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Do supply shocks in the audit partner labor market affect auditor choice? Evidence from a quasi-natural experiment

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ABSTRACT

We examine whether supply shocks in the audit partner labor market induce clients to switch audit partners. We argue that audit partners in their early careers (i.e., junior partners) charge low audit fees to attract clients, which induces client firms to switch from senior partners to junior partners when there are more junior partners available. Utilizing the Big4 localization policy, we find that Big4 clients are more likely to replace senior auditors with junior auditors to cut costs after the policy. Furthermore, the results are mainly driven by clients who are charged high fees. Our empirical evidence enriches the understanding of auditor choice determinants and informs the ongoing debates surrounding new regulations for Big4 firms in China.

1. Introduction

Recent reforms in corporate governance regulations and developments in the audit market motivate researchers to investigate the determinants and consequences of auditor choice and audit partner changes

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(Carson et al., 2012; DeFond and Zhang, 2014; Simnett et al., 2016; Stewart et al., 2016; Lennox and Wu, 2018).[1] Regulators and professional bodies are interested in audit partner changes because they consider that such changes assure audit independence, leading to improved audit quality and hence higher financial reporting quality (Laurion et al., 2017; Kuang et al., 2020). However, empirical research on the determinants of auditor changes at the partner level is limited due to a lack of data, as few jurisdictions require the disclosure of audit partners' names in audit reports (Laurion et al., 2017; Lennox and Wu, 2018). In addition, prior literature primarily focuses on the demand side of client firms, such as client firm characteristics, whereas the supply-side factors are largely overlooked (DeFond and Zhang, 2014; Lennox and Wu, 2018). In particular, the existing literature on the audit labor market primarily focuses on the effects on audit pricing and audit outcomes. However, the effects of supply shocks in the audit partner labor market on clients' choice of audit partners remain unexplored (Cascino et al., 2021; Lee et al., 2021).

This study aims to fill this gap in the literature by examining whether the increased supply of qualified audit partners leads to client firms switching their audit partner in the context of a unique setting, the Big4 localization policy, which requires Big4 accounting firms to promote more Chinese Institute of Certified Public Accountants (CICPA)-certified audit partners in China. In 2012, the Ministry of Finance (MOF) of China issued the regulation named the "Joint venture accounting firm localization plan." The preliminary objective of the localization plan is that audit partners without CICPA certification should make up less than 20% of both the total number of audit partners and the accounting firm management committee. Accordingly, the Big4 firms had five years (i.e., from 2012 to 2017) to change their audit partner structure to comply with the regulation. By the end of the five-year period, the Big4 audit firms had to reach the 20% threshold by recruiting more local audit partners. As a result, more audit partners were available for the Big4 firms, especially newly recruited junior partners.

We expect clients to change from senior to junior audit partners after the implementation of the Big4 localization policy based on three rationales. First, prior studies document that the level of experience of audit partners is significantly and positively associated with audit price (Cahan and Sun, 2015). Senior audit partners usually charge higher fees to reflect their experience, high-quality service and reputation (He et al., 2016). In contrast, junior audit partners have limited experience and reputation, and adopt a low-price strategy to attract clients and develop their portfolios (Cahan and Sun, 2015; Chang et al., 2021). With the increased supply of junior partners, clients are likely to change from senior to junior partners in search of lower audit fees (Cascino et al., 2021).[2] Second, senior audit partners may have high downward audit fee stickiness, [3]which leads to reluctance to decrease their audit fees. For example, senior partners may be unwilling to reduce their fees because discounting the fee for one client lead to other clients demanding lower fees, which could make senior audit partners feel that the fees received do not reflect their experience, high-quality service and reputation (Frankel et al., 2002; He et al., 2016). Third, if senior audit partners respond to the increased number of junior partners and the competitive pressure within audit firms by lowering their audit prices, this might create a "race to the bottom" in audit fees (Knechel, 2016).[4] After the implementation of the Big4 localization policy, the increase in junior partners who are likely to charge relatively low audit fees might create more significant competitive pressures. However, it is possible that senior audit partners are unwilling to adapt to this increased competitiveness by offering discounted fees. Based on these three rationales and given that auditor choice is mainly cost-driven in China (Huang et al., 2015; Huang et al., 2016),[5] we expect clients to change from senior audit partners to junior auditors, who may offer lower audit fees after the introduction of the policy.

Using a sample of 18,507 firm-year observations in the Chinese market between 2007 and 2017, we find that the increased audit partner supply caused by the Big4 localization policy leads to a significant increase in audit

[1] Following prior literature, we use the terms auditor and audit partner interchangeably (DeFond and Zhang, 2014; Lennox and Wu, 2018).

[2] Prior literature reports that less experienced CICPA auditors' audit quality is not significantly impaired in the Big4 firms, possibly due to quality control systems and their better understanding of the corporate governance environment in China (Chang et al., 2021).

[3] Following Chang et al. (2019), upward (downward) stickiness is defined as auditors' reluctance to increase (decrease) audit fees with an increase (a decline) in audit costs.

[4] The downward spiral channel is when prices (fees) are beaten down via competitive pressures and quality deteriorates, putting further downward pressure on prices (Knechel, 2016).

[5] The demand for high-quality audits is relatively low in Chinese listed companies (Chan et al., 2006; Chen et al., 2010).

partner switches within Big4 audit firms. This result suggests that clients are likely to switch from senior partners to junior partners in search of lower audit fees due to the increased supply of junior CICPA partners (Cascino et al., 2021; Chang et al., 2021). Consistent with this conjecture, we find that the increase in auditor switching is driven by client firms replacing senior audit partners with junior audit partners. Further analysis also shows that this effect is more pronounced in the subset of clients who are charged high audit fees. Together, these findings indicate that increased audit partner supply in Big4 audit firms induces clients to switch audit partners in response to cost-cutting incentives.

