

Investigating the Causal Relationships between Causes of and Vulnerabilities to Corruption in the Chinese Public Construction Sector

Yun Le¹; Ming Shan²; Albert P. C. Chan³; and Yi Hu⁴

Abstract: Understanding relationships between causes of and vulnerabilities to corruption are essential in corruption research in construction because it addresses the fundamental issues of the widespread corruption in the public construction sector. Through an empirical survey, this study aims to investigate effects of the two causes of corruption, the flawed regulation systems and lack of a positive industrial climate, on five various kinds of corrupt vulnerabilities in China. The data were collected from officials, practitioners, and academics involved in the Chinese public construction sector, and then analyzed by factor analysis and partial least-squares structural equation modeling. The analysis results suggest that the flawed regulation systems have a higher influence on corruption vulnerabilities than the lack of a positive industrial climate. The results also indicate that the most influential item on the flawed regulation systems is negative leader roles, followed by inadequate sanctions, lack of rigorous supervision, and multifarious licenses and permits. The most influential item on the lack of a positive industrial climate is interpersonal connections, followed by overclose relationships among contracting parties, great project complexity, and poor professional ethical standards. Based on these research findings, this study contributes to knowledge by validating the theoretical hypothesis in China. Finally, recommendations for future practice and research are provided in this study. DOI: [10.1061/\(ASCE\)CO.1943-7862.0000886](https://doi.org/10.1061/(ASCE)CO.1943-7862.0000886). © 2014 American Society of Civil Engineers.

Author keywords: Corruption vulnerabilities; Cause; Public construction sector; China; Labor and personnel issues.

Introduction

The positive social image of the public construction sector has deteriorated because of a growing number of corrupt practices worldwide over the past decade, particularly in developing countries, which are the result of continual economic growth and rapid urbanization worldwide (Ehrlich and Francis 1999; Mo 2001; Méon and Sekkat 2005; Harboon and Heinrich 2011). A number of researchers stated that there exists an increase of corrupt vulnerabilities in public projects around the world (Brent 2009; Tabish and Jha 2011), which may ruin the public construction sector at multiple levels and lead to underperformance of public projects, such as quality defects, cost overruns, and delivery delay (Kenny 2009). Thus, a growing number of research studies have been devoted to corruption in construction, particularly in developing countries

(Alutu 2007; Alutu and Udhawuve 2009; de Jong et al. 2009; Tabish and Jha 2011; 2012; Bowen et al. 2012; Le et al. 2014).

As one of largest developing countries with a population of more than 1.3-billion, China has experienced a process of rapid urbanization and made huge investments in the public construction sector as a result of outstanding economic developments over the past two decades. According to the National Bureau of Statistics of China (2012), the total investment of public infrastructure and construction projects increased almost 19 times from 2 trillion (Chinese Yuan) (US\$0.28 trillion) in 1995 to CNY 37.4 trillion in 2012 (US \$5.34 trillion). However, these investments have caused vulnerabilities to corruption in the Chinese public construction sector. The National Bureau of Corruption Prevention reported 15,010 cases of corruption recorded in the public construction sector between 2009 and 2011, which involved 1,167 suspects holding senior positions in county government or above and caused an estimated loss of CNY 3 billion (approximately US\$490 million) (Xinhua Net 2011). This fact indicates the country is facing a significant challenge in preventing corruption in the public construction sector.

Understanding relationships between causes of corruption and vulnerabilities to corruption is vital to corruption prevention. Although a growing number of research efforts have been devoted to this topic (Tanzi 1998; Treisman 2000; Sohail and Cavill 2008; Bowen et al. 2012), they seldom address the challenges in the Chinese public construction sector. Therefore, this paper aims to examine relationships between causes of and vulnerabilities to corruption in the Chinese public construction sector by conducting an empirical survey.

Theoretical Framework

Corruption has many definitions that vary across different cultures, norms, and laws (Jain 2001). Corruption is defined as a conduct

¹Professor and Head of Dept. of Construction Management and Real Estate, Associate Director of Research Institute of Complex Engineering and Management, School of Economics and Management, Tongji Univ., Shanghai 200092, China.

²Ph.D. Candidate (Joint Program), Research Institute of Complex Engineering and Management, School of Economics and Management, Tongji Univ., Shanghai 200092, China; and Dept. of Building and Real Estate, Hong Kong Polytechnic Univ., Hung Hom, Kowloon, Hong Kong, China (corresponding author). E-mail: ming.shan@connect.polyu.hk

³Professor and Interim Dean of Faculty of Construction and Environment, Professor of Dept. of Building and Real Estate, Hong Kong Polytechnic Univ., Hung Hom, Kowloon, Hong Kong, China.

⁴Ph.D. Candidate, Dept. of Building and Real Estate, Hong Kong Polytechnic Univ., Hung Hom, Kowloon, Hong Kong, China.

Note. This manuscript was submitted on January 24, 2014; approved on April 17, 2014; published online on May 21, 2014. Discussion period open until October 21, 2014; separate discussions must be submitted for individual papers. This paper is part of the *Journal of Construction Engineering and Management*, © ASCE, ISSN 0733-9364/05014007(12)/\$25.00.

that deviates from the formal duties of a public role because of private-regarding (e.g., personal, close family, private clique) pecuniary gains (Nye 1967). Based on principal-agent theory, Alam (1989) defined corruption as conduct that sacrifices the interest of principals for the interest of agents or violates norms for behavior of the agents. Levy (2000) considered corruption as violation of administrative ethics and responsibilities for private gains. Although there is no consensus on the definition of corruption, most researchers have agreed that it includes misconducts committed by officials for their private gains (Ko and Weng 2011). In the construction sector, corruption is the abuse of an entrusted power at the expense of a public construction project.

Causes of Corruption

Sustained efforts have been made to investigate causes of corruption in the construction sector, particularly in the public sector. Because corruption is regarded as a result of an unethical decision (Zarkada-Fraser and Skitmore 2000; Liu et al. 2004; Moodley et al. 2008), prior studies have revealed several explanations at the macro-level. First, a defective law system may provide opportunity for corruption in the construction sector (Bologna and Del Nord 2000; Sha 2004). Ling and Tran (2012) observed that overclose relationships among contracting parties could lead to corruption. Bowen et al. (2012) stated that the negative role models of public officials and absence of deterrents and sanctions are key causes of corruption in construction. Apart from these causes, Sohail and Cavill (2008) and Tabish and Jha (2011) emphasized that the occurrence of corruption is due to deregulation in the public construction sector, excess competition of the construction market, and inappropriate political interference in investment decision making. Tanzi (1998) further examined causes of corruption at multiple levels and aspects, such as regulations and authorizations, discretionary decisions, wage level of public servants, penalty systems, institutional controls, and transparency as well as role models of leadership. Based on the previous reviews, causes of corruption could be grouped under two categories, namely, the flawed regulation system (FRS) and the lack of a positive industrial climate (LPIC).

The FRS is measured by five items. They are multifarious licenses or permits (FRS1), deficiencies in rules and laws (FRS2), lack of rigorous supervision (FRS3), inadequate sanctions (FRS4), and negative leader roles (FRS5). Multifarious licenses or permits (FRS1) are a compulsory requirement for related organizations and professionals to be engaged in the construction sector. By issuing these licenses or permits, the government and affiliated officials are able to have monopoly power to manage project parties involved in construction projects and supervise project execution. Under such circumstances, some officials possibly make use of the authorization power to ask bribes from those who want to obtain the licenses or permits (Tanzi 1998; Rose-Ackerman 2008). Bologna and Del Nord (2000) and Sha (2004) pointed out that deficiencies in rules and laws (FRS2) become a hurdle to successful regulation on corrupt practices, which might motivate corrupt practices. Tanzi (1998) opined that corruption should be discouraged or discovered by honest and effective supervisors and auditors, and that the lack of rigorous supervision (FRS3) can facilitate corruption. Based on an online questionnaire survey in South Africa, Bowen et al. (2012) identified inadequate sanctions (FRS4) and negative leader roles (FRS5) as two main causes of corruption in the construction sector.

