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From chaos to compliance: Standards-setting and financial fraud

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ABSTRACT

Limited research has explored the impact of national or industry standards-setting on corporate behavior. In this study, we provide empirical evidence on the negative effect of corporate standards-setting on financial fraud by analyzing manually collected data on the counts and citations of national and industry standards among Chinese listed companies. Our findings reveal that this suppression effect is robust by applying the instrumental variable approach. Our analysis further highlights that corporate standards-setting inhibit financial fraud primarily by increasing the market value of firms, enhancing innovation capacity, sending positive signals, and enabling companies to obtain government subsidies. These results emphasize the critical role of corporate standards-setting in combating financial fraud in emerging markets like China.

"First-class enterprises create standards, second-class enterprises build brands, and third-class enterprises produce products."

1. Introduction

Standards play a pivotal role in promoting economic development and enhancing the quality of life (Blind et al., 2017). Standards not only regulate market competition and safeguard intellectual property rights but also facilitate the rapid transformation of new technologies into products that can be manufactured on a large scale, leading to societal benefits. Scholars have devoted considerable attention to patents and have analyzed the various macro, market, and micro factors that impact corporate innovation and its economic implications (He and Tian, 2018). However, the study of companies' conduct in the standard-setting process is still relatively limited. Only a few researchers have examined the motives of individuals or organizations to participate in standard development, relying on case studies and questionnaires (Blind et al., 2018). Research on the economic consequences of standards is even scarcer, and the few available studies have mainly focused on the innovation effects of standards, as well as their interaction with patents and papers (Zhang et al., 2020; Di and Yuan, 2021; Blind et al., 2022). Regrettably, there is currently no literature exploring the impact and mechanisms of standard setting on financial fraud.

This research aims to address a gap in the literature by examining the influence of the quantity and quality of standard setting on financial fraud using data from Chinese publicly traded companies. By manually collecting data on financial fraud cases and the firms' national and industry standards from 2007 to 2021, we find a negative relationship between the quantity and quality of standards and

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financial misconduct. Additionally, this association is robust and consistent when employing instrumental variable methodology. Finally, we propose and test four mechanisms include improving the firm's market value, motivating technological innovation, releasing positive signals to attract the attention of potential investors, and facilitating access to government subsidies.

There are three ways in which this paper can contribute to the field of research. Firstly, this study is the first to formally investigate the role of standards-setting in financial fraud, which addresses a significant gap in the existing literature. We presents novel data on the link between standard setting and financial misconduct, which is a significant contribution to the literature. Secondly, to measure the quantity and quality of standards, we developed a methodology based on the construction of patent quantity and quality. Thirdly, we propose four mechanisms include improving market value, promoting innovation, releasing positive signals, and obtaining government subsidies.

2. Literature review and research hypotheses

Standards can be defined as a consensus that has been established among different agents based on mutually agreed-upon rules (Nickerson and Muehlen, 2006; Scott and Orlikowski, 2022). Technical standards, on the other hand, can be regarded as a set of specifications that cover all aspects of a specific range of products, processes, formats, or procedures that must adhere to a specific set of criteria. The function of technical standards can be understood from both production and consumer perspectives. In terms of production, technical standards represent a synthesis of well-established concepts in design and production, which enables the organization of the hierarchical structure and functional parameters of specific product types. From a consumer perspective, technical standards reflect the desire to reach agreements on unified technical formats, thereby allowing for the integration and interchangeability of various products (Narayanan and Chen, 2012). Essentially, technical standards represent a collective choice that balances consumer utility, technological possibilities, manufacturer costs, and the constraints imposed by political, social, and economic institutions (Hu and Liu, 2022).

Companies use standards for several purposes, including market access, quality enhancement, and risk mitigation (Blind and Mangelsdorf, 2016). Firstly, standardization simplifies quality assurance and communication between companies and customers, resulting in improved customer satisfaction and loyalty. This can ultimately lead to increased sales and revenue for the company. Furthermore, standardization facilitates exports by ensuring that products meet international quality standards, allowing companies to expand into new markets. Secondly, supply chains also benefit from standardization, with most companies reporting benefits in their tendering processes such as increased efficiency, cost savings, and a reduction in manufacturing errors. Additionally, standardization can enhance the quality of subcontracts, ensuring that suppliers meet the required standards. Moreover, companies can reduce negative environmental impacts by adopting eco-friendly practices and complying with regulations, which can improve their public image and reputation. Finally, companies participate in standard-setting committees to influence standards, network with other experts, and gain early access to upcoming standards, which can provide a competitive advantage and contribute to their long-term success.

Participation in standard setting can enable market control effects. When a company incorporates its patented technology into a standard, it gains the ability to regulate the use of its technology in the standard by using various methods, such as refusing to license, charging high license fees, charging license fees fairly and without discrimination, and engaging in cross-licensing or free licensing (Tanaka and Chen, 2013; Fontagné et al., 2019). Irrespective of the specific method used, the company leading the standard setting process can leverage its position to gain market power and create a monopolistic situation. Hussinger and Schwiebacher (2015) conducted an investigation on the impact of participation in Standard Setting Organizations on market value. The authors found that disclosure of patented information to Standard Setting Organizations and participation in them can lead to an increase in market value, despite the potential risks associated with disclosures. In a related study, Miller and Toh (2022) analyzed the relationship between ownership of Standard Essential Patents and financial performance. They found evidence to suggest that owning Standard Essential Patents can enhance a company's performance. In summary, the following research hypotheses are proposed:

H1: ***Standards-setting discourages financial fraud by enhancing firm value.***

Standards have been found to have a positive impact on innovation. This is because the norms already embedded within standards can effectively circumscribe the scope of genuinely inventive activities. Thus, firms can concentrate on truly innovative areas, without needing to design standard components or interfaces. By utilizing a unified platform provided by technical standards, technology can quickly and efficiently transition from the laboratory to the field of production (Delmas and Pekovic, 2013; Zhang et al., 2020). Standardization and technological progress have a close relationship, complementing and promoting each other. Standardization acts as a critical "bridge" for the transformation of scientific and technological achievements into productivity. By utilizing standardized means, advanced scientific and technological achievements can be transformed into productivity, thus promoting social progress.

Participation in standardization activities also offers the following benefits to innovation: First, participation in standardization activities facilitates the establishment of network relationships with potential competitors, suppliers, customers, and other innovators by firms. Second, by contributing to technical standards, firms are encouraged to share their technology, thereby triggering knowledge spillover effects. Third, standardization activities offer firms an opportunity to gain early access to forthcoming standards. This allows member firms to prepare their products in advance, minimizing the need for significant modifications to comply with standards and reducing associated costs. Fourth, firms can influence the development of standards, rendering them adaptable to existing products, markets that interest them, or technology. Fifth, Core patents are often the technology required to comply with standards, providing firms with advantages or additional revenue streams (Blind and Mangelsdorf, 2016). Based on the above analysis, the following

research hypotheses are proposed:

H2: ***Standards-setting discourages financial fraud by motivating innovation.***

The development of standards prevents disorderly competition in the industry by eliminating companies that do not meet the standards, and increases the competition threshold, thus promoting the overall development of the industry and improving product quality. From a public perception standpoint, companies that participate in standardization activities are perceived to have high reputations in the industry, strong technological capabilities, and at a certain level, government recognition (Egli et al., 2006; Teubner et al., 2021). This participation enhances their trust and authority with the public.

In addition, considering that standards development is a public activity with government participation, the companies involved in standards development will go through a rigorous selection process. These companies are subject to strict government and public scrutiny, which can also significantly increase the cost of corporate misconduct (Ayers et al., 2011). Therefore, the third hypothesis is proposed:

H3: ***Standards-setting discourages financial fraud by signal effects.***

The engagement of firms in the standard-setting process indicates a robust innovation capability, enabling them to foster a positive reputation and elevate their corporate image (Rotolo et al., 2022). The transparent nature of standards serves as a trustworthy indicator of the company's interests to stakeholders, thereby facilitating the promotion of new technologies, products, and services while mitigating ambiguity concerning the value of technological innovation for the firm. Moreover, the prestige and network garnered through active participation in the standard-setting process can aid firms in securing government subsidies.

The government provides rewards and incentives for companies that participate in standardization efforts (Lu et al., 2020; Li and Li, 2021). Companies are encouraged to engage in standard development and revision work and may receive financial subsidies from local governments. Moreover, companies involved in producing and revising standards can benefit from various policy incentives, including the declaration of high-tech enterprises, designation as technology center enterprises, and participation in intellectual property pilot projects. In summary, the last hypothesis of this paper is as follows:

H4: ***Standards-setting discourages financial fraud by obtaining government subsidies.***

3. Research design

3.1. Samples and data

This study focuses on Chinese A-share listed companies that were traded on the Shanghai Stock Exchange and Shenzhen Stock Exchange between 2007 and 2021. The initial research sample was processed as follows: Firstly, we included companies that were subject to special treatment (ST, PT) as a significant proportion of financial fraud cases are often accompanied by such treatment. This helped ensure the sample was unbiased. Secondly, samples with missing values were excluded. Finally, continuous variables were winsorized at the 1% and 99% levels to reduce the interference of outliers. The resulting sample comprises 40,600 firm-year observations and is appropriate for investigating the impact of corporate standards setting on financial fraud.