In our additional tests, we investigate the effect of the Big4 localization policy on the overall pricing of Big4 audit firms. If low-priced junior partners replace high-priced senior partners after the Big4 localization policy, we expect to observe that the overall audit price of Big4 audit firms decreases after the policy. Our investigation confirms that this is the case, adding supplementary evidence supporting our main tests of auditor switching.

Finally, we ask what the consequence of the Big4 localization policy is for audit quality. On the one hand, the policy could have a negative impact on audit quality as junior partners' audit quality is lower than that of senior auditors (Lee et al., 2019). Moreover, lower audit price generally indicates lower audit quality (Hribar et al., 2014). On the other hand, Chang et al. (2021) report that the quality of junior partners' audit services is not significantly impaired in the Big4 firms, possibly due to their quality control systems. Furthermore, there are several reasons why audit quality could actually increase after the Big4 localization policy. First, the supply shock in the audit labor market created by the Big4 localization policy could lead to a new equilibrium with lower prices but higher quality.[6] This notion is consistent with the recent study of Cascino et al. (2021), who find that the CPA Mobility provisions decrease audit price without impairing audit quality. Second, newly promoted CICPA audit partners might better understand the local business environment in China, which could help to improve audit quality (Chan et al., 2021). Third, supply shocks in the audit labor market could increase the availability of audit partners, thus lowering the workload of partners and improving audit quality (Lo et al., 2019). Our empirical results indicate that audit quality (proxied by upward discretionary accruals and restatement) increased after the Big4 localization policy came into effect. Further analysis indicates that the effect is stronger in the subsample characterized by a greater decrease in partner workload. Together, our results support the hypothesis that audit quality improves as a result of the Big4 localization policy.

Our study makes two important contributions. First, it complements the literature concerning auditor choice and audit partner changes (Carson et al., 2012; DeFond and Zhang, 2014; Simnett et al., 2016; Stewart et al., 2016). Our results suggest that the increased number of new audit partners recruited after this key legislative change led to an increase in audit partner supply, causing clients to switch from more costly (senior) audit partners to less costly (junior) audit partners. Second, we provide empirical evidence of the consequences of the implementation of the Big4 localization policy in China. Our results suggest that the Big4 localization policy leads to lower audit fees but higher audit quality, implying the benefits of increasing the supply of CICPA audit partners. This empirical evidence enriches our understanding of the determinants of auditor choice and informs the ongoing debate around new regulations for Big4 firms in China.

2. Institutional background

In the 1980s, the Big4 accounting firms set up offices in mainland China under the "Temporal regulations on foreign companies." Subsequent to the establishment of the Chinese stock market in 1992, the Big4 firms started to provide auditing services to listed companies in China by setting up a joint venture with Chinese accounting firms under the "Foreign joint venture company law." In addition, the Big4 firms had a special agreement with the Chinese government that during the term of the joint venture (usually 20 years), they would not need to comply with specific regulations as other local accounting firms do, including the requirements surrounding audit partner eligibility. Although only audit partners with CICPA qualifications can sign

[6] Lee et al. (2021) document that audit quality is higher when audit offices are closer to the sources of labor supply, namely universities and accredited business universities.

audit reports, the Big4 audit firms also recruit a considerable number of audit partners without CICPA qualifications. These audit partners generally provide advice to the signing partners, especially those from foreign client firms who operate in China. However, when the joint venture is finished, the Big4 firms should be treated equally to other local accounting firms and should comply with all regulations relevant to accounting firms in China, including the audit partner eligibility requirements.

In 2009, the Ministry of Finance (MOF) issued the No. 56 regulation to facilitate the development of the CPA industry. The No. 56 regulation mentions the possibility of the Big4 foreign joint venture finishing earlier to allow local accounting firms to compete with the Big4 more equally. In 2010, with the Big4 joint venture term close to its end (i.e., from 1992 to 2012) and the implementation of the No. 56 regulation, the Big4 started to make enquiries to the MOF on its detailed plan after the joint venture term. In response, the MOF set up a special office to discuss with the Big4 what they should do after the joint venture term in 2011, namely the Big4 localization policy.

On 2 May 2012, the MOF issued the Joint Venture Accounting Firm Localization Plan. The primary objective of the localization plan was to reduce the proportion of audit partners who do not have a CICPA certificate to less than 40% in terms of the total number of audit partners and the accounting firm management committee. The ultimate objective was that the percentage should be less than 20% by 2017. Accordingly, the Big4 had five years (2012 to 2017) to change the structure of audit partners to comply with the localization regulation.

The localization plan applied to Big4 accounting firms only, and other accounting firms were not affected. If the current chief partner (or executive partner) of a Big4 firm was a foreigner, the firm was expected to replace the partner with a Chinese partner within three years. Accordingly, the Big4 reported in 2015 that they had changed their chief partners to Chinese partners (all of the Big4's chief partners were foreigners in 2012). For other partners, the number who do not have a CICPA certificate (non-CICPA partners) should be less than 40% of the total number of partners. By the end of 2014, the non-CICPA partners should be less than 35%. By the end of 2016, the non-CICPA partners should be less than 25%. By the end of 2017, the non-CICPA partners should be less than 20%.[7]

3. Literature review and hypothesis development

3.1. Auditor switch and audit fees

A long-standing stream of research investigates how auditors' pricing strategy determines the audit fees, and reveals that a change in the audit firm is likely to create pressure to engage in initial-year audit fee discounting because of the client's switching costs (DeAngelo, 1981; Magee and Tseng, 1990; Lennox and Wu, 2018). For example, Huang et al. (2009) find that auditors charge a lower initial-year audit fee in the pre-SOX period. Ghosh and Pawlewicz (2009) report that initial audit fee discounts do not exist among Big4 auditors and exist only among non-Big4 auditors in the post-SOX period. However, Desir et al. (2014) find that audit firms discount their initial-year audit fees during the entire sample period of 2007 to 2010. Moreover, Huang et al. (2015) suggest that when one or both prior audit partners continue to serve as the audit partner following an audit firm change, the pressure to reduce the audit fees is lower. More recently, Cho et al. (2021) find that non-audit fees in the first year of engagement are negatively related to the propensity for lowballing audit fees. They argue that clients are better off receiving audit and non-audit services from the same accounting firm (Simunic, 1984; Antle and Demski, 1991), whereas the provision of non-audit services can increase auditors' investment in reputational capital. Thus, auditors are not likely to jeopardize their reputation to satisfy the demands of any single client (Frankel et al., 2002).

[7] According to a survey by the MOF office at the end of 2010, the percentages of non-CICPA partners in the Big4 firms were as follows: KPMG 70%, EY 55%, Deloitte 50%, PwC 61%. Appendix B shows the summary statistics of audit partners before and after the implementation of the localization plan. On average, only approximately 50% of Big4 audit partners had CICPA qualifications before the implementation of the Big4 localization policy. After the implementation, the percentage of audit partners with CICPA qualifications dramatically increased to 80%, whereas the total numbers of audit partners also increased from 405 to 614 (including both CICPA and non-CICPA partners).

3.2. Supply shock in the audit partner labor market and auditor switching

As discussed above, audit pricing is one of the main determinants of auditor switches. In China particularly, the cost of audit services is a key determinant of auditor choice (Huang et al., 2015; Huang et al., 2016). Therefore, we develop our core argument based on the difference in audit pricing strategy between senior audit partners and junior audit partners.

We expect clients to change from senior partners to junior partners after the implementation of the Big4 localization policy based on three rationales. First, prior literature documents that audit fees are positively associated with audit partners' experience because experienced auditors make better decisions (He et al., 2016). Experienced audit partners are likely to charge relatively high audit fees to better reflect their high-quality services, experience and reputation (Cahan and Sun, 2015; He et al., 2016; Lee et al., 2019). In contrast, junior audit partners have less experience and little reputation. Thus, these junior auditors adopt a low-price strategy at the early stage of their careers to attract more client firms and build up their portfolios (Cahan and Sun, 2015; Chang et al., 2021).

Second, senior audit partners have high downward audit fee stickiness (they have greater reluctance to decrease their audit fees due to the risk of unintended consequences). For example, senior partners might have concerns about the spill-over effect on the prices demanded by other clients, who might also bargain to decrease their audit fees. Senior partners might feel that the discounted audit fees do not fully reflect their experience, high-quality services and reputation (Frankel et al., 2002; He et al., 2016).

Finally, if senior audit partners adapt to the increased number of junior partners and the competitive pressure within audit firms by lowering their audit prices, a race to the bottom may develop in the setting of audit fees. This "downward spiral channel" refers to a situation wherein audit fees are beaten down via competitive pressure, and quality is compromised, with a corresponding downward pressure on prices (Knechel, 2016). Therefore, this also creates reluctance for senior audit partners to decrease their audit fees.

Based on these three rationales that junior audit partners charge lower audit fees and senior audit partners are less likely to decrease their audit fees, we expect that clients are more likely to change from senior audit partners to junior CICPA partners in pursuit of lower audit fees. We express our first hypothesis as follow:

H1*: Big4 audit firm clients are more likely to replace senior audit partners with junior partners after the implementation of the Big4 localization policy in China.*

As discussed previously, the cost of audit services is an important determinant of auditor choice in China (Huang et al., 2015; Huang et al., 2016). If clients are charged high audit fees, we expect that they have strong cost incentives to change from senior partners to junior partners. Therefore, we expect that auditor switches from senior to junior partners are more likely in cases where clients are charged high audit fees. Thus, we express our second hypothesis as follows:

H2*: Auditor switches from senior audit partners to junior partners are more pronounced for clients who are charged high audit fees.*

4. Research design

4.1. Sample construction

We start with an initial sample of 27,599 Chinese A-share firm-year observations for the 2007–2017 period included in the China Securities Markets and Accounting Research Database (CSMAR). We first collect the information about CPAs from a public inquiry system on the CICPA website, which includes the year when the individual qualified as a Chinese CPA.[8] Then, we retrieve each firm's signing auditor names from the audit report database of CSMAR and match each signing auditor name with their CPA information, such as CPA registration year. We then start sample cleaning by eliminating 2580 firm-year observations from 2012, as this is the year in which the policy was implemented. We then exclude the following observations: (a) 445 observations from the financial services industry; (b) 3954 observations that involve audit firm changes; and (c) 2113

[8] The data are available in Chinese at http://cmis.cicpa.org.cn.

observations with missing financial data. This data selection process yields a sample of 18,507 firm-year observations. We summarize the sample selection process in Panel A of Table 1 and present the industry distributions in Panel B and Panel C of Table 1. Our sample distribution is similar to that reported in previous studies (e.g. Chen et al., 2011), demonstrating that most firms are from the manufacturing industry, with 11,684 listed firms out of 18,507 (63.13%). Panel C also shows that the Big4 market share is relatively low in terms of client numbers, which is consistent with the characteristics of the Chinese audit market.

Table 1
Sample selection and distribution.

Panel A: Sample Selection			**Observations**
Firm-year observations in CSMAR (2007–2017)			27,599
Less			
Observations in 2012			–2,580
Financial services industry			–445
Observations with audit firm changes			–3,954
Observations with missing financial data			–2,113
The final sample used to estimate the auditor switch model			18,507
Panel B: Sample Distribution by Year and Big4			
Year	Big4=0	Big4=1	Total
2007	925	65	990
2008	1,132	79	1,211
2009	1,121	81	1,202
2010	1,387	84	1,471
2011	1,540	102	1,642
2013	2,100	109	2,209
2014	2,173	113	2,286
2015	2,173	116	2,289
2016	2,330	128	2,458
2017	2,612	137	2,749
Total	17,493	1,014	18,507
Panel C: Sample Distribution by Industry and Big4			
Industry	Big4=0	Big4=1	Total
Agriculture, Forestry & Fishing	335	1	336
Mining	401	75	476
Manufacturing: Food & Beverage	1,286	50	1,336
Manufacturing: Chemicals	3,411	99	3,510
Manufacturing: Metal & Nonmetal	6,145	331	6,476
Manufacturing: Others	356	6	362
Electricity Production and Supply	595	51	646
Construction	435	42	477
Wholesale & Retail	1,019	53	1,072
Transportation	527	147	674
Hotel and catering	82	9	91
Information & Technology	945	25	970
Real estate	919	86	1,005
Broadcasting & Media	193	25	218
Conglomerates	91	0	91
Utilities	172	6	178
Services	28	0	28
Education	8	0	8
Hygiene and social welfare	26	0	26
Recreation industry	184	2	186
Others	335	6	341
Total	17,493	1,014	18,507

4.2. Difference-in-differences

4.2.1. Identification strategy

The CICPA partner percentage could be increased by either increasing the number of CICPA partners or decreasing the number of non-CICPA partners. The Chinese government specifies that the Big4 localization policy aims to increase the CICPA percentage by increasing the number of CICPA partners rather than dismissing non-CICPA partners (MOF, 2014). According to a survey (MOF, 2014), the Big4 planned to increase their percentage of CICPA partners to more than 60%, 65%, 75% and 80% by the end of 2014, 2015, 2016 and 2017, respectively.

The MOF (MOF, 2015) reported that the total number of partners in Big4 firms was 515 by the end of 2014, representing an increase of 110 compared with the figure of 405 at the beginning of the Big4 localization policy. The number of CICPA partners in Big4 firms increased from 202 at the beginning of the Big4 localization policy to 343 by the end of 2014, which corresponds to an increase in the percentage of CICPA partners in the Big4 firms from 50% to 66%. In other words, the number of CICPA partners in the Big4 firms increased by approximately 70%. The number of partners in non-Big4 accounting firms increased from 1,399 in 2012 to 2,244 in 2014, representing an increase of 60.4%.

By the end of the Big4 localization policy in 2017, the CICPA (2018) reported that the Big4 had successfully achieved the requirement that the percentage of CICPA partners reach 80%. In 2017, the total number of partners in Big4 firms was approximately 614, of which 495 were CICPA partners. Compared with the number at the beginning of the Big4 localization policy, this represents an additional 293 CICPA partners (an increase of 144%). The number of partners in non-Big4 accounting firms was approximately 2,736 in 2017, an increase of 1,337 (95%) compared with the number when the Big4 localization policy came into effect.

4.2.2. Supply shocks in audit partner labor market and auditor switches

As stated previously, the Big4 localization policy requires that audit partners who do not have a CICPA certificate represent less than 40% of the total number of audit partners and the accounting firm management committee. In response, the Big4 firms have hired or promoted more audit partners with CICPA qualifications and increased the overall number of available audit partners within their firms. Based on our argument that senior partners charge higher fees and are less likely to decrease their audit price, we expect to observe an increase in auditor switching driven by junior partners replacing senior partners. To test this hypothesis, we first examine whether audit partner switches within Big4 firms increase after the policy and then test whether the increase in switching is driven by junior partners replacing senior partners. We first use Eq. (1) to test whether audit partner switches within Big4 firms increase after the implementation of the policy as follows:

$$SWITCH_{it} = b_0 + b_1 BIG4 \times POLICY + b_2 BIG4 + b_3 POLICY + b_4 Controls_{it} + FE + \varepsilon_i. \quad (1)$$

where $SWITCH_{it}$ is a dummy variable, coded 1 if the firm does not change audit firm but does change its audit partner in the current year, and 0 otherwise. Our variable of interest is the interaction term $BIG4 \times POLICY$. $BIG4$ is a dummy variable coded 1 if the audit firm is one of the Big4 international audit firms, and 0 otherwise. $POLICY$ is a dummy variable coded 1 if the financial year is after 2012 (after the implementation of the Big4 localization policy), and 0 otherwise. We expect b_1 to be significant and positive.

Following prior studies (Stefaniak et al., 2009; He et al., 2017; Cao et al., 2021), we control for other factors that could influence audit firms' client choices in our regression model, including firm size ($SIZE$), leverage (LEV), profitability ($LOSS$ and ROA), total accruals ($TACC$), modified audit opinion (MAO), state-owned entity (SOE) and individual auditor's tenure in the prior year ($TENURE\_PAR\_PRE$). We also include year and industry dummy variables in the regression model to control for year and industry fixed effects. Finally, all continuous variables are winsorized at the 1% level to ensure that outliers do not significantly affect the results.

We then examine whether increases in audit partner switches are driven by junior partners replacing senior partners by estimating Eq. (2) as follows:

$$OLD\_to\_NEW_{it} = b_0 + b_1 BIG4 \times POLICY + b_2 BIG4 + b_3 POLICY + b_4 Controls_{it} + FE + \varepsilon_i. \quad (2)$$

Table 2
Descriptive statistics for variables.

Variable	N	Mean	SD	Q1	Median	Q3
BIG4	18,507	0.055	0.228	0.000	0.000	0.000
POLICY	18,507	0.648	0.478	0.000	1.000	1.000
SWITCH	18,507	0.568	0.495	0.000	1.000	1.000
OLD_to_NEW	10,488	0.228	0.420	0.000	0.000	0.000
FEE	18,507	13.620	0.722	13.120	13.530	14.000
ABFEE	18,507	–0.002	0.348	–0.222	0.000	0.208
SIZE	18,507	21.990	1.315	21.080	21.850	22.730
LEV	18,507	0.460	0.227	0.286	0.452	0.617
LOSS	18,507	0.099	0.299	0.000	0.000	0.000
ROA	18,507	0.037	0.072	0.011	0.037	0.070
TACC	18,507	0.001	0.100	–0.050	–0.004	0.046
MAO	18,507	0.042	0.201	0.000	0.000	0.000
SOE	18,507	0.444	0.497	0.000	0.000	1.000
TENURE_PAR_PRE	18,507	1.297	0.459	0.693	1.386	1.609
TENURE_FIRM	18,507	1.684	0.638	1.099	1.792	2.197
CLIENTS_FIRM	18,507	4.725	1.043	3.912	4.913	5.684
TENURE_PAR	18,507	1.402	0.421	1.099	1.386	1.792

The full sample consists of 18,507 firm-year observations for the 2007–2017 period. All variables except the indicator variables are winsorized at the 1% and 99% levels and are defined in Appendix A.

where $OLD\_to\_NEW_{it}$ is a dummy variable, coded 1 if the client's current year's auditor has a CPA registration year later than that of the prior year's auditor, and 0 otherwise. Variable $OLD\_to\_NEW_{it}$ indicates that senior (more experienced) partners are replaced by junior (less experienced) partners (Lennox et al., 2020).[9] Moreover, Eq. (2) is estimated using the subsample of observations in which an auditor partner switch occurs only. Significant and positive b_1 indicates that switches from senior partners to junior partners in the Big4 audit firms increased significantly after the implementation of the policy. The control variables in Eq. (2) are the same as those in Eq. (1).

4.2.3. Characteristics of the clients who choose to switch

We argue that as the supply of audit partners increases, client firms switch from senior audit partners to junior audit partners to reduce costs. As a result, we might observe that these switches from senior to junior audit partners are mainly driven by clients who are charged high audit fees. Following Ettredge et al. (2007), we use abnormal fee (*ABFEE*) to proxy for clients charged high audit fees, which is calculated as the residual of Eq. (3) as follows:

$$FEE_{it} = b_0 + b_1 Controls_{it} + FE + \varepsilon_i. \quad (3)$$

where the dependent variable is FEE_{it}, which is the log of audit fees. *Controls* encompass factors that are commonly included in the prior literature (e.g., DeFond and Zhang, 2014), such as *BIG4*, *SIZE*, *LEV*, *LOSS*, *ROA*, *TACC*, *MAO*, *SOE*, individual auditor's experience (*EXP_PAR*) and tenure in the current year (*TENURE_PAR*), audit firm's tenure in the current year (*TENURE_FIRM*) and audit firm's number of clients (*CLIENTS_FIRM*). Then, we divide our sample into subsamples based on the median value of *ABFEE* in year *t*–1 and re-estimate Eq. (2) within subsamples.

[9] It is also possible that a non-CICPA senior partner is replaced by junior CICPA partners in the audit team. Given that the data for non-CICPA partners are unavailable (because only CICPA partners are eligible to sign and be disclosed on the audit report), we acknowledge this as a limitation of our study.

Table 3
Supply shock in the audit partner labor market and auditor switching.

Panel A: Full Sample

VARIABLES	(1) FULL *SWITCH*	(2) OLD_to_NEW *SWITCH*
BIG4 × POLICY	0.254*	0.701**
	(1.89)	(2.32)
BIG4	–0.178	–0.268
	(–1.64)	(–1.00)
POLICY	–0.252***	0.647***
	(–3.17)	(4.08)
SIZE	–0.015	0.014
	(–0.99)	(0.48)
LEV	–0.050	–0.104
	(–0.57)	(–0.62)
LOSS	0.111*	0.115
	(1.80)	(1.01)
ROA	0.535*	0.795
	(1.73)	(1.38)
TACC	0.367**	–0.358
	(2.13)	(–1.15)
MAO	–0.174**	–0.255
	(–2.08)	(–1.57)
SOE	–0.078**	–0.190***
	(–2.26)	(–3.02)
TENURE_PAR_PRE	0.527***	0.256***
	(15.69)	(4.38)
YEAR FE	INCLUDE	INCLUDE
INDUSTRY FE	INCLUDE	INCLUDE
Constant	0.270	–1.522**
	(0.81)	(–2.52)
Observations	18,507	5,939
Pseudo R-squared	0.0138	0.0189

Panel B: PSM Sample

VARIABLES	**(1) FULL *SWITCH***	**(2) OLD_to_NEW *SWITCH***
BIG4×POLICY	0.406**	1.346***
	(1.98)	(2.97)
BIG4	–0.325**	–0.655*
	(–2.00)	(–1.66)
POLICY	–0.123	0.037
	(–0.45)	(0.06)
SIZE	–0.061	–0.152*
	(–1.22)	(–1.78)
LEV	0.210	0.040
	(0.54)	(0.06)
LOSS	0.276	0.303
	(1.08)	(0.70)
ROA	0.177	0.833
	(0.15)	(0.44)
TACC	–0.859	–0.656
	(–1.34)	(–0.51)
MAO	–0.336	0.809
	(–0.79)	(1.41)
SOE	–0.089	–0.083
	(–0.72)	(–0.37)
TENURE_PAR_PRE	0.546***	0.167
	(4.92)	(0.81)

YEAR FE	INCLUDE	INCLUDE
INDUSTRY FE	INCLUDE	INCLUDE
Constant	0.306	3.568*
	(0.26)	(1.66)
Observations	1,743	505
Pseudo R-squared	0.0257	0.0676

This table examines the association between supply shocks in the audit partner labor market and auditor switches using the following model:

$SWITCH_{it} = b_0 + b_1 BIG4 \times POLICY + b_2 BIG4 + b_3 POLICY + b_4 Controls_{it} + FE + \varepsilon_i$.

where *SWITCH* is a dummy variable, coded 1 if the firm does not change audit firm but does change its audit partner in the current year, and 0 otherwise. *BIG4* is a dummy variable coded 1 for Big4 international audit firms, and 0 otherwise. *POLICY* is a dummy variable coded 1 after the implementation of the Big4 localization policy, and 0 otherwise. Controls include firm size (*SIZE*), leverage (*LEV*), loss indicator (*LOSS*), return on assets (*ROA*), total accruals (*TACC*), modified opinion indicator (*MAO*), state-owned entity (*SOE*) and auditor tenure (*TENURE_PAR_PRE*) in the prior year; ε is the error term. Figures in parentheses are *t*-statistics. *** (**, *) indicates significance at the 1% (5%, 10%) level for two-tailed tests. All variables are defined in Appendix A.

5. Empirical results

5.1. Summary statistics

Table 2 reports the summary statistics for selected variables from our sample. The results in Table 2 show that approximately 5.48% of the firm-year observations are clients of Big4 auditors. In total, 64.8% of samples are considered post-implementation of the Big4 localization policy in China. The descriptive statistics of the other variables are similar to those found in prior Chinese studies (e.g., Huang et al., 2015; Huang et al., 2016; He et al., 2017; Chang et al., 2019). For example, the mean (median) of *SIZE* is 21.990 (21.85), that of *LEV* is 0.46 (0.452), that of *ROA* is 0.0372 (0.0368) and that of *LOSS* is 0.0994 (0), which are comparable.

5.2. Regression results

We first examine the association between the implementation of the Big4 localization policy and switches in audit partners in Big4 audit firms. The result reported in column 1 of Panel A in Table 3 shows that auditor switching significantly increases ($p < 0.1$) after the implementation of the Big4 localization policy. In column (2), the coefficient on *BIG4* × *POLICY* indicates that auditor switching from senior partners to junior partners increases significantly ($p < 0.05$). Overall, these results indicate that the Big4 localization policy triggers senior audit partners to transfer clients to junior partners.

Although we control for client characteristics that might influence auditor switching decisions, there is still potential selection bias due to observable covariates. We employ a propensity score matching (PSM) procedure to obtain a propensity score-matched group to mitigate this concern. Specifically, we use a logit regression model to estimate the probability of having a Big4 audit firm. The model has *BIG4* as its dependent variable and includes all control variables. We use the predicted probabilities computed using the auditor choice model to match each client audited by a Big4 audit firm with a client audited by a non-Big4 audit firm. We use matching without replacement and impose a 1% maximum distance in the propensity score to exclude firms without a reasonable match in the sample.

Using the PSM sample, we re-examine the efficacy of the Big4 localization policy. Panel B of Table 3 shows the results for testing the matched sample using the PSM sample. The coefficient of interest, b_1 in column 1, is positive and significant at the 5% level, which again indicates that audit partner switching increases significantly after the implementation of the Big4 localization policy. In addition, b_1 in column 2 is positive and significant at the 1% level, which is qualitatively similar to the result in the full sample and indicates that the increase in audit partner switching in Big4 audit firms is mainly driven by junior audit partners replacing

senior audit partners. In sum, the results obtained using the PSM sample support the notion that the Big4 localization policy is effective in triggering junior partners to replace senior partners in Big4 audit firms.

Our evidence suggests that the Big4 localization policy effectively triggers senior audit partners to be replaced by junior audit partners in Big4 audit firms. Furthermore, we argue that this change is driven by client firms who are charged high audit fees. To examine whether this is the case, we first estimate abnormal fees (*ABFEE*) based on the same year and industry as the residual of our audit fee model in Eq. (3). Then, we divide our sample based on the median of the prior year's value of *ABFEE* and re-estimate Eq. (2) separately in each subsample. We expect to see that switching is significantly more common for clients whose *ABFEE* is higher in the prior year.

Table 4 reports the regression results. Column (1) in Panel A reports the results using a subsample including only firms whose prior year's abnormal fee is higher than the median. We find a significant increase in client switches from old auditors to new auditors in the Big4 audit firms after the implementation of the localization policy, as shown by the positive coefficient on $BIG4 \times POLICY$ ($p < 0.5$). In contrast, column (2) reports the results using the subsample of firms whose prior year's abnormal fee is lower than the median, showing that the association is statistically insignificant. Furthermore, we use the procedure above to construct a PSM sample and re-estimate our tests, finding qualitatively similar results, as shown in Panel B of Table 4. The evidence indicates that clients who were previously charged high audit fees are more likely to replace senior audit partners with junior audit partners.

5.3. Additional analyses

5.3.1. Supply shock in the audit partner labor market and audit price

We provide evidence that increased audit partner supply in the Big4 audit firms causes client firms to replace senior partners with junior partners. Thus, we might also see that audit fees decrease in general because junior auditors usually charge lower fees, and clients switch from senior to junior audit partners to avoid high fees. To test whether this is the case, we use Eq. (5) as follows:

$$FEE_{it} = b_0 + b_1 BIG4 \times POLICY + b_2 BIG4 + b_3 POLICY + b_4 Controls_{it} + FE + \varepsilon_i. \quad (5)$$

where the dependent variable is FEE_{it}, which is the log of audit fees. A significant and negative value of b_1 would indicate that a Big4 audit firm's audit fees decrease significantly after the implementation of the policy.

The results of the regression model (5) are reported in Table 5. Column 1 reports the regression results for the association between $BIG4 \times POLICY$ and audit fees using the full sample. The coefficient on $BIG4 \times POLICY$ is negative and significant ($p < 0.01$). Furthermore, we use all of the control variables to construct a PSM sample and re-estimate Eq. (5) to find qualitatively similar results, as shown in Column 2 of Table 5. These results suggest that the audit fees of the Big4 firms decrease after the implementation of the localization plan, which also provides additional evidence that the Big4 localization policy results in low-priced junior audit partners replacing high-priced senior audit partners.

5.3.2. Supply shock in the audit partner labor market and audit quality

We also ask what the consequence of the Big4 localization policy is for audit quality. First, decreases in audit fees generally result in decreases in audit quality (Hribar et al., 2014). Furthermore, the newly recruited audit partners generally have less experience, which could result in lower audit quality (Lee et al., 2019). Consequently, the audit quality of the Big4 firms could be jeopardized. However, Big4 audit firms have stringent quality control systems and the audit quality of less experienced auditors is monitored (Chang et al., 2021). Furthermore, there are several reasons to believe that audit quality could in fact increase. First, prior studies report that the audit labor market is associated with audit quality (Cascino et al., 2021; Lee et al., 2021). A recent study by Cascino et al. (2021) finds that the CPA Mobility provisions in the US, which remove licensing-induced geographic barriers, decrease audit price without impairing audit quality. Similarly, the Big4 localization policy creates a supply shock in the audit labor market and could lead to a new equilibrium with lower prices but higher quality. Second, newly promoted CICPA audit partners might have better local knowledge, helping them to better understand the local business environment in China, and hence improving audit quality (Chan et al., 2021). Third, the supply shock in the audit labor market could increase the avail-

Table 4
Characteristics of the clients who switch.

Panel A: Full Sample

VARIABLES	(1) $ABFEE_{t-1}$ > Median *OLD_to_NEW*	(2) $ABFEE_{t-1}$ < Median *OLD_to_NEW*
BIG4 × POLICY	0.805**	–0.123
	(2.07)	(–0.18)
BIG4	–0.369	0.742
	(–1.06)	(1.21)
POLICY	0.796***	0.377
	(3.77)	(1.39)
SIZE	–0.020	0.055
	(–0.57)	(1.03)
LEV	–0.114	–0.217
	(–0.53)	(–0.72)
LOSS	0.012	0.325
	(0.08)	(1.62)
ROA	1.048	0.699
	(1.44)	(0.65)
TACC	–0.512	–0.137
	(–1.26)	(–0.25)
MAO	–0.319	–0.026
	(–1.50)	(–0.09)
SOE	–0.202**	–0.252**
	(–2.48)	(–2.31)
TENURE_PAR_PRE	0.151**	0.302***
	(2.05)	(2.79)
YEAR FE	INCLUDE	INCLUDE
INDUSTRY FE	INCLUDE	INCLUDE
Constant	–1.192	–1.453
	(–1.55)	(–1.29)
Observations	4,001	1,931
Pseudo R-squared	0.0239	0.0226

Panel B: PSM Sample

VARIABLES	**(1) $ABFEE_{t-1}$>Median** ***OLD_to_NEW***	**(2) $ABFEE_{t-1}$<Median** ***OLD_to_NEW***
BIG4×POLICY	1.949***	–0.395
	(3.20)	(–0.36)
BIG4	–1.100**	1.400
	(–2.07)	(1.43)
POLICY	–0.840	0.331
	(–1.06)	(0.23)
SIZE	0.035	–0.209
	(0.31)	(–1.00)
LEV	–1.862**	0.816
	(–2.14)	(0.51)
LOSS	0.044	0.422
	(0.07)	(0.47)
ROA	–1.483	–0.025
	(–0.59)	(–0.01)
TACC	–1.090	0.075
	(–0.63)	(0.03)
MAO	1.470*	–0.049
	(1.78)	(–0.04)
SOE	–0.148	–0.279
	(–0.49)	(–0.58)
TENURE_PAR_PRE	0.085	0.895*
	(0.33)	(1.78)

YEAR FE	INCLUDE	INCLUDE
INDUSTRY FE	INCLUDE	INCLUDE
Constant	0.314	2.427
	(0.12)	(0.55)
Observations	338	156
Pseudo R-squared	0.0934	0.195

This table examines the characteristics of the switched clients using the following model:
$OLD\_to\_NEW_{it} = b_0 + b_1 BIG4 \times POLICY + b_2 BIG4 + b_3 POLICY + b_4 Controls_{it} + FE + \varepsilon_i$.
where *OLD_to_NEW* is a dummy variable, coded 1 if the client's current year's auditor's CPA registration year is later than the prior year's auditor's CPA registration year, and 0 otherwise. *BIG4* is a dummy variable coded 1 for the Big4 international audit firms, and 0 otherwise. *POLICY* is a dummy variable coded 1 after the implementation of the Big4 localization policy, and 0 otherwise. Controls include firm size (*SIZE*), leverage (*LEV*), loss indicator (*LOSS*), return on assets (*ROA*), total accruals (*TACC*), modified opinion indicator (*MAO*), state-owned entity (*SOE*) and auditor tenure (*TENURE_PAR_PRE*) in the prior year; ε is the error term. Figures in parentheses are *t*-statistics. *** (**, *) indicates significance at the 1% (5%, 10%) level for two-tailed tests. All variables are defined in Appendix A.

ability of audit partners, thus reducing the workload of partners and leading to higher audit quality (Lo et al., 2019). For example, Lo et al. (2019) find that accounting firms with lower staff–partner ratios have a lower likelihood of restatements of their clients' financial statements. Furthermore, the literature on auditor workload suggests that audit partners with a lower workload may achieve higher audit quality (e.g., Lopez and Peters, 2012; Sundgren and Svanström, 2014; Goodwin and Wu, 2016; Gul et al., 2017; Lai et al., 2018; Chen et al., 2020; Christensen et al., 2021). Thus, the effect of junior partners replacing senior partners could reduce the workload of audit partners on average and lead to higher audit quality.

We test the influences of the Big4 localization policy on audit quality using Eq. (6) as follows:

$$AuditQuality_{it} = b_0 + b_1 BIG4 \times POLICY + b_2 BIG4 + b_3 POLICY + b_4 Controls_{it} + FE + \varepsilon_i. \quad (6)$$

where *Audit_Quality* represents audit quality measured by two methods, namely restatement and the performance-matched discretionary accruals method of Kothari et al. (2005). The results reported in Table 6 demonstrate that the clients of the Big4 firms are less likely to have restatements ($p < 0.1$) and also have a lower level of discretionary accruals ($p < 0.01$) after the implementation of the Big4 localization policy. These results suggest that the implementation of the policy has a positive impact on audit quality.

5.3.3. Possible mechanism of the effect on audit quality

Previous studies suggest that higher audit quality is generally associated with higher audit fees (DeFond and Zhang, 2014). In the present case, the audit fees of the Big4 firms decrease while audit quality increases. Therefore, further investigation of the possible mechanism of this effect would be valuable. Due to data availability, we test how signing CICPA audit partners affect workloads.[10]

In the auditor switch test described above, we provide evidence that client firms replace senior partners with junior partners to reduce audit costs after the Big4 localization policy. It would also be reasonable to expect that the average number of clients assigned to each individual auditor in the Big4 audit firms decreases. In this section, we test whether this is the case by replacing the dependent variable *SWITCH* in Eq. (1) with the log of auditors' average number of clients (*LN_BUSY*) and re-estimating Eq. (1).

Table 7 reports the regression results. In column (1), we find a significant decrease in client numbers for auditors in the Big4 audit firms after the implementation of the localization policy, as shown by the negative coefficient on $BIG4 \times POLICY$ ($p < 0.1$), which is consistent with the consequence of auditor switching. As shown in column (2), we construct a PSM sample using all of the control variables in the model and re-estimate. Again, we find qualitatively similar results, as shown by the negative coefficient on $BIG4 \times POLICY$ ($p < 0.01$). This evidence further supports the hypothesis that the Big4 localization policy increases the auditor supply and triggers clients to switch from senior audit partners to junior audit partners.

[10] We acknowledge a lack of non-CICPA data as a limitation of this study.

Table 5
Supply shocks in the audit partner labor market and audit price.

	(1) FULL	(2) PSM
VARIABLES	*FEE*	*FEE*
BIG4 × POLICY	–0.279***	–0.200***
	(–10.51)	(–3.89)
BIG4	1.005***	0.841***
	(46.50)	(20.74)
POLICY	0.404***	0.162**
	(25.36)	(2.34)
SIZE	0.358***	0.503***
	(116.42)	(38.30)
LEV	0.089***	–0.179*
	(5.10)	(–1.91)
LOSS	0.037***	0.139**
	(3.00)	(2.18)
ROA	–0.228***	–0.483*
	(–3.75)	(–1.76)
TACC	–0.030	–0.260*
	(–0.89)	(–1.66)
MAO	0.166***	0.086
	(10.03)	(0.76)
SOE	–0.062***	–0.106***
	(–9.04)	(–3.50)
TENURE_PAR	0.003	–0.012
	(0.46)	(–0.39)
TENURE_FIRM	0.035***	0.018
	(7.04)	(0.92)
CLIENTS_FIRM	0.042***	0.071***
	(13.56)	(4.24)
YEAR FE	INCLUDE	INCLUDE
INDUSTRY FE	INCLUDE	INCLUDE
Constant	5.223***	2.512***
	(78.16)	(6.41)
Observations	18,507	1,580
R-squared	0.691	0.711

This table examines the association between supply shocks in the audit partner labor market and audit price using the following model: $FEE_{it} = b_0 + b_1 BIG4 \times POLICY + b_2 BIG4 + b_3 POLICY + b_4 Controls_{it} + \varepsilon_i$.
where *FEE* is the audit fees. *BIG4* is a dummy variable coded 1 for the Big4 international audit firms, and 0 otherwise. *POLICY* is a dummy variable coded 1 after the implementation of the Big4 localization policy, and 0 otherwise. Controls include firm size (*SIZE*), leverage (*LEV*), loss indicator (*LOSS*), return on assets (*ROA*), total accruals (*TACC*), modified opinion indicator (*MAO*), state-owned entity (*SOE*), individual auditor tenure (*TENURE_PAR*), audit firm tenure (*TENURE_FIRM*) and audit firm's client number (*CLIENTS_FIRM*); ε is the error term. Figