctioned correspondingly for
392 corrupt practices they have performed (He 2000). Furthermore, a wide gap exists
393 between the identification of sanctions in the legislative and regulative systems and
394 the sanctions that are actually imposed. In certain cases, political or administrative
395 interference prevent the timely or full application of sanctions. This may be due to the
396 high social cost that is reluctant to be afforded by accusers, such as losing friend. In
397 addition, judges who impose sanctions could have been accessible to corruption
398 themselves or may have personal biases (Tanzi 1998). The above factors limit the role

399 of sanctions in preventing corrupt acts, which also brings toleration for small corrupt
400 acts that may gradually evolve to bigger ones.

401 The lack of rigorous supervision (FRS3) received the third ranking among the
402 measurement items on the flawed regulation systems (FRS). Generally, the most
403 effective control against corruption in the public construction sector should be the
404 rigorous supervision that is added by site supervisors and auditors, namely, the third
405 party beyond clients and contractors (Tanzi 1998). In the construction sector of China,
406 the site supervisors and auditors are paid for their services by clients (Guo and Yang
407 2008). In this case, the quality of supervision provided by the site supervisors and
408 auditors may be affected by the corrupt clients. Furthermore, in most cases, the profit
409 rates of site supervisors and auditors given by clients are low (Guo and Yang 2008).
410 Thus the site supervisors and auditors may fail in maintaining their integrity to take
411 bribes from corrupt contractors and loosen their supervision. Gradually, a negative
412 climate of relaxed supervision in the site supervisors and auditors formulate and lead
413 to more corruption in the public construction sector of China.

414 The multifarious authorizations (FRS1) had the fourth high factor loading (0.600)
415 in the list of measurement items on the flawed regulation systems (FRS). Numerous
416 authorizations must be obtained from the governmental administrative department
417 before a company engaging in a construction project (Zou et al. 2007). For example,
418 one hundred and eight authorizations are needed in Guangdong Province (Southern
419 Metropolis Daily 2013). Additionally, in most cases, the approval of these
420 authorizations is opaque or is not even available publicly, or cannot be achieved only

421 from a specific office or department (Tanzi 1998; Neelankavil 2002). Thus, these
422 authorizations generate the need for frequent contacts between companies and
423 governmental officials (Park 2003). A great amount of time is spent by companies in
424 the process of acquiring these authorizations or dealing with governmental officials.
425 Hence, some companies choose to pay bribes to accelerate the approval process of
426 governmental authorizations (Tanzi 1998; Argandona 2001).

427 ***Lack of Positive Industrial Climate***

428 Interpersonal connections (LPIC6) had the highest factor loading (0.789) on the lack
429 of a positive industrial climate (LPIC). The term of interpersonal connections is
430 common in studies that discussed culture factors affecting doing business in China
431 (Alston 1989). In a society which has been ruled a long time by man instead of by law,
432 an organization can gain a distinctly competitive advantage by building good
433 interpersonal connections with the governmental officials. Interpersonal connections
434 may bring vital resources, personal gains, and cost savings to the individuals or
435 organizations that employ them. However, these benefits are often obtained by
436 exchanging favors of various parties, especially by exchanging money and power
437 (Fan 2002). In China, to a certain extent, interpersonal connections are regarded as a
438 synonym for corrupt acts such as bribery, nepotism and fraud (Yang 1994). Although
439 corruption can be found in any country, interpersonal connections in China provide a
440 more fertile soil than any other country for corruption to flourish (Fan 2002).

441 The close relationships among contract parties (LPIC4) had the second high

442 factor loading (0.783) on the lack of positive industrial climate (LPIC). The close
443 relationships among contract parties (LPIC4) have been considered to be a vital
444 success factor of public construction project (Ning and Ling 2013). These
445 relationships can yield a wide range of benefits, such as securing rare resources,
446 obtaining information and privilege, and providing insurance against uncertainty in
447 the implementation of projects. However, close relationships among contract parties
448 can also cause collusion, a typical form of corrupt act. According to Zarkada-Fraser
449 and Skitmore (2000), collusion in the construction sector can be defined as the corrupt
450 acts of various parties that coordinate their behaviors surreptitiously, which brings lost
451 to the benefits of projects. Additionally, collusion caused by the close relationships
452 among contract parties is even more difficult to be disclosed, as the collusive
453 behaviors may not violate the regulation systems under the collaboration of the
454 collusive parties.

455 The complexity of public construction projects (LPIC5) was the third high factor
456 loading (0.691) on the lack of positive industrial climate (LPIC). The complexity of
457 public construction projects has created an extra burden on construction participants
458 and trigger corruption risks (El-Sayegh 2008). Tanzi and Davoodi (1998) stated that
459 project complexity may increase difficulties in the contractual design, engineering
460 design, project construction, and site supervision of public construction projects. The
461 uncertainties caused by project complexity provide good opportunities for potential
462 corruptors to reap private gains (Tanzi and Davoodi 1998). For example, the complex,
463 non-standard production processes of construction projects may foster asymmetric

464 information stocks between the contract parties, thus providing opportunity for the
465 occurrence of corruption (de la Cruz et al. 2006; Kenny 2009).

466 The poor standards of professional ethics (LPIC2) ranked fourth in the factor
467 loadings of all items on the lack of a positive industrial climate (LPIC). Professionals
468 refer to a group of well-trained people organized to serve a body of specialized
469 knowledge in the interests of society (Appelbaum and Lawton 1990). Professional
470 ethics can be regarded as a set of moral principles that govern the conduct for these
471 professionals (Allen 1990). Sohail and Cavill (2008) highlighted the seven principles
472 for ethical behaviors of professionals, namely fair reward, integrity, honesty,
473 objectivity, accountability, reliability, and fairness. However, previous studies have
474 revealed the common existence of unethical behaviors in the construction industry,
475 which have received a large amount of research concern in the past (Vee and Skitmore
476 2003; Bowen et al. 2007a; 2007b). Obviously, poor standards of professional ethics
477 (LPIC2) compromise the integrity of individuals or organizations, which are apt to
478 produce a negative effect on decision making of key project parties, such as clients,
479 the government, and others.

480 **Conclusion and Recommendations**

481 To examine the relationships between the causes of corruption and corruption risks in
482 the public construction sector of China, this study conducted a questionnaire survey.
483 PLS-SEM results of the survey strongly supported the hypothesis that the causes of
484 corruption are positively correlated with corruption risks.

485 Analysis results showed that the causes of corruption could be grounded under
486 two constructs, namely, the flawed regulation systems (FRS), and the lack of a
487 positive industrial climate (LPIC). In addition, the flawed regulation systems (FRS)
488 had a higher path coefficient on corruption risks in the public construction sector of
489 China than the lack of a positive industrial climate (LPIC). This result indicates that
490 the flawed regulation systems (FRS) have a higher influence on corruption risks than
491 the lack of a positive industrial climate (LPIC). Thus, anti-corruption strategies
492 referring to regulation issues deserve more attention.

493 According to the factor loading of each measurement item on the flawed
494 regulation systems (FRS), the descending order of the measurement items'
495 contribution to corruption is, the negative role models of leadership (FRS5),
496 inadequate sanctions (FRS4), the lack of rigorous supervision (FRS3), and
497 multifarious authorizations (FRS1). In light of the analysis results, four
498 recommendations were provided for preventing corruption in the public construction
499 sector of China: (1) appoint an upright and honest leader in an organization. A fixed
500 channel for employees to report their corrupt leaders must be in place and these
501 informers must be protected effectively, (2) make sure that each corrupt act is dealt
502 with adequate sanction, and ensure the information of corruption cases sanctioned is
503 available to the public, (3) a third independent party should be employed to assess the
504 quality of supervision work at regular intervals, and (4) simplify the authorizations
505 that need to be approved by the government and clarify the procedures and their
506 respective time limits for the application of authorizations.

507 Based on the factor loading of each measurement item on the lack of a positive
508 industrial climate (LPIC), the descending order of the measurement items'
509 contribution to corruption is, interpersonal connections (LPIC6), close relationships
510 among contract parties (LPIC4), complexity of public construction projects (LPIC5),
511 and poor standards of professional ethics (LPIC2). Therefore, specific suggestions are
512 formulated in this study: (1) consolidate, clarify, and announce the procedures of
513 awarding public construction projects, hence reduce the adverse influence resulted by
514 the interpersonal connections between business and government, (2) impose rigorous
515 supervision and auditing on public projects implemented by contract parities having
516 long-term cooperation, to remit the collusion risks these projects are confronted with,
517 (3) publish the information of complex public construction projects in time to avoid
518 the information isolated island that may result in corruption. In addition, a sound
519 system that could well manage the complexity is also necessary, and (4) strengthen
520 the training of professional standards among the practitioners in the construction
521 sector. A mutual evaluation of professional ethics among employees could be
522 performed at intervals.

523 This study has contributed to establishment of the body of knowledge in
524 corruption in developing economies by examining the relationships between the
525 causes of corruption and corruption risks in the Chinese context through an empirical
526 survey. The findings are beneficial to scholars in relevant fields because it revealed
527 the sources of corruption in the public construction sector of China. This study also
528 provides guidelines for professionals and organizations involved in the construction

529 industry in China on corruption prevention. Although empirical evidences of this
530 study are from public construction projects in China, the results might also provide
531 reference for other developing countries with a large public construction sector.

532 The main limitation of this study lies in the opinion-based nature of the
533 questionnaire survey. However, this study has attempted to relieve bias of participants
534 by qualifying the selection of participants and administering the questionnaire in an
535 anonymous way. Additionally, there is a common view by the academics that reliable
536 findings are still available in corruption research based on questionnaire survey as
537 long as the items included in the questionnaire are specific and derived systematically
538 (Jain et al. 2001; Kaufmann et al. 2006; Sampford et al. 2006).

539 Future research is recommended to focus on the investigation of rationale of
540 various causes of corruption using an appropriately chosen quantitative and/or
541 qualitative research method. In addition, as the measurement items of corruption risks
542 has been identified in this study, future research should develop a systematic model to
543 measure corruption risk index in public construction projects.

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Tables in “Investigating the Relationship between the Causes of Corruption and Corruption Risks in the Public Construction Sector of China”

Table 1 Backgrounds of interviewees

No.	Employer	Position	Years of experience	Largest project ever managed/consulted	Working place*
A	Government	Director	20	USD 363 million	Eastern developed areas
B	Government	Deputy Director	16	USD 308 million	Central and western developing areas
C	Client	Project Manager	19	USD 363 million	Eastern developed areas
D	Client	Project Manager	17	USD 308 million	Eastern developed areas
E	Client	Director	13	USD 167 million	Central and western developing areas
F	Contractor	General Manager	25	USD 363 million	Eastern developed areas
G	Contractor	Project Manager	20	USD 122 million	Central and western developing areas
H	Contractor	Director	15	USD 85 million	Central and western developing areas
I	Consultant	General Manager	20	USD 363 million	Eastern developed areas
J	Consultant	Project Manager	16	USD 122 million	Central and western developing areas
K	Consultant	Project Manager	15	USD 85 million	Central and western developing areas
L	Academic	Professor	22	USD 197 million	Eastern developed areas
M	Academic	Professor	17	USD 73 million	Central and western developing areas
N	Academic	Associate Professor	13	USD 363 million	Eastern developed areas

Note: *Working places are divided into eastern areas with GDP per capita above USD 8,000, and central and western areas with GDP per capita below USD 5,000, according to the National Bureau of Statistics of China (2012).

Table 2 Backgrounds of respondents

Personal attributes	Categories	Number of respondents	Percentage	Cumulative percentage
Organization	Government	20	10.6	10.6
	Client	43	22.9	33.5
	Contractor	43	22.9	56.4
	Consultant	46	24.5	80.9
	Designer	26	13.8	94.7
	Academic	10	5.3	100
Position	Top managerial level (e.g., director, general manager, and professor)	49	26.1	26.1
	Middle managerial level (e.g., project manager)	88	46.8	72.9
	Professional (e.g., engineer, and quantity surveyor)	51	27.1	100
Years of experience	>20	24	12.8	12.8
	11-20	40	21.3	34.1
	6-10	76	40.4	74.5
	<5	48	25.5	100
Working place*	Eastern developed areas	96	51.1	51.1
	Central and western developing areas	92	48.9	100

Note: *Working places are divided into eastern areas with GDP per capita above USD 8,000, and central and western areas with GDP per capita below USD 5,000, according to the National Bureau of Statistics of China (2012).

Table 3 Measurement items of causes of corruption

Construct	Code	Measurement item	Source ^I											Evaluation	Factor loading	Variance explained	
			A	B	C	D	E	F	G	H	I	J	K				
Flawed regulation systems (FRS)	FRS1	Multifarious authorizations			✓	✓									4.50	0.631	38.668%
	FRS2	Deficiencies in rules and laws			✓							✓	✓		3.93	0.474 ^{III}	
	FRS3	Lack of rigorous supervision			✓	✓									4.14	0.630	
	FRS4	Inadequate sanctions		✓	✓								✓		3.50	0.707	
	FRS5	Negative role model of leadership		✓	✓										3.57	0.840	
Lack of a positive industrial climate (LPIC)	LPIC1	Low wage level			✓	✓									2.21 ^{II}	-	15.492%
	LPIC2	Poor standards of professional ethics	✓			✓		✓	✓	✓			✓		3.07	0.568	
	LPIC3	Excessive competition in the construction market		✓											3.79	0.452 ^{III}	
	LPIC4	Close relationships among contract parties			✓			✓							3.36	0.792	
	LPIC5	Complexity of public construction projects			✓										3.21	0.777	
	LPIC6 ^{II}	Interpersonal connections												✓	3.96	0.764	

Note: I : A= Bowen et al. 2012; B= Sohail and Cavill 2008; C = Tanzi 1998; D = Neelankavil 2002; E = Ling and Tran 2012; F = Liu et al. 2004; G= Moodley et al. 2008; H= Zarkada-Fraser and Skitmore 2000; I= Bologna and Del Nord 2000; J= Zarkada-Fraser 2000; K= Supplementation from interviewees;

II : LPIC1 was dropped with an evaluation score lower than 2.5 points in the interviews; LPIC6 was added by the interviewees;

III: FRS2 and LPIC3 were dropped with factor loadings lower than 0.5.

Table 4 Measurement items of corruption risks

Construct	Code	Measurement item	Evaluation	Factor loading	Variance explained
Immorality (Professional standards irregularities)	IMM1	The work is not executed as per original design accorded	3.93	0.727	33.679%
	IMM2	Work is executed without the availability of funds for the said purpose	3.93	0.474 ^{II}	
	IMM3	The changes, especially in abnormally high rated and high value items are not properly monitored and verified	3.29	0.696	
	IMM4 ^I	Contractors provide false certificates in bidding	3.96	0.673	
	IMM5 ^I	Substitution of unqualified materials in construction	3.54	0.735	
	IMM6 ^I	Site supervisor neglects his duties for taking bribe from contractor	3.91	0.750	
Unfairness (Fairness irregularities)	UNF1	The consultant is not appointed after proper publicity and open competition	3.64	0.797	9.718%
	UNF2	The criteria adopted in prequalification of consultant are restrictive and benefit only few consultants	3.43	0.849	
	UNF3	The selection of consultant not done by appropriate authority	3.57	0.451 ^{II}	
	UNF4	The criteria for selection of contractor are restrictive and benefit only few contractors	3.00	0.708	
	UNF5	The conditions/specifications are relaxed in favor of contractor to whom the work is being awarded	3.50	0.636	
	UNF6 ^I	Confidential information of bidding is disclosed to a specific bidder	3.76	0.654	
Opacity (Transparency irregularities)	OPA1	Adequate & wide publicity is not given to tender	2.71	0.720	6.644%
	OPA2	Adequate time for submission of tender/offer not given	2.64	0.482 ^{II}	
	OPA3	The evaluation of tenders is not done exactly as per the notified Criteria	2.57	0.752	
	OPA4	The negotiation on tender not done as per laid down guidelines	3.00	0.759	
	OPA5 ^I	A large project should have called for bids is split into several small projects and contracted without bidding	3.40	0.616	
Procedural violation (Procedural	PRV1	Administrative approval and financial sanction not taken to execute the work	2.79	0.742	6.300%
	PRV2	Lack of the sanctioned financial provisions from the government	3.86	0.707	
	PRV3	Work is not executed for the same purpose for which the sanction was accorded	2.93	0.640	

Construct	Code	Measurement item	Evaluation	Factor loading	Variance explained
accountability irregularities)	PRV4	The proper record of hindrances is not being maintained from the beginning	2.93	0.440 ^{II}	
Contractual violation	COV1	Escalation clause is not applied correctly for admissible payment	3.57	0.746	5.281%
(Contract monitoring and regulation irregularities)	COV2	Compliance with conditions regarding deployment of technical staff not being followed by contractor	3.71	0.573	
	COV3	The work order/supply order is not placed within justified rates	2.71	0.443 ^{II}	

Note: I : IMM4, IMM5, IMM6, UNF6, and OPA5 were added by the interviewees;

II : IMM2, UNF3, OPA2, PRV4, and COV3 were excluded with factor loadings lower than 0.5.

Table 5 Added measurement items and evaluations

Code	Measurement item	Interviewee														Evaluation
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	
LPIC6	Interpersonal connections				✓	✓	✓		✓		✓	✓	✓		✓	3.96
IMM4	Contractors provide false certificates in bidding	✓	✓	✓				✓	✓		✓		✓	✓		3.96
IMM5	Substitution of unqualified materials in construction	✓	✓		✓	✓				✓	✓	✓	✓	✓	✓	3.54
IMM6	Site supervisor neglects his duties for taking bribe from contractor		✓	✓	✓	✓				✓	✓		✓	✓	✓	3.91
UNF6	Confidential information of bidding is disclosed to a specific bidder	✓			✓			✓		✓		✓	✓		✓	3.76
OPA5	A large project should have called for bids is split into several small projects and contracted without bidding				✓	✓	✓		✓		✓	✓	✓		✓	3.40

Table 6 Measurement model evaluation

Construct	Code	Loading	T-value	AVE	CR
FRS	FRS1	0.600	8.3170	0.5143	0.8069
	FRS3	0.683	10.1444		
	FRS4	0.737	10.9578		
	FRS5	0.830	14.0376		
LPIC	LPIC2	0.669	9.9917	0.5403	0.8238
	LPIC4	0.783	13.0040		
	LPIC5	0.691	7.7230		
	LPIC6	0.789	13.4034		
IMM	IMM1	0.687	11.9562	0.5485	0.8584
	IMM3	0.732	11.4736		
	IMM4	0.719	11.3353		
	IMM5	0.772	14.248		
	IMM6	0.789	14.1749		
UNF	UNF1	0.767	15.3066	0.5600	0.8638
	UNF2	0.801	14.1633		
	UNF4	0.767	13.2561		
	UNF5	0.689	11.5474		
	UNF6	0.712	15.58		
OPA	OPA1	0.615	5.8088	0.5523	0.8301
	OPA3	0.801	12.6199		
	OPA4	0.789	12.174		
	OPA5	0.752	11.4131		
PRV	PRV1	0.794	11.2432	0.5461	0.7820
	PRV2	0.658	8.9278		
	PRV3	0.758	10.791		
COV	COV1	0.799	9.4346	0.6686	0.8013
	COV2	0.836	10.4413		

Table 7 Correlation matrix and square root of Average Variance Extracted of constructs

	COV	FRS	IMM	LPIC	OPA	PRV	UNF
COV	0.8177						
FRS	0.4069	0.7171					
IMM	0.5599	0.4882	0.7406				
LPIC	0.1854	0.4726	0.3092	0.7351			
OPA	0.2316	0.2465	0.4492	0.1674	0.7432		
PRV	0.3990	0.3329	0.4210	0.1167	0.4601	0.7390	
UNF	0.4615	0.3836	0.5508	0.2310	0.5941	0.5012	0.7483

Table 8 Cross loadings for individual measurement items

	COV	FRS	IMM	LPIC	OPA	PRV	UNF
COV1	0.7989	0.3114	0.3944	0.1566	0.2110	0.3704	0.3396
COV2	0.8361	0.3527	0.5164	0.1472	0.1699	0.2864	0.4125
FRS1	0.3553	0.5999	0.3808	0.2287	0.2085	0.2156	0.2624
FRS3	0.2882	0.6826	0.3130	0.3633	0.1534	0.2878	0.3102
FRS4	0.1967	0.7369	0.2412	0.3204	0.1419	0.2351	0.1974
FRS5	0.3403	0.8298	0.4621	0.4186	0.2093	0.2235	0.3277
IMM1	0.4503	0.3510	0.6870	0.1693	0.3286	0.2989	0.2964
IMM3	0.4893	0.3108	0.7319	0.2437	0.2742	0.2383	0.3226
IMM4	0.3435	0.3348	0.7194	0.1615	0.4024	0.2999	0.5502
IMM5	0.3764	0.3796	0.7716	0.2522	0.3459	0.3250	0.3899
IMM6	0.4301	0.4254	0.7888	0.314	0.3051	0.3867	0.4508
LPIC2	0.1199	0.4166	0.1964	0.6691	0.0905	0.0095	0.1492
LPIC4	0.1280	0.3210	0.2865	0.7833	0.1571	0.1131	0.1869
LPIC5	0.0285	0.1986	0.1138	0.6908	0.0878	0.0241	0.0753
LPIC6	0.2371	0.4200	0.2846	0.7891	0.1477	0.1742	0.2420
OPA1	0.1268	-0.0063	0.1417	0.0982	0.6153	0.2725	0.3146
OPA3	0.2881	0.2573	0.3402	0.1277	0.8010	0.3038	0.5066
OPA4	0.1791	0.1216	0.3517	0.0750	0.7894	0.3891	0.4164
OPA5	0.0864	0.2944	0.4454	0.1887	0.7523	0.3926	0.4977
PRV1	0.3164	0.2091	0.2806	0.0146	0.3927	0.7941	0.3743
PRV2	0.2344	0.2282	0.1999	0.1595	0.3021	0.6582	0.3585
PRV3	0.3247	0.2974	0.4298	0.0979	0.3236	0.7580	0.3801
UNF1	0.2632	0.2484	0.3445	0.1671	0.4047	0.4006	0.7673
UNF2	0.3276	0.1954	0.3227	0.0974	0.3448	0.3751	0.8014
UNF4	0.3383	0.2326	0.3891	0.1850	0.5197	0.4684	0.7667
UNF5	0.2793	0.2171	0.4125	0.1707	0.4829	0.1846	0.6888
UNF6	0.4877	0.5031	0.5629	0.2299	0.4561	0.4174	0.7118

Table 9 Evaluation of hierarchical models

Paths	Path coefficient	T-value	CR
FRS→CC	0.605	15.330	0.8320
LPIC→CC	0.560	14.306	
CR→IMM	0.820	22.166	0.9045
CR→UNF	0.861	51.096	
CR→OPA	0.738	17.325	
CR→PRV	0.685	16.841	
CR→COV	0.640	12.106	

Note: CC represents for causes of corruption

CR represents for corruption risks