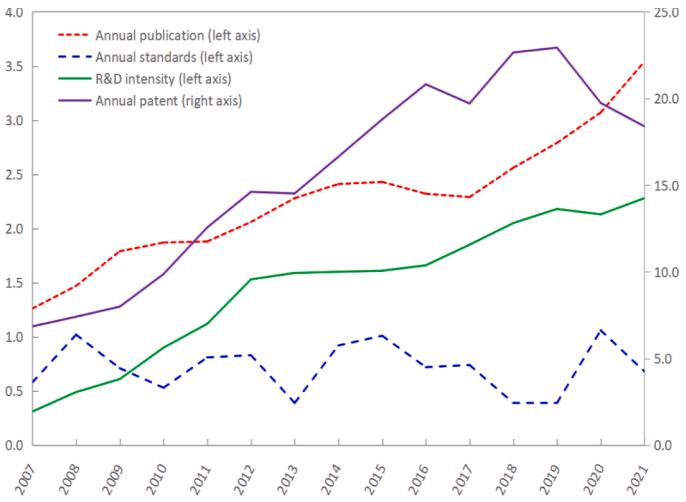

Fig. 1. Trends in standard setting, academic publishing and patenting: Chinese listed firms, 2007–2021.

3.2. Variables

3.2.1. Corporate standards quantity and quality

We constructed the quantity and quality of standards by referring to the method used for constructing the quantity and quality of enterprise patents in existing studies. In this paper, we collected data on national and industry standards that were drafted by all A-share listed companies and their subsidiaries in China from previous years, solely through manual search on the ChaoXingFaXian Database ("超星发现"). In addition, we collected data on how each standard was cited by other standards. To the best of our knowledge, this dataset has not been previously addressed in existing studies.

Fig. 1 displays the annual trends of standards, R&D intensity, patents, and publications for Chinese listed companies from 2007 to 2021. In contrast to the consistent growth trend observed in the intensity of corporate R&D investment, patents, and papers, corporate standards show a clear pattern of fluctuation. This suggests that participation in standards-setting has not yet received sufficient attention from Chinese enterprises. Thus, investigating the motivation behind standard setting and its economic consequences is an issue of significant interest.

3.2.2. Corporate financial frauds

We developed two outcome variables, *FinFraud_Dum* and *FinFraud_Num*, to quantify the degree of corporate financial fraud. *FinFraud_Dum* is an indicator variable that equals 1 if the company engaged in any financial fraud cases during the year, while *FinFraud_Num* represents the number of cases in which the firm was involved in financial fraud during the same period. It is worth noting that the financial fraud indicators reflect the events occurring in the respective year.

3.3. Empirical model

Our aim is to quantify the impact of the breadth and depth of corporate standards setting on the probability of financial fraud. To accomplish this, we utilize Probit and Poisson regressions as follows:

$$\begin{aligned} Probit\left(FinFraud\_Dum_{i,t}\right) = {} & \alpha_0 + \alpha_1 \times Ln\left(Total\_Standard\_Num_{i,t-1}\left(Total\_Standard\_Cite_{i,t-1}\right)\right) + \alpha_2 \times R\&D/Assets_{i,t-1} \\ & + \alpha_3 \times R\&D\_Missing_{i,t-1} + \alpha_4 \times Ln\left(Assets_{i,t-1}\right) + \alpha_5 \times Firm\_Age_{i,t-1} + \alpha_6 \times Leverage_{i,t-1} \\ & + \alpha_7 \times M/B\_Ratio_{i,t-1} + \alpha_8 \times ROA_{i,t-1} + \alpha_9 \times Sales\_Growth_{i,t-1} + \alpha_{10} \times Stock\_Return_{i,t-1} \\ & + \alpha_{11} \times Stock\_Volatility_{i,t-1} + \alpha_{12} \times Ln\left(Board\_Size_{i,t-1}\right) + \alpha_{13} \times Institute\_Ratio_{i,t-1} \\ & + \alpha_{14} \times Ind\_Dire\_Ratio_{i,t-1} + \alpha_{15} \times Ln\left(TMT\_Salary_{i,t-1}\right) + \alpha_{16} \times Top10Share\_HHI_{i,t-1} \\ & + \alpha_{17} \times Big4\_Audit_{i,t-1} + \alpha_{18} \times Ln\left(Analysts_{i,t-1}\right) + \alpha_{19} \times Market\_Index_{i,t-1} + Firm + Year + \varepsilon_{i,t} \end{aligned} \tag{1}$$

Table 1
Summary statistics.

Variable	Whole sample (N = 40,600)			Firms without standards (N = 31,915)	Firms with standards (N = 8685)
	Mean (1)	Median (2)	SD (3)	Mean (4)	Mean (5)
(a)Measures of corporate financial fraud variables.					
FinFraud_Dum	0.1811	0.0000	0.3851	0.1904	0.1470***
FinFraud_Num	0.4526	0.0000	1.4221	0.4842	0.3364***
(b)Measures of corporate standard variables.					
Ln_Tot_Standard_Num	0.2527	0.0000	0.5659	0.0000	1.1815***
Ln_Tot_Standard_Cite	0.0968	0.0000	0.4875	0.0000	0.4527***
(c)Measures of control variables.					
R&D/Assets	1.6457	1.1722	1.9339	1.5385	2.0397***
R&D_Missing	0.2324	0.0000	0.4224	0.2634	0.1188***
Ln(Assets)	15.2293	14.9940	1.5246	15.0675	15.8235***
Firm_Age	19.0704	19.0000	6.2520	19.0599	19.1092
Leverage	0.4477	0.4344	0.2295	0.4397	0.4774***
M/B_Ratio	0.6170	0.6171	0.2492	0.6057	0.6587***
ROA	0.0493	0.0515	0.0840	0.0484	0.0524***
Sales_Growth	0.2202	0.1138	0.7395	0.2271	0.1947***
Stock_Return	0.1542	-0.0317	0.7363	0.1583	0.1390**
Stock_Volatility	0.0307	0.0289	0.0101	0.0309	0.0299***
Ln(Board_Size)	2.2521	2.3026	0.1884	2.2446	2.2799***
Institute_Ratio	0.4473	0.4651	0.2444	0.4339	0.4966***
Ind_Dire_Ratio	37.4342	34.3100	5.4264	37.4361	37.4270
Ln(TMT_Salary)	5.9504	5.9529	0.8953	5.8936	6.1593***
Top10Share_HHI	0.1617	0.1314	0.1165	0.1585	0.1735***
Big4_Audit	0.0656	0.0000	0.2477	0.0523	0.1148***
Ln(Analysts)	1.3814	1.3863	1.1946	1.2868	1.7292***
Market_Index	9.9045	10.1130	3.5687	9.8469	10.1162***

$$\begin{aligned} Poisson\left(FinFraud\_Num_{i,t}\right) = {} & \alpha_0 + \alpha_1 \times Ln\left(Total\_Papers\_Num_{i,t-1}\left(Total\_Papers\_Cite_{i,t-1}\right)\right) + \alpha_2 \times R\&D/Assets_{i,t-1} \\ & + \alpha_3 \times R\&D\_Missing_{i,t-1} + \alpha_4 \times Ln\left(Assets_{i,t-1}\right) + \alpha_5 \times Firm\_Age_{i,t-1} + \alpha_6 \times Leverage_{i,t-1} \\ & + \alpha_7 \times M/B\_Ratio_{i,t-1} + \alpha_8 \times ROA_{i,t-1} + \alpha_9 \times Sales\_Growth_{i,t-1} + \alpha_{10} \times Stock\_Return_{i,t-1} \\ & + \alpha_{11} \times Stock\_Volatility_{i,t-1} + \alpha_{12} \times Ln\left(Board\_Size_{i,t-1}\right) + \alpha_{13} \times Institute\_Ratio_{i,t-1} \\ & + \alpha_{14} \times Ind\_Dire\_Ratio_{i,t-1} + \alpha_{15} \times Ln\left(TMT\_Salary_{i,t-1}\right) + \alpha_{16} \times Top10Share\_HHI_{i,t-1} \\ & + \alpha_{17} \times Big4\_Audit_{i,t-1} + \alpha_{18} \times Ln\left(Analysts_{i,t-1}\right) + \alpha_{19} \times Market\_Index_{i,t-1} + Firm + Year + \varepsilon_{i,t} \end{aligned} \quad (2)$$

Our regression models include regression coefficients represented by α and an error term represented by ε. We use *FinFraud_Dum* and *FinFraud_Num* as dependent variables and proxies for corporate financial frauds. Our main test variables, Ln(*Total_Standard_Num*) and Ln(*Total_Standard_Cite*), measure the quantity and quality of national and industry standards, respectively. We include several controls, such as *R&D/Assets, R&D_Missing*, Ln(*Assets*), *Firm_Age, Leverage, M/B_Ratio, ROA, Sales_Growth, Stock_Return, Stock_Volatility*, Ln(*Board_Size*), *Institute_Ratio, Ind_Dire_Ratio*, Ln(*TMT_Salary*), *Top10Share_HHI, Big4_Audit*, Ln(*Analysts*), and *Market_Index*, to isolate the influence of standards-setting on financial fraud. Our regression models also incorporate firm and year fixed effects.

3.4. Descriptive statistics

Table 1 presents summary statistics for the main variables. On average, 18.11% of firms are involved in at least one type of financial

Table 2
Effects of standards-setting on financial frauds.

	FinFraud_Dum		*FinFraud_Num*	
	Probit	Probit	Poisson	Poisson
	(1)	(2)	(3)	(4)
Ln_Tot_Standard_Num	-0.1002***		-0.2286***	
	(0.0206)		(0.0440)	
Ln_Tot_Standard_Cite		-0.0801***		-0.2037***
		(0.0221)		(0.0477)
R&D/Assets	-0.0343***	-0.0369***	-0.0904***	-0.0969***
	(0.0075)	(0.0076)	(0.0174)	(0.0176)
R&D_Missing	-0.1274***	-0.1157***	-0.2206***	-0.2007**
	(0.0345)	(0.0344)	(0.0826)	(0.0829)
Ln(Assets)	0.0299*	0.0231	0.1195***	0.1069***
	(0.0157)	(0.0155)	(0.0372)	(0.0372)
Firm_Age	-0.0045*	-0.0046*	-0.0060	-0.0064
	(0.0026)	(0.0026)	(0.0058)	(0.0058)
Leverage	0.3333***	0.3313***	0.3062**	0.2988**
	(0.0650)	(0.0651)	(0.1517)	(0.1512)
M/B_Ratio	-0.4540***	-0.4479***	-0.7930***	-0.7823***
	(0.0597)	(0.0597)	(0.1282)	(0.1284)
ROA	-1.6218***	-1.6132***	-2.1714***	-2.1717***
	(0.1260)	(0.1260)	(0.2050)	(0.2060)
Sales_Growth	0.0517***	0.0528***	0.1041***	0.1062***
	(0.0109)	(0.0109)	(0.0185)	(0.0185)
Stock_Return	-0.1155***	-0.1172***	-0.2568***	-0.2613***
	(0.0120)	(0.0121)	(0.0295)	(0.0298)
Stock_Volatility	6.1190***	6.1108***	9.6430***	9.6609***
	(0.9573)	(0.9576)	(1.8851)	(1.8824)
Ln(Board_Size)	-0.1827**	-0.1835**	-0.3670*	-0.3757*
	(0.0823)	(0.0825)	(0.1914)	(0.1918)
Institute_Ratio	-0.2816***	-0.2899***	-0.3749**	-0.3912**
	(0.0659)	(0.0660)	(0.1630)	(0.1633)
Ind_Dire_Ratio	-0.0029	-0.0028	-0.0067	-0.0067
	(0.0025)	(0.0025)	(0.0052)	(0.0052)
Ln(TMT_Salary)	-0.0242	-0.0228	-0.1045***	-0.1017***
	(0.0176)	(0.0177)	(0.0362)	(0.0365)
Top10Share_HHI	-0.8020***	-0.7934***	-1.9190***	-1.9042***
	(0.1365)	(0.1366)	(0.3097)	(0.3105)
Big4_Audit	-0.2683***	-0.2664***	-0.6717***	-0.6686***
	(0.0655)	(0.0655)	(0.1537)	(0.1537)
Ln(Analysts)	-0.0222*	-0.0222*	-0.0621**	-0.0629**
	(0.0119)	(0.0119)	(0.0254)	(0.0254)
Market_Index	-0.0155***	-0.0158***	-0.0211*	-0.0218**
	(0.0048)	(0.0048)	(0.0109)	(0.0109)
Firm FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes
N	35,186	35,186	35,186	35,186
Pseudo R-squared	0.0548	0.0542	0.0842	0.0830
Log likelihood	-16,088	-16,099	-37,696	-37,745

fraud. Univariate tests show that the percentage of financial fraud in firms with standards (14.7%) is significantly lower than that in firms without standards (19.04%). In all three categories, the percentage of financial misconduct is significantly lower for enterprises with standards than for those without standards. The mean and standard deviation of Ln_*Total_Standard_Num* (*Ln_Total_Standard_Cite*) are 0.2527 and 0.5659 (0.0968 and 0.4875), respectively, indicating that the quantity and quality of corporate standards vary significantly. The sample distributions for all variables are consistent with existing research.

4. Empirical results

4.1. Standard setting and financial frauds

We examine the effects of a firm's quantity and quality of standards on the probability of financial fraud occurrence by utilizing Probit and Poisson models, based on the constructed financial fraud proxies. The regression output of the benchmark models in Eq. (1) and (2) is presented in Table 2. The results indicate a significant and negative relationship between Ln_*Tot_Standard_Num* (*Ln_Tot_Standard_Cite*) and both proxies of financial fraud, *FinFraud_Dum* and *FinFraud_Num*, with coefficients of -0.1002 (-0.0801) and -0.2286 (-0.2037), respectively. This finding demonstrates that standard setting reduces financial fraud, both statistically and economically.

4.2. Instrumental variable estimation

To address the issue of endogeneity, we proposed instrumental variables and constructed instrumental variable Probit models. Referring to Zhang et al. (2020) and Deng et al. (2022), we suggest two instrumental variables associated with a firm's standards but not related to financial fraud: Peer Effects (*Ln_Peer_Standards*) and Standard Accessibility (*Ln_Capital_Hours*). Ln_*Peer_Standards* represents the log of annual mean number of standards drafted by all other companies located in the same province and belonging to the same industry, while Ln_*Capital_Hours* represents the time cost to travel to Beijing, the capital of China.

As for Peer Effects (*Ln_Peer_Standards*), given the transparency associated with standard setting and the competitive advantages it confers, enterprises face peer pressure from potential competitors, prompting them to seek active participation in the standard-setting process. In addition, the selection of enterprises to participate in standard setting is primarily based on their technological standing, meaning that the involvement of peer enterprises does not significantly affect the financial fraud motivation of enterprises, nor does it lead to a notable impact on financial fraud.

The China National Standardization Administration Committee was established in 2001 to manage the development of standards throughout the country and is headquartered in the capital city of Beijing. According to Deng et al. (2022), we have developed Standard Accessibility (*Ln_Capital_Hours*) as an instrument variable for corporate standards. Standard Accessibility is defined as the time cost for enterprises to travel to Beijing, the capital city. The rationale for this definition rests on two main points. First, formulating standards necessitates frequent communication among members. Enterprises closer to Beijing have lower transportation costs, which heightens their willingness to participate. Second, financial fraud mainly under the purview of the China Securities Regulatory Commission in Beijing, as well as the Shanghai and Shenzhen Stock Exchanges. Regulatory authorities are scattered, and there is no clear correlation between a company's distance from Beijing and the likelihood of financial fraud.

The results of the second-stage analysis of the IV Probit regressions are presented in Table 3. These two primary independent variables are now grounded in the first-stage regressions, which eliminates the concern of omitted variables in their explanatory power for financial fraud. The results of the weak instrumental variable test (Wald test) and the over-identification test (Amemiya-Lee-Newey test) demonstrating that the two instrumental variables are reasonable. The results indicate that instrumented Ln_*Tot_Standard_Num* and Ln_*Tot_Standard_Cite* are negatively associated with *FinFraud_Dum*, which establishes a causal explanation for our primary findings.

Table 3
Instrumental variable approach.

	1st Stage *Ln_Tot_Standard_Num* (1)	2nd Stage *FinFraud_Dum* (2)	1st Stage *Ln_Tot_Standard_Cite* (3)	2nd Stage *FinFraud_Dum* (4)
Ln_Tot_Standard_Num		-0.7144***		
		(0.2174)		
Ln_Tot_Standard_Cite				-2.1124***
				(0.6291)
Ln_Peer_Standards (IV-1)	0.0828***		0.0252***	
	(0.0137)		(0.0062)	
Ln_Capital_Hours (IV-2)	-0.0176***		-0.0065***	
	(0.0059)		(0.0024)	
Controls	yes	yes	yes	yes
Firm	yes	yes	yes	yes
Year	yes	yes	yes	yes
Wald test	7.77($p = 0.00$)		7.52($p = 0.00$)	
Amemiya-Lee-Newey test	2.37($p = 0.12$)		1.83($p = 0.18$)	
Observations	35,186	35,186	35,186	35,186

4.3. Potential mechanism

In this section, we explore the mechanisms by which the quantity and quality of standards reduce the likelihood of financial fraud by firms. First, we construct four mechanism variables, namely the firm's market value (*Tobin_Q*), scientific research output (*Ln_Tot_Papers*), the number of R&D related analyst reports (*Ln_R&D_News*), and the government R&D subsidy (*Ln_R&D_Subsidy*). Second, we examine the effects of the quantity and quality of the standards on these four impact mechanism variables separately. Finally, we introduce each of these four mechanism variables into the benchmark model to test if the quantity and quality of the standards deter corporate financial fraud through these four mechanisms. The results of the specific mechanism analysis are presented in Table 4, which show that the mechanism tests are significant and consistent with our expectations.

4.4. Heterogeneous tests

We investigate corporate heterogeneity by examining internal and external corporate governance, industry attributes, and environmental factors. Table 5 shows the results of heterogeneity analysis. Firstly, we compare domestic Chinese audit firms to international audit firms, finding that the latter maintain higher standards, place a higher value on their reputation, and are less likely to facilitate fraudulent behavior. Secondly, we find that Non-SOEs face greater financial and performance pressures and have stronger incentives to commit financial fraud than SOEs. Thirdly, high-tech firms have a greater incentive to manipulate their financial statements due to the high uncertainty of innovation and financial pressure. Then, we use lottery sales per capita in the province where the company is located to measure local gaming culture. The stronger the gaming culture, the higher the propensity for financial fraud. Finally, we find that if a company operates in a more competitive industry, it may choose to exaggerate its performance to gain a higher market value.

Table 4
. Mechanism tests.

Mechanism (1): Market value.						
	Tobin_Q		*FinFraud_Dum*		*FinFraud_Num*	
	OLS	OLS	Probit	Probit	Poisson	Poisson
	(1)	(2)	(3)	(4)	(5)	(6)
Ln_Tot_Standard_Num	0.0419*		-0.0992***		-0.2283***	
	(0.0245)		(0.0206)		(0.0438)	
Ln_Tot_Standard_Cite		0.0306**		-0.0799***		-0.2036***
		(0.0139)		(0.0221)		(0.0477)
Tobin_Q			-0.0190***	-0.0194***	-0.0400***	-0.0400***
			(0.0061)	(0.0061)	(0.0095)	(0.0095)
Mechanism (2): Innovation effects.						
	Ln_Tot_Papers		*FinFraud_Dum*		*FinFraud_Num*	
	OLS	OLS	Probit	Probit	Poisson	Poisson
	(1)	(2)	(3)	(4)	(5)	(6)
Ln_Tot_Standard_Num	0.4023***		-0.0788***		-0.1955***	
	(0.0244)		(0.0213)		(0.0457)	
Ln_Tot_Standard_Cite		0.2666***		-0.0639***		-0.1759***
		(0.0225)		(0.0222)		(0.0470)
Ln_Tot_Papers			-0.0624***	-0.0708***	-0.0991**	-0.1204***
			(0.0180)	(0.0176)	(0.0425)	(0.0413)
Mechanism (3): Signal effects.						
	Ln_R&D_News		*FinFraud_Dum*		*FinFraud_Num*	
	OLS	OLS	Probit	Probit	Poisson	Poisson
	(1)	(2)	(3)	(4)	(5)	(6)
Ln_Tot_Standard_Num	0.0208*		-0.1000***		-0.2279***	
	(0.0107)		(0.0206)		(0.0440)	
Ln_Tot_Standard_Cite		0.0266**		-0.0797***		-0.2014***
		(0.0120)		(0.0221)		(0.0478)
Ln_R&D_News			-0.0155	-0.0154	-0.1109**	-0.1097**
			(0.0254)	(0.0253)	(0.0448)	(0.0447)
Mechanism (4): R&D subsidy.						
	Ln_R&D_Subsidy		*FinFraud_Dum*		*FinFraud_Num*	
	OLS	OLS	Probit	Probit	Poisson	Poisson
	(1)	(2)	(3)	(4)	(5)	(6)
Ln_Tot_Standard_Num	0.3930***		-0.1050***		-0.2375***	
	(0.0507)		(0.0207)		(0.0439)	
Ln_Tot_Standard_Cite		0.2299***		-0.0824***		-0.2093***
		(0.0486)		(0.0221)		(0.0481)
Ln_R&D_Subsidy			-0.0134***	-0.0126***	-0.0268***	-0.0254***
			(0.0033)	(0.0033)	(0.0077)	(0.0077)

4.5. Sub-sample analysis

Considering that our sample encompasses the international financial crisis of 2008 and the anti-corruption campaign launched by President Xi Jinping after his inauguration in 2012, we intend to ensure the general applicability of our findings by performing sub-sample regression analyses. The global financial crisis is likely to have a substantial impact on the financing costs of firms, leading some to experience financial difficulties, which, in turn, may exacerbate the motivation for committing financial fraud. Moreover, the 2012 anti-corruption campaign has had an additional impact on companies in light of China's tightly-knit government-business nexus, thereby amplifying the risks of corporate financial fraud exposure. Table 6 presents the influence of corporate standards on financial fraud both pre and post the global financial crisis, as well as before and after the anti-corruption campaign. Our findings indicate that the principal conclusions of this study remain robust and are not significantly affected by either the global financial crisis or the anti-corruption campaign.

5. Conclusion

Based on data that was hand-collected on the number and citations of national and industry standards that were drafted by Chinese listed companies and their subsidiaries, this paper explores the impact and mechanism of the quantity and quality of standards on corporate financial fraud. The findings suggest that when firms participate in standards development, they are significantly less likely to commit financial fraud. This is because their participation in standards development helps to increase their value, stimulate innovation, send positive signals, and capture government support. This study fills a gap in the research on corporate standard setting and financial fraud. Furthermore, it provides new perspectives and inspiration for promoting high-quality development of listed companies and protecting the rights and interests of investors in emerging markets where the development of capital markets is still evolving.

Ethical approval

The manuscript was not submitted to multiple journals for consideration at the same time.
The submitted work is original and has not been published elsewhere in any form or language (in part or in whole).

Table 5
Cross-sectional heterogeneity effects of standards setting on financial frauds.

	FinFraud_Num Poisson (1)	*FinFraud_Num* Poisson (2)	*FinFraud_Num* Poisson (3)	*FinFraud_Num* Poisson (4)
(a)International auditing vs. Non-international auditing				
	Non-international	International	Non-international	International
Ln_Tot_Standard_Num	-0.2426***	0.0301		
	(0.0451)	(0.1634)		
Ln_Tot_Standard_Cite			-0.2291***	0.0574
			(0.0509)	(0.1319)
(b)SOE vs. Non SOE				
	Non SOE	SOE	Non SOE	SOE
Ln_Tot_Standard_Num	-0.2348***	-0.0500		
	(0.0483)	(0.0888)		
Ln_Tot_Standard_Cite			-0.2394***	-0.0427
			(0.0567)	(0.0750)
(c)High-tech firms vs. Low-tech firms				
	Low	High	Low	High
Ln_Tot_Standard_Num	-0.1630**	-0.3521***		
	(0.0743)	(0.1087)		
Ln_Tot_Standard_Cite			-0.2871	-0.5926***
			(0.1748)	(0.1856)
(d)High lottery culture vs. Low lottery culture				
	Low	High	Low	High
Ln_Tot_Standard_Num	-0.1625	-0.3140***		
	(0.1020)	(0.0736)		
Ln_Tot_Standard_Cite			-0.2588	-0.5934***
			(0.1658)	(0.1695)
(e)High competition vs. Low competition				
	Low	High	Low	High
Ln_Tot_Standard_Num	-0.1255	-0.4309***		
	(0.0932)	(0.0801)		
Ln_Tot_Standard_Cite			-0.2383	-0.6655***
			(0.1513)	(0.1784)

Table 6
Excluding international financial crisis (2008) and anti-corruption campaign (2012).

	FinFraud_Dum		*FinFraud_Num*	
	Probit	Probit	Poisson	Poisson
	(1)	(2)	(3)	(4)
(a)Only including the period before international financial crisis of 2008				
Ln_Tot_Standard_Num	-0.1053		-0.7349**	
	(0.1194)		(0.3208)	
Ln_Tot_Standard_Cite		-0.4318**		-1.1141*
		(0.2113)		(0.5890)
(b)Only including the period after international financial crisis of 2008				
Ln_Tot_Standard_Num	-0.1087***		-0.2446***	
	(0.0297)		(0.0704)	
Ln_Tot_Standard_Cite		-0.1150**		-0.3887**
		(0.0567)		(0.1530)
(c)Only including the period before anti-corruption campaign of 2012				
Ln_Tot_Standard_Num	-0.0946**		-0.2374***	
	(0.0389)		(0.0770)	
Ln_Tot_Standard_Cite		-0.0363		-0.1071**
		(0.0251)		(0.0522)
(d)Only including the period after anti-corruption campaign of 2012				
Ln_Tot_Standard_Num	-0.0986***		-0.2150***	
	(0.0234)		(0.0490)	
Ln_Tot_Standard_Cite		-0.1350***		-0.2666***
		(0.0391)		(0.0895)

Consent to participate

Not applicable

Consent to publish

Not applicable

Disclosure statement

The authors declare no conflict of interest.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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