The LPIC is measured by five items: the low wage level (LPIC1), poor professional ethical standards (LPIC2), excessive competition in the construction market (LPIC3), overclose relationships among contracting parties (LPIC4), and great project complexity (LPIC5). Haque and Sahay (1996) revealed a statistically

significant correlation between the serious corruption situation and the low wage level (LPIC1). Numerous studies have provided evidence for the essential role of the poor professional ethical standards (LPIC2) as a root cause of corruption in construction (Zarkada-Fraser 2000; Zarkada-Fraser and Skitmore 2000; Liu et al. 2004; Moodley et al. 2008; Bowen et al. 2012). Sohail and Cavill (2008) and Tabish and Jha (2011) stated that misconducts of contractors who try to secure contracts from clients in the excessively competitive market can also lead to corruption (LPIC3). A number of scholars also identified overclose relationships among contracting parties (LPIC4) as a cause of corruption (Sohail and Cavill 2008; Ling and Tran 2012). Sohail and Cavill (2008) further stated that great project complexity (LPIC5) is correlated with corruption.

Vulnerabilities to Corruption

Corruption vulnerabilities play a central role in corruption research, particularly in developing countries that lack a good legislative and administration system (Doig 1997; Lee et al. 2010). Sohail and Cavill (2008) examined various corruption vulnerabilities and evaluated their relationships with related stakeholders in the project execution and delivery process. Tabish and Jha (2011) conceived key corruption vulnerabilities in public procurement in terms of irregularities. In their study, Tabish and Jha (2011) identified 61 irregularities in the Indian public procurement projects and categorized these irregularities into five groups, namely, transparency, professional standards, fairness, contract monitoring and regulation, and procedural accountability irregularities.

Hypothesis Development

Based on the literature review, an initial theoretical model consisting of two second-order constructs was hypothesized to examine the causal relationships between causes of and vulnerabilities to corruption. The development of the model adopted the second-order construct approach suggested by Wetzels et al. (2009) because it maximizes the interpretability of both measurement and the hierarchical models. In the proposed model, the hypothesis that causes of corruption are positively correlated with corruption vulnerabilities in public construction projects is to be tested.

As shown in Fig. 1, causes of corruption are considered a two-dimensional and second-order construct, which comprise the flawed regulation systems and the lack of a positive industrial climate. Corruption vulnerabilities are deemed as a five-dimensional and second-order construct. This study extended corruption irregularities and their categorizations proposed by Tabish and Jha (2011) to measure vulnerabilities in public procurement projects. This is because China and India have many similar aspects, such as close locations, economy, population, and industrial structures. Consequently, the corruption vulnerabilities construct in this study was measured by irregularities grouped under transparency, professional standards, fairness, contract monitoring and regulation, and procedural accountability. Before adopting these irregularities to develop the questionnaire, all items of irregularities should pass verifications by selected experts in China through interviews.

Research Methods

The whole research process includes four steps. First, a theoretical model for defining the relationships between causes of and vulnerabilities to corruption was formulated by literature review. Second, the model was refined by interviewing selected experts to fit in the Chinese context. Third, a questionnaire instrument was developed

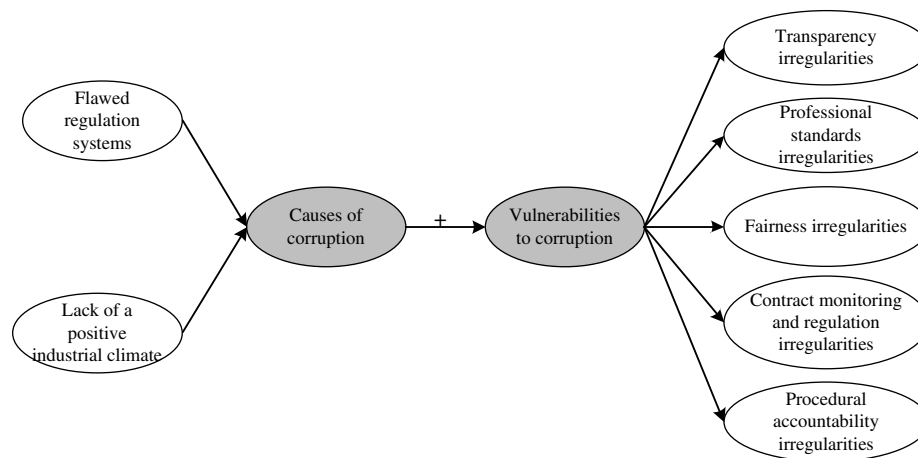


Fig. 1. Initial theoretical model and research hypothesis

based on the refined framework and was used in the survey to collect opinion-based data from target respondents. Last, both factor analysis (FA) and partial least-squares structural equation modeling (PLS-SEM) were conducted to analyze the data collected and validate the proposed framework. In this study, the former was used to analyze the interview feedback, and the latter was to validate the proposed framework. Qualitative and quantitative methods were sequentially adopted in this study. Results obtained from different methods can triangulate and complement each other, thus yielding stronger and more reliable findings (Hon et al. 2012; Hwang et al. 2013; Zhao et al. 2014).

Structured Interviews

To verify the theoretical model derived from the literature review and make it fit in with the Chinese context, a series of structured face-to-face interviews were conducted between July and August 2013. First, a list of measurement items regarding cause of and vulnerabilities to corruption for interviews was prepared in terms of the developed theoretical model. Fourteen experienced industrial and academic experts were then invited and participated in the interviews. Each interviewee was requested to provide opinions on the constructs and their affiliated measurement items in terms of

a five-point Likert scale with 1 being strongly disagree, 2 being disagree, 3 being neutral, 4 being agree, and 5 being strongly agree.

To ensure the reliability and quality of interviews, a purposive approach was adopted to select interviewees. All the interviewees had at least 10 years of experience in public construction sector and senior positions within their organizations. The selection of interviewees also considers the diversity of professional expertise and geographic locations of experts, which could increase the heterogeneity of the interview panel and thus improved the validity of interviews. Table 1 shows the backgrounds of interviewees.

Based on interview feedback, the mean score of each measurement item was calculated. Only those whose mean achieves a value of 2.5 or above were used in the final questionnaire for the survey. This method is also suggested by Hsueh et al. (2009). Finally, nine measurement items regarding causes of corruption and 19 (irregularities) regarding corruption vulnerabilities were extracted and used in the questionnaire survey, respectively (Tables 2 and 3). In addition, a new measurement item (i.e., interpersonal connections) regarding causes of corruption and five (i.e., contractors provide false certificates in bidding, substitution of unqualified materials in construction, site supervisor neglects duties for taking bribe from contractor, confidential information of bidding is disclosed to a specific bidder, and a large project should have called

Table 1. Backgrounds of Interviewees

Interviewee	Employer	Position	Years of experience	Largest project ever managed or consulted	Working place ^a
A	Government	Director	20	US\$363 million	Eastern China
B	Government	Deputy director	16	US\$308 million	Central China
C	Client	Project manager	19	US\$363 million	Western China
D	Client	Project Manager	17	US\$308 million	Eastern China
E	Client	Director	13	US\$167 million	Northeastern China
F	Contractor	General manager	25	US\$363 million	Eastern China
G	Contractor	Project manager	20	US\$122 million	Western China
H	Contractor	Director	15	US\$85 million	Central China
I	Consultant	General manager	20	US\$363 million	Eastern China
J	Consultant	Project manager	16	US\$122 million	Western China
K	Consultant	Project manager	15	US\$85 million	Northeastern China
L	Academic	Professor	22	US\$197 million	Central China
M	Academic	Professor	17	US\$73 million	Western China
N	Academic	Associate professor	13	US\$363 million	Northeastern China

^aWorking places are divided into eastern China with gross domestic product (GDP) per capita approximately US\$8,600, central China with GDP per capita approximately US\$4,700, western China with GDP per capita approximately US\$4,400, and northeastern China with GDP per capita approximately US\$6,600, according to the National Bureau of Statistics of China (2012).

Table 2. Measurement Items of Causes of Corruption

Construct	Code	Measurement item	Source ^a											Evaluation	Factor loading	Variance explained (%)
			A	B	C	D	E	F	G	H	I	J	K			
FRS	FRS1	Multifarious licenses or permits			X	X								4.50	0.631	38.668
	FRS2	Deficiencies in rules and laws			X						X	X		3.93	0.474 ^b	
	FRS3	Lack of rigorous supervision			X	X								4.14	0.630	
	FRS4	Inadequate sanctions	X		X							X		3.50	0.707	
	FRS5	Negative leader roles	X		X									3.57	0.840	
LPIC	LPIC1	Low wage level			X	X								2.21 ^c	—	15.492
	LPIC2	Poor professional ethical standards	X			X		X	X	X		X		3.07	0.568	
	LPIC3	Excessive competition in the construction market		X										3.79	0.452 ^b	
	LPIC4	Overclose relationships among contracting parties		X			X							3.36	0.792	
	LPIC5	Great project complexity		X										3.21	0.777	
	LPIC6 ^b	Interpersonal connections											X	3.96	0.764	

^aA = 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.

^bFRS2 and LPIC3 were dropped with factor loadings lower than 0.5.

^cLPIC1 was dropped with an evaluation score lower than 2.5 points in the interviews; LPIC6 was added by the interviewees.

for bids is split into several small projects and contracted without bidding) regarding corruption vulnerabilities advocated by most experts were added to elaborate the theoretical model and make a tailor fit with the Chinese context (Table 4). Titles of five kinds of corrupt vulnerabilities were modified as opacity (formerly transparency), immorality (formerly professional standards), unfairness (formerly fairness), contractual violation (formerly contract monitoring and regulation), and procedural violation (formerly procedural accountability) in terms of interview feedbacks. Consequently, the revised theoretical model was refined as shown in Fig. 2.

Questionnaire Survey

An empirical questionnaire was developed based on the measurement items consolidated in the structured interviews. The target respondents included clients, contractors, designers, consultants, governmental officials, and academics involved in public construction projects in China. To maximize the number of potential survey respondents, a number of government agencies, research institutions, and companies within the construction industry were contacted. In the end, eight institutions agreed to facilitate the dissemination of questionnaires. They are all active players in the public sector in China. Each of them represents a huge number of governmental officials or industry professionals or researchers from a broad range of the entire sector. These institutions are:

- Research Institute of Complex Engineering & Management, Tongji University;
- Shanghai Construction Consultants Association;
- Shanghai Xian Dai Architectural Design (Group) Co., Ltd.;
- School of Civil Engineering and Transportation, South China University of Technology;
- College of Civil Engineering, Shenzhen University;
- Zhengzhou Municipal Construction Commission;
- Zhengzhou Metro Group Co., Ltd.; and
- China Construction Eighth Engineering Division Company.

The questionnaire was disseminated between September and October 2013 through three channels. First, an online questionnaire was developed and disseminated to professionals and academics through the eight institutions. Second, hard copies were also distributed in a national industrial forum held in Shanghai, China.

Some qualified attendants were invited and agreed to participate in this survey. Third, field studies were conducted to disseminate questionnaires on sites in Shanghai (in eastern China), Jinan city (in eastern China), and Zhengzhou city (in central China), respectively. The three survey approaches adopted in this study enhance the maximized number of survey respondents. Last, 188 valid replies were recorded: 87 were from the online survey, 20 from the forum, and 81 from the field survey. Table 5 shows the backgrounds of respondents.

Tools for Data Analysis

Factor Analysis

FA is a statistical technique commonly adopted to identify a small number of individual factors beneath a set of interrelated variables (Choi et al. 2011). FA was conducted using *Statistical Package for the Social Sciences 17.0* to condense and summarize measurement items proposed in this study. Principal component analysis was conducted to identify the underlying principal factors for its simplicity and distinctive capacity of data reduction (Chan et al. 2010). To obtain principal factors for a clearer image, factor extraction with promax rotation and Kaiser normalization suggested by Conway and Huffcutt (2003) was conducted. Before FA, both Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity analyses were conducted to examine the appropriateness of employing FA technique in this study. According to Norusis (2008) and Choi et al. (2011), a KMO value should be higher than the 0.5 threshold; meanwhile, the significance level of Bartlett's test for sphericity should also be small (e.g., p -value = 0.000).

Partial Least-Squares Structural Equation Modeling

PLS-SEM was adopted to test the hypothesis in the refined theoretical model. PLS-SEM is a combined technique consisting of principal components analysis, path analysis, and regression to simultaneously evaluate theory and data (Aibinu and Al-Lawati 2010). PLS-SEM can estimate parameters for links between measurement items and their corresponding constructs and links among different constructs (Mohamed 2002). PLS-SEM has a minimum requirement on sample size, but it can handle nonnormal data sets

Table 3. Measurement Items of Vulnerabilities to Corruption

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 ^a	
	IMM3	The changes, especially in abnormally high rated and high value items, are not properly monitored and verified	3.29	0.696	
	IMM4 ^b	Contractors provide false certificates in bidding	3.96	0.673	
	IMM5 ^b	Substitution of unqualified materials in construction	3.54	0.735	
	IMM6 ^b	Site supervisor neglects 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 ^a	
	UNF4	The criteria for selection of contractor are restrictive and benefit only few contractors	3.00	0.708	
	UNF5	The conditions and specifications are relaxed in favor of contractor to whom the work is being awarded	3.50	0.636	
	UNF6 ^b	Confidential information of bidding is disclosed to a specific bidder	3.76	0.654	
Opacity (transparency irregularities)	OPA1	Adequate and wide publicity is not given to tender	2.71	0.720	6.644
	OPA2	Adequate time for submission of tender or offer not given	2.64	0.482 ^a	
	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 ^b	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 accountability irregularities)	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	
	PRV4	The proper record of hindrances is not being maintained from the beginning	2.93	0.440 ^a	
Contractual violation (contract monitoring and regulation irregularities)	COV1	Escalation clause is not applied correctly for admissible payment	3.57	0.746	5.281
	COV2	Compliance with conditions regarding deployment of technical staff not being followed by contractor	3.71	0.573	
	COV3	The work order or supply order is not placed within justified rates	2.71	0.443 ^a	

^aIMM2, UNF3, OPA2, PRV4, and COV3 were excluded with factor loadings lower than 0.5.

^bIMM4, IMM5, IMM6, UNF6, and OPA5 were added by the interviewees.

(Reinartz et al. 2009; Ringle et al. 2012). Therefore, PLS-SEM was adopted in this study.

Results of PLS-SEM include a set of measurement models and a structural model. In this study, three indicators, such as composite reliability, loadings of measurement items on the corresponding construct, and average variance extracted (AVE), were examined to evaluate four kinds of validity of the measurement models: (1) internal consistency reliability, (2) indicator reliability, (3) convergent validity, and (4) discriminating validity (Hair et al. 2011; Ning and Ling 2013; Zhao et al. 2013). Composite reliability is used to assess the internal consistency reliability, whose value should be larger than 0.7 (Hair et al. 2011). Loadings of measurement items on the corresponding construct are used to assess the

indicator reliability, whose value should be at least larger than 0.4 (Hair et al. 2011; Ning and Ling 2013). The AVE is used to evaluate the convergent validity, whose value should be larger than 0.5 (Hair et al. 2011). Loadings of measurement items on the corresponding construct and the AVE are also used to evaluate the discriminating validity: the AVE on each construct should be larger than the construct's highest squared correlation with any other latent construct; a measurement item's loading should be larger than all of its cross loadings (Cenfetelli and Bassellier 2009; Hair et al. 2011; Ning 2014; Zhao et al. 2013). Regarding the evaluation of the structural model, the significance of path coefficients was adopted with the aid of bootstrapping (Hair et al. 2011; Ning and Ling 2013; Zhao et al. 2013).

Table 4. 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				X	X	X		X		X	X	X		X	3.96
IMM4	Contractors provide false certificates in bidding	X	X	X				X	X		X		X	X		3.96
IMM5	Substitution of unqualified materials in construction	X	X		X	X				X	X	X	X	X	X	3.54
IMM6	Site supervisor neglects duties for taking bribe from contractor		X	X	X	X				X	X		X	X	X	3.91
UNF6	Confidential information of bidding is disclosed to a specific bidder	X			X			X		X		X	X		X	3.76
OPA5	A large project that should have called for bids is split into several small projects and contracted without bidding				X	X	X		X		X	X	X		X	3.40

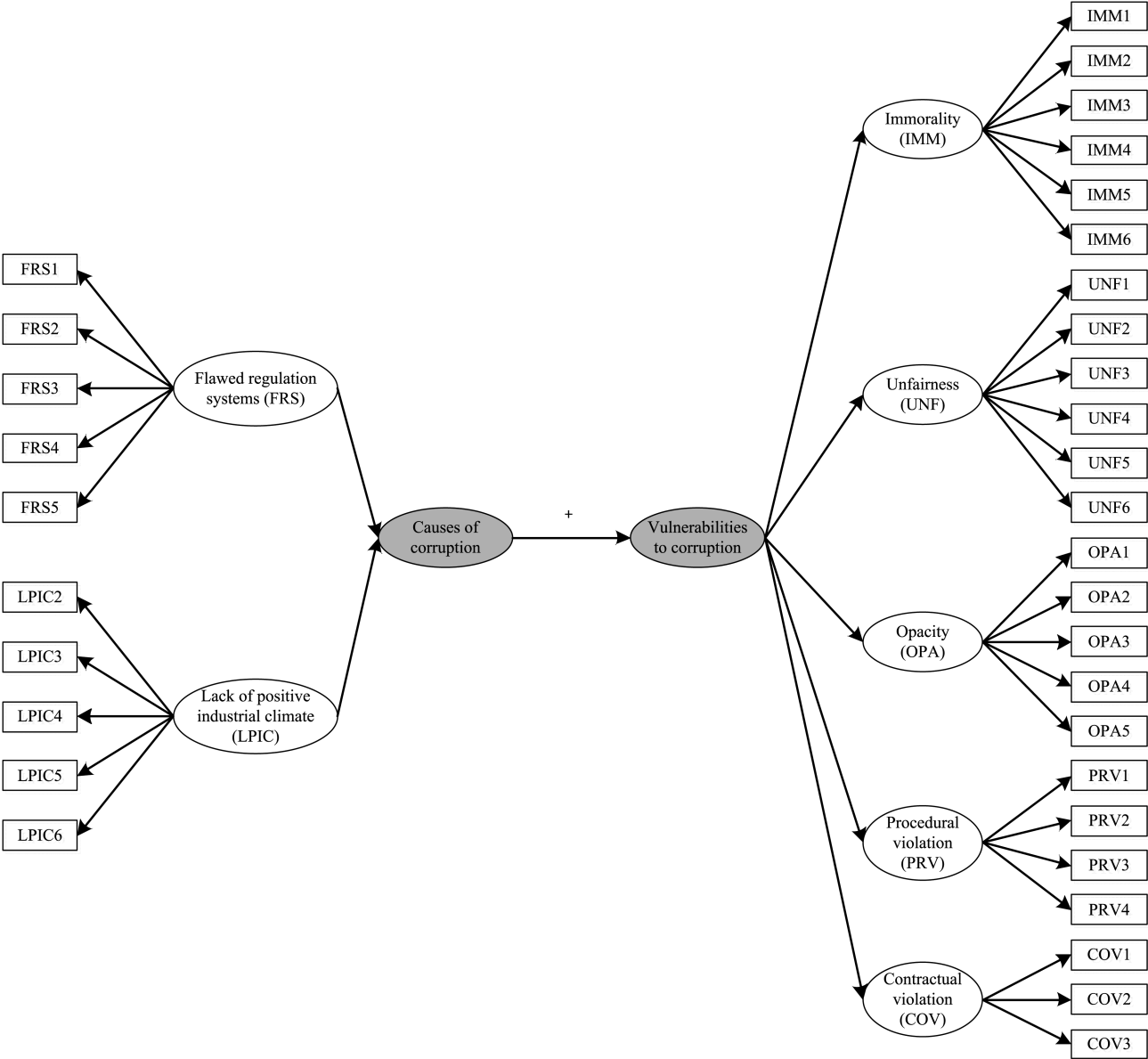


Fig. 2. Refined proposed theoretical model

Table 5. 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, professor)	49	26.1	26.1
	Middle managerial level (e.g., project manager)	88	46.8	72.9
	Professional (e.g., engineer, 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 ^a	Eastern China	63	33.5	33.5
	Central China	55	29.2	62.7
	Western China	37	19.7	82.4
	Northeastern China	33	17.6	100

^aWorking places are divided into eastern China with gross domestic product (GDP) per capita approximately US\$8,600, central China with GDP per capita approximately US\$4,700, western China with GDP per capita approximately US\$4,400, and northeastern China with GDP per capita approximately US\$6,600, according to the National Bureau of Statistics of China (2012).

Results

Factor Analysis

Table 2 shows FA results of measurement items of causes of corruption. Two constructs encapsulating 11 measurement items were generated. The KMO value is 0.789, which is considered to be acceptable to adopt the FA (Norusis 2008). The total variance explained is 54.160%. The Bartlett's test of sphericity produced an approximate $\chi^2 = 486.044$ (degrees of freedom = 55, $p = 0.000$), indicating the correlations among measurement items were high (Dziuban and Shirkey 1974). Hair et al. (2010) stated that the loading of each measurement item on its corresponding construct should not be lower than 0.5. Therefore, FRS2 and LPIC3 were deleted from the list of measurement items.

Table 3 shows FA results of measurement items of corruption vulnerabilities. Five constructs encapsulating 24 measurement items were generated. The KMO value is 0.863, which is considered to be acceptable (Norusis 2008). The total variance explained is 61.623%. The Bartlett's test of sphericity produced an approximate $\chi^2 = 1,308.051$ (degrees of freedom = 276, $p = 0.000$), indicating that the correlations among measurement items were high (Dziuban and Shirkey 1974). The IMM2, UNF3, OPA2, PRV4, and COV3 were deleted from the list of measurement items because their factor loadings were lower than 0.5 (Hair et al. 2010).

Evaluation of Measurement Models

Tables 6–8 show the evaluation results of measurement models.

As shown in Table 6, three observations are obtained: (1) all loadings are larger than 0.6 with t -values larger than 2.58, indicating the acceptable indicator reliability (Hair et al. 2011; Ling et al. 2013; Ning and Ling 2013); (2) the values of composite reliability are more than 0.7, suggesting a satisfactory level of reliability of internal indicators with each construct (Hair et al. 2011; Ning 2014); (3) the values of AVE are higher than 0.5, showing a satisfactory level of convergent validity of the constructs (Hair et al. 2011; Ning 2014).

Table 7 shows that each construct's AVE is higher than its squared correlation with any other construct.

Table 8 indicates that each measurement item has the highest loading on the corresponding construct. These data indicate the high discriminate validity of the constructs (Hair et al. 2011; Ling et al. 2013; Ning 2014). The results of measurement model evaluation suggest that each construct has internal consistency reliability.

Table 6. Measurement Model Evaluation

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

Note: COV = contractual violation; CR = composite reliability; IMM = immorality; OPA = opacity; PRV = procedural violation; UNF = unfairness.

Table 7. Correlation Matrix and Square Root of Average Variance Extracted of Constructs

Construct	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

Note: COV = contractual violation; CR = composite reliability; IMM = immorality; OPA = opacity; PRV = procedural violation; UNF = unfairness. Bold values are significant at 0.01 level.

Table 8. Cross Loadings for Individual Measurement Items

Measurement item	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

Note: COV = contractual violation; CR = composite reliability; IMM = immorality; OPA = opacity; PRV = procedural violation; UNF = unfairness. Bold values are significant at 0.01 level.

Evaluation of Hierarchical Models

Table 9 shows that all path coefficients for the hierarchical models are significant (t -value > 2.58). Values of composite reliability are also greater than 0.7, which suggests a satisfactory level of reliability of first-order constructs with the corresponding second-order construct (Bagozzi and Yi 1988; Ling et al. 2013).

Evaluation of Structural Model

The path coefficient between causes of and vulnerabilities to corruption has a t -value higher than 2.58, indicating its statistical significance at the 0.01 level (Henseler et al. 2009). The hypothesis that causes of corruption are positively correlated with corruption vulnerabilities is supported in the hypothesized sign. Fig. 3 shows the testing results of the theoretical model.

Table 9. Evaluation of Hierarchical Models

Paths	Path coefficient	t -Value	CR
FRS \rightarrow CC	0.605	15.330	0.8320
LPIC \rightarrow CC	0.560	14.306	
VC \rightarrow IMM	0.820	22.166	0.9045
VC \rightarrow UNF	0.861	51.096	
VC \rightarrow OPA	0.738	17.325	
VC \rightarrow PRV	0.685	16.841	
VC \rightarrow COV	0.640	12.106	

Note: CC = causes of corruption; COV = contractual violation; CR = composite reliability; IMM = immorality; OPA = opacity; PRV = procedural violation; VC = vulnerabilities to corruption; UNF = unfairness.

Discussion

According to the PLS-SEM results, all the statistical indicators were found to be acceptable, which validated the hypothesis developed in the study (Hair et al. 2011). The PLS-SEM results suggested that the causes of corruption have a positive correlation with corruption vulnerabilities in the Chinese public construction sector. The results also showed that FRS and LPIC had significant correlations with the second-order construct the causes of corruption. The FRS emerged as the most principal set of causes of corruption with a path coefficient of 0.605. LPIC emerged as the second most principal set of causes of corruption with a path coefficient of 0.560.

Flawed Regulation Systems

Negative leader roles (FRS5) received the highest factor loading (0.830) on the FRS. Leadership plays a vital role in the formation of an organization's ethically oriented culture (Sims 1992, 2000; Schein 2006). Positive leader roles can facilitate achievement of a mission through fair and honest actions (Tabish and Jha 2012). Conversely, negative leader roles can lead to corruption if leaders engage in corrupt practices themselves, or they overlook such practices performed by their friends, relatives, or colleagues. Under such circumstances, their subordinates may not behave differently (Tanzi 1998). According to Li et al. (2013), in most cases corruption is undertaken by the collective involving executives and staff within an organization. In a recent survey in South Africa, Bowen et al. (2012) also reported similar findings that corrupt practices by an organization's leaders could have negative effects on their subordinates, which would be followed by the subordinates.

Inadequate sanctions (FRS4) had the second highest factor loading (0.737) on the FRS. Theoretically, imposing significant sanctions on corrupt crimes to a large extent reduce the occurrence of corruption (Tanzi 1998; Zarkada-Fraser 2000). However, the Chinese public believes that only very limited suspects receive sanctions for their corrupt crimes (He 2000). Even though the suspects may be sentenced to jail for their corrupt crimes, their terms of imprisonment are usually commuted by paying bribery to the judicial department (Xinhua Net 2014).

Lack of rigorous supervision (FRS3) received the third ranking among the measurement items on the FRS. Rigorous supervision is usually regarded as one of the most effective anticorruption measures (Tanzi 1998). However, there seems to be a significant gap between the specification of supervising rules and its execution in the Chinese context (Ko and Weng 2011). This may be due to a high social cost that is reluctant to be afforded by the supervisors, such as losing a friend (Guo and Yang 2008). In addition, supervisors themselves may have been accessible to corruption, which could also lead to the lack of rigorous supervision (Li et al. 2013).

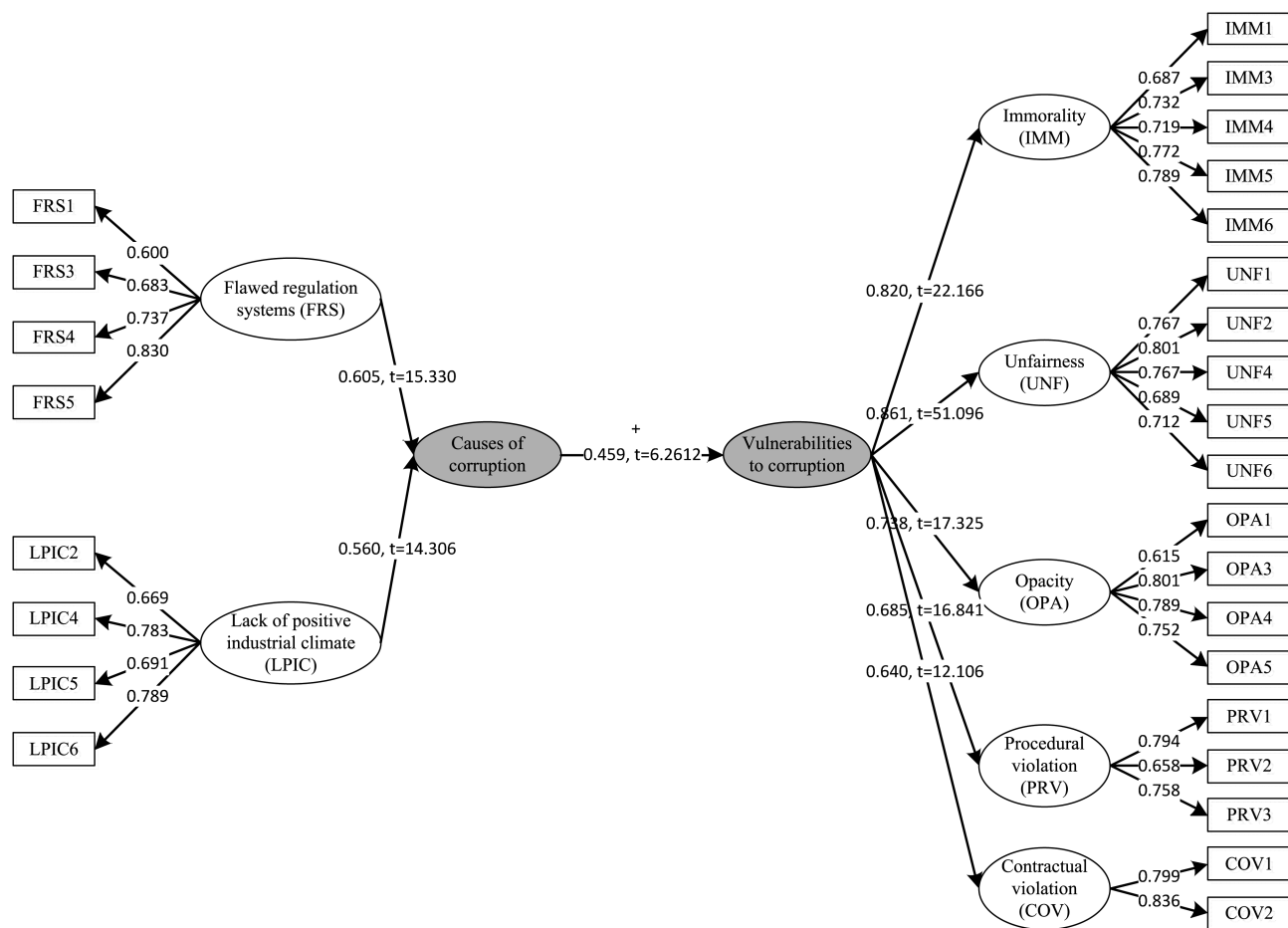


Fig. 3. Testing results of the theoretical model

Under such circumstances, small corrupt practices could have the opportunity to evolve into bigger ones.

The item multifarious licenses and permits (FRS1) had the fourth highest factor loading (0.600) in the list of measurement items on the FRS. Obtaining several compulsory licenses and permits from government agencies are indispensable for a company to enter into the public construction sector (Zou et al. 2007). It is estimated that a company needs to obtain 108 licenses and permits to enter into the public construction market of Guangdong Province (Southern Metropolis Daily 2013). There also exists a lack of access to information and procedures regarding obtaining related licenses and permits in developing countries (Tanzi 1998; Neelankavil 2002). To accelerate the process of obtaining licenses and permits, some companies may choose to bribe government officials (Tanzi 1998; Argandona 2001).

Lack of Positive Industrial Climate

Interpersonal connections (LPIC6) had the highest factor loading (0.789) on LPIC. Previous studies indicated that interpersonal connections are regarded as a critical factor for doing business in China (Alston 1989). In a transitional society that lacks mature legislative and administrative systems, a company can gain competitive advantages and achieve business success by developing good interpersonal connections with governmental officials (Chan et al. 1999). Although interpersonal connections can make a company competitive and achieve business benefits, these benefits are often obtained by exchanging favors by various parties, especially

by exchanging money and power (Fan 2002). In China, interpersonal connections are to a certain extent regarded as a synonym for corrupt acts such as bribery, nepotism, and fraud (Yang 1994). Although corruption is common in every country, interpersonal connections provide a more fertile soil in China than in any other country for corruption to flourish (Fan 2002).

Overclose relationships among contracting parties (LPIC4) had the second highest factor loading (0.783) on LPIC. Although close relationships among contracting parties (LPIC4) is regarded as a critical factor for the success of public construction projects (Ning and Ling 2013), overclose relationships can also trigger a risk in collusion, a form of corruption. Zarkada-Fraser and Skitmore (2000) defined collusion as a corrupt act in which various parties coordinate their behaviors surreptitiously and gain benefits by bringing loss to project benefits. In practice, it is very difficult to identify collusion. Such wrongdoing is a quite common kind of corrupt practice referring to various contracting parties including clients, contractors, designers, consultants, and suppliers in the Chinese public construction sector (Legal Daily 2012).

Great project complexity (LPIC5) received the third place with factor loading of 0.691 on LPIC. Project complexity may impose pressure on parties involved in a construction project and thus trigger corruption risk (El-Sayegh 2008). Tanzi and Davoodi (1998) further stated that project complexity may increase difficulties in project management tasks such as contractual design, engineering design, project construction, and site supervision. Task uncertainty caused by project complexity also provides opportunities for potential corruptors (e.g., contractors) to reap personal benefits (Tanzi

and Davoodi 1998). Le et al. (2013) and Li et al. (2013) reported that the complex and nonstandard production process of construction projects in the Chinese context may foster asymmetric information stocks between contracting parties, thus providing opportunity for the occurrence of corruption.

Poor professional ethical standards (LPIC2) ranked fourth in the factor loadings of all items on LPIC. Professional refers to a group of well-trained people organized to serve a body of specialized knowledge in the interests of society (Appelbaum and Lawton 1990). Professional ethics is a set of moral principles that govern the conduct for these professionals. Sohail and Cavill (2008) highlighted the seven principles for being an ethical professional, namely, fair reward, integrity, honesty, objectivity, accountability, reliability, and fairness. However, previous studies have revealed the lack of professional and public morality in the construction sector of developing countries (Vee and Skitmore 2003; Bowen et al. 2007a, b). Poor professional ethical standards (LPIC2) is a root cause of this situation in developing countries.

Limitation of this Study

The main limitation of this study lies in the sample size of the questionnaire survey. Although this study has made great efforts in disseminating questionnaires and collecting feedback from various regions of China and the empirical data obtained have supported the developed hypothesis, this study still has room for collecting more empirical data and providing stronger evidence for model validation.

Conclusion and Recommendations

To examine relationships between causes of and vulnerabilities to corruption in the Chinese public construction sector, an empirical survey was conducted in this study. PLS-SEM results of the survey strongly supported the hypothesis that causes of corruption are positively correlated with corrupt vulnerabilities.

Analysis results showed that the causes of corruption could be grounded under two constructs, namely, the FRS and LPIC. In addition, FRS had a higher path coefficient on corruption vulnerabilities in the Chinese public construction sector than LPIC. This result indicates that FRSs have a higher influence on corruption vulnerabilities than LPIC. Consequently, more anticorruption efforts should be directed to this aspect.

Based on the factor loading of each measurement item on its corresponding construct, the prioritization of various causes of corruption under each construct was identified. With respect to the construct FRS, the descending order of the measurement items is the negative leader roles (FRS5), inadequate sanctions (FRS4), lack of rigorous supervision (FRS3), and multifarious licenses and permits (FRS1). As to the construct LPIC, the descending order of the measurement items is interpersonal connections (LPIC6), overclose relationships among contracting parties (LPIC4), great project complexity (LPIC5), and poor professional ethical standards (LPIC2). In light of these results, several anticorruption strategies for the Chinese public construction sector were proposed in this study as follows:

- Improve procedure design and implementation, and information disclose of awarding public construction projects.
- Impose rigorous supervision and auditing on public projects. Enforce the execution of corruption-related laws and regulations in practice.
- Establish the professional ethical standard and strengthen related training.

Although empirical evidence of this study is from China, the methodology derived from this study may provide reference for similar studies in other countries. Based on sufficient empirical findings generated from different countries, a corruption body of knowledge in construction may be established for wider practical application in future.

Acknowledgments

This study has been funded by the joint Ph.D. scheme between Hong Kong Polytechnic University and Tongji University, and the National Natural Science Foundation of China (Grant Nos. 71172107 and 71390523). The authors gratefully acknowledge the Department of Building and Real Estate at Hong Kong Polytechnic University, as well as the Research Institute of Complex Engineering & Management at Tongji University for providing support to conduct this research study. Special thanks go to Dr. K. N. Jha and Dr. S.Z.S. Tabish at Indian Institute of Technology, Delhi, India, for permitting the use of their questionnaire instrument. The authors would also like to appreciate the contributions of all professionals involved in the survey.

References

- Aibinu, A. A., and Al-Lawati, A. M. (2010). "Using PLS-SEM technique to model construction organizations' willingness to participate in e-bidding." *Auto. Constr.*, 19(6), 714–724.
- Alam, M. S. (1989). "Anatomy of corruption: An approach to the political economy of underdevelopment." *Am. J. Econ. Sociol.*, 48(4), 441–456.
- Alston, J. P. (1989). "Wa, guanxi, and inhwa: Managerial principles in Japan, China, and Korea." *Bus. Horizons*, 32(2), 26–31.
- Alutu, O. E. (2007). "Unethical practices in Nigerian construction industry: Prospective engineers' viewpoint." *J. Prof. Issues Eng. Educ. Pract.*, 10.1061/(ASCE)1052-3928(2007)133:2(84), 84–88.
- Alutu, O. E., and Udhawuwe, M. L. (2009). "Unethical practices in Nigerian engineering industries: Complications for project management." *J. Manage. Eng.*, 10.1061/(ASCE)0742-597X(2009)25:1(40), 40–43.
- Appelbaum, D., and Lawton, S. (1990). *Ethics and the professions*, Prentice-Hall, Englewood Cliffs, NJ.
- Argandona, A. (2001). "Corruption: The corporate perspective." *Bus. Ethics Eur. Rev.*, 10(2), 163–175.
- Bagozzi, R. P., and Yi, Y. (1988). "On the evaluation of structural equation models." *J. Acad. Market. Sci.*, 16(1), 74–94.
- Bologna, R., and Del Nord, R. (2000). "Effects of the law reforming public works contracts on the Italian building process." *Build. Res. Inf.*, 28(2), 109–118.
- Bowen, P., Akintoye, A., Pearl, R., and Edwards, P. J. (2007a). "Ethical behaviour in the South African construction industry." *Constr. Manage. Econ.*, 25(6), 631–648.
- Bowen, P., Pearl, R., and Akintoye, A. (2007b). "Professional ethics in the South African construction industry." *Build. Res. Inf.*, 35(2), 189–205.
- Bowen, P. A., Edwards, P. J., and Cattell, K. (2012). "Corruption in the South African construction industry: A thematic analysis of verbatim comments from survey participants." *Constr. Manage. Econ.*, 30(10), 885–901.
- Brent, R. J. (2009). "Cost-benefit analysis and the evaluation of the effects of corruption on public projects." *Handbook of research on cost-benefit analysis*, Edward Elgar Publishing, Cheltenham, U.K., Northampton, MA, 388–413.
- Cenfetelli, R. T., and Bassellier, G. (2009). "Interpretation of formative measurement in information systems research." *MIS Q.*, 33(4), 689–708.
- Chan, A. P., Lam, P. T., Chan, D. W., Cheung, E., and Ke, Y. (2010). "Critical success factors for PPPs in infrastructure developments: Chinese perspective." *J. Constr. Eng. Manage.*, 10.1061/(ASCE)CO.1943-7862.0000152, 484–494.

- Chan, W. K., Wong, F. K., and Scott, D. (1999). "Managing construction projects in China-the transitional period in the millennium." *Int. J. Proj. Manage.*, 17(4), 257–263.
- Choi, T. N., Chan, D. W., and Chan, A. P. (2011). "Perceived benefits of applying pay for safety scheme (PFSS) in construction—A factor analysis approach." *Safety Sci.*, 49(6), 813–823.
- Conway, J. M., and Huffcutt, A. I. (2003). "A review and evaluation of exploratory factor analysis practices in organizational research." *Organ. Res. Meth.*, 6(2), 147–168.
- de Jong, M., Henry, W. P., and Stansbury, N. (2009). "Eliminating corruption in our engineering/construction industry." *Leadership Manage. Eng.*, 10.1061/(ASCE)1532-6748(2009)9:3(105), 105–111.
- Doig, A. (1997). "The privatisation of the property services agency: risk and vulnerability in contract-related fraud and corruption." *Publ. Policy Adm.*, 12(3), 6–27.
- Dziuban, C. D., and Shirkey, E. C. (1974). "When is a correlation matrix appropriate for factor analysis? Some decision rules." *Psychol. Bull.*, 81(6), 358–361.
- Ehrlich, I., and Francis, T. L. (1999). "Bureaucratic corruption and endogenous economic growth." *J. Polit. Econ.*, 107(S6), S270–S293.
- El-Sayegh, S. M. (2008). "Risk assessment and allocation in the UAE construction industry." *Int. J. Proj. Manage.*, 26(4), 431–438.
- Fan, Y. (2002). "Guanxi's consequences: Personal gains at social cost." *J. Bus. Ethics*, 38(4), 371–380.
- Guo, Z., and Yang, M. (2008). "New standards of payment for the site supervisors and the corresponding strategies." *Project Manage.*, 59(4), 46–47 (in Chinese).
- Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., and Tatham, R. L. (2010). *Multivariate data analysis*, Prentice Hall, Upper Saddle River, NJ.
- Hair, J. F., Ringle, C. M., and Sarstedt, M. (2011). "PLS-SEM: Indeed a silver bullet." *J. Market. Theo. Pract.*, 19(2), 139–151.
- Haque, N. U., and Sahay, R. (1996). "Do government wage cuts close budget deficits? Costs of corruption." *Staff papers—International monetary fund*, Palgrave Macmillan, Hants, U.K., 754–778.
- Harboon, D., and Heinrich, F. (2011). *Bribe payers index 2011*, Transparency International, Berlin.
- He, Z. (2000). "Corruption and anti-corruption in reform China." *Comm. Post Commun. Stud.*, 33(2), 243–270.
- Henseler, J., Ringle, C., and Sinkovics, R. (2009). "The use of partial least squares path modeling in international marketing." *Adv. Int. Market.*, 20, 277–320.
- Hon, C. K. H., Chan, A. P. C., and Yam, M. C. H. (2012). "Empirical study to investigate the difficulties of implementing safety practices in the repair and maintenance sector in Hong Kong." *J. Constr. Eng. Manage.*, 10.1061/(ASCE)CO.1943-7862.0000497, 877–884.
- Hsueh, P. R., et al. (2009). "Consensus statement on the management of invasive candidiasis in intensive care units in the Asia-Pacific Region." *Int. J. Antimicrob. Agents*, 34(3), 205–209.
- Hwang, B. G., Zhao, X., and Ng, S. Y. (2013). "Identifying the critical factors affecting schedule performance of public housing projects." *Habitat Int.*, 38, 214–221.
- Jain, A. K. (2001). "Corruption: A review." *J. Econ. Surv.*, 15(1), 71–121.
- Kenny, C. (2009). "Transport construction, corruption and developing countries." *Transport Rev.*, 29(1), 21–41.
- Ko, K., and Weng, C. (2011). "Critical review of conceptual definitions of Chinese corruption: A formal-legal perspective." *J. Contemp. China*, 20(70), 359–378.
- Le, Y., Shan, M., Chan, A. P. C., and Hu, Y. (2014). "Overview of corruption research in construction." *J. Manage. Eng.*, 10.1061/(ASCE)ME.1943-5479.0000300, 02514001.
- Le, Y., Zhang, B., Guan, X., and Li, Y. (2013). "Collusion study of public investment projects based on SNA." *J. Public Manage.*, 10(3), 29–40 (in Chinese).
- Lee, S. H., Oh, K., and Eden, L. (2010). "Why do firms bribe?" *Manage. Int. Rev.*, 50(6), 775–796.
- Legal Daily. (2012). "Corruption tricks in the construction sector, revealed by the prosecutors." (http://www.legaldaily.com.cn/bm/content/2012-08/29/content_3800902.htm?node=20736) (Dec. 20, 2013).
- Levy, R. (2000). "FUBAI: Differing Chinese views of corruption since Tiananmen: Does a road paved with corruption lead to socialism?" *Int. J. Public Adm.*, 23(11), 1863–1898.
- Li, Y., Le, Y., Zhang, B., and Shan, M. (2013). "The correlations among corruption severity, power and behavior features in construction industry: An empirical study based on 148 typical cases." *Manage. Rev.*, 25(8), 21–31 (in Chinese).
- Ling, F. Y., Ning, Y., Ke, Y., and Kumaraswamy, M. M. (2013). "Modeling relational transaction and relationship quality among team members in public projects in Hong Kong." *Auto. Constr.*, 36, 16–24.
- Ling, F. Y. Y., and Tran, P. Q. (2012). "Effects of interpersonal relations on public sector construction contracts in Vietnam." *Constr. Manage. Econ.*, 30(12), 1087–1101.
- Liu, A. M., Fellows, R., and Ng, J. (2004). "Surveyors' perspectives on ethics in organisational culture." *Eng. Construct. Architect. Manage.*, 11(6), 438–449.
- Méon, P., and Sekkat, K. (2005). "Does corruption grease or sand the wheels of growth?" *Publ. Choice*, 122(1–2), 69–97.
- Mo, P. H. (2001). "Corruption and economic growth." *J. Comp. Econ.*, 29(1), 66–79.
- Mohamed, S. (2002). "Safety climate in construction site environments." *J. Constr. Eng. Manage.*, 10.1061/(ASCE)0733-9364(2002)128:5(375), 375–384.
- Moodley, K., Smith, N., and Preece, C. N. (2008). "Stakeholder matrix for ethical relationships in the construction industry." *Constr. Manage. Econ.*, 26(6), 625–632.
- National Bureau of Statistics of China. (2012). "China statistical yearbook." (<http://www.stats.gov.cn/tjsj/ndsj/2012/indexch.htm>) (Dec. 10, 2013).
- Neelankavil, J. P. (2002). "International business corruption: A framework of causes, effects, and prescriptions." *28th European Int. Business Academy Conf.*, European International Business Academy, Brussels, Belgium.
- Ning, Y. (2014). "Quantitative effects of drivers and barriers on networking strategies in public construction projects." *Int. J. Proj. Manage.*, 32(2), 286–297.
- Ning, Y., and Ling, F. (2013). "Reducing hindrances to adoption of relational behaviors in public construction projects." *J. Constr. Eng. Manage.*, 10.1061/(ASCE)CO.1943-7862.0000745, 04013017.
- Norusis, M. J. (2008). *SPSS 16.0 advanced statistical procedures companion*, Prentice-Hall, Upper Saddle River, NJ.
- Nye, J. S. (1967). "Corruption and political development: A cost-benefit analysis." *Am. Polit. Sci. Rev.*, 61(2), 417–427.
- Reinartz, W., Haenlein, M., and Henseler, J. (2009). "An empirical comparison of the efficacy of covariance-based and variance-based SEM." *Int. J. Res. Market.*, 26(4), 332–344.
- Ringle, C., Sarstedt, M., and Straub, D. (2012). "A critical look at the use of PLS-SEM in MIS Quarterly." *MIS Q.*, 36(1), iii–xiv.
- Rose-Ackerman, S. (2008). "Briefing: Risks of corruption in government infrastructure projects." *Proc. Inst. Civ. Eng. Munic. Eng.*, 161(3), 149–150.
- Schein, E. H. (2006). *Organizational culture and leadership*, 3rd Ed., Jossey-Bass, San Francisco.
- Sha, K. (2004). "Construction business system in China: An institutional transformation perspective." *Build. Res. Inf.*, 32(6), 529–537.
- Sims, R. R. (1992). "The challenge of ethical behavior in organizations." *J. Bus. Ethics*, 11(7), 505–513.
- Sims, R. R. (2000). "Changing an organization's culture under new leadership." *J. Bus. Ethics*, 25(1), 65–78.
- Sohail, M., and Cavill, S. (2008). "Accountability to prevent corruption in construction projects." *J. Constr. Eng. Manage.*, 10.1061/(ASCE)0733-9364(2008)134:9(729), 729–738.
- Southern Metropolis Daily. (2013). "The administrative authorizations in Guangdong may continue to be reduced in next month." (http://epaper.oeeee.com/A/html/2013-11/26/content_1978414.htm) (Jan. 10, 2014).
- Statistical Package for the Social Sciences 17.0 [Computer software]. SPSS Incorporated, Chicago, IL.

- Tabish, S., and Jha, K. N. (2011). "Analyses and evaluation of irregularities in public procurement in India." *Constr. Manage. Econ.*, 29(3), 261–274.
- Tabish, S., and Jha, K. N. (2012). "The impact of anti-corruption strategies on corruption free performance in public construction projects." *Constr. Manage. Econ.*, 30(1), 21–35.
- Tanzi, V. (1998). "Corruption around the world: Causes, consequences, scope, and cures." *Staff Papers-International Monetary Fund*, Palgrave Macmillan, Hants, U.K., 559–594.
- Tanzi, V., and Davoodi, H. (1998). *Corruption, public investment, and growth*, H. Shibata and T. Iori, eds., Springer, Tokyo, Japan, 41–60.
- Treisman, D. (2000). "The causes of corruption: A cross-national study." *J. Public Econ.*, 76(3), 399–457.
- Vee, C., and Skitmore, C. (2003). "Professional ethics in the construction industry." *Eng. Construct. Architect. Manage.*, 10(2), 117–127.
- Wetzels, M., Odekerken-Schroder, G., and van Oppen, C. (2009). "Using PLS path modeling for assessing hierarchical construct models: guidelines and empirical illustration." *MIS Q.*, 33(1), 177–195.
- Xinhua Net. (2011). "More efforts will be imposed on the investigation of corruption in public construction sector in China." (http://news.xinhuanet.com/legal/2011-05/17/c_121426891.htm) (Dec. 10, 2013).
- Xinhua Net. (2014). "The truth behind commuting sentences: Bribing the staffs of judicial department and making misjudged cases." (http://news.xinhuanet.com/politics/2014-03/15/c_126270268.htm) (Apr. 8, 2014).
- Yang, M. M. (1994). *Gifts, favors, and banquets: The art of social relationships in China*, Cornell University Press, Ithaca, NY.
- Zarkada-Fraser, A. (2000). "A classification of factors influencing participating in collusive tendering agreements." *J. Bus. Ethics*, 23(3), 269–282.
- Zarkada-Fraser, A., and Skitmore, M. (2000). "Decisions with moral content: Collusion." *Constr. Manage. Econ.*, 18(1), 101–111.
- Zhao, X., Hwang, B. G., and Low, S. P. (2013). "Critical success factors for enterprise risk management in Chinese construction companies." *Constr. Manage. Econ.*, 31(12), 1199–1214.
- Zhao, X., Hwang, B. G., and Low, S. P. (2014). "Investigating enterprise risk management maturity in construction firms." *J. Constr. Eng. Manage.*, 10.1061/(ASCE)CO.1943-7862.0000873, 05014006.
- Zou, P. X., Fang, D., Wang, S. Q., and Loosemore, M. (2007). "An overview of the Chinese construction market and construction management practice." *J. Technol. Manage. China*, 2(2), 163–176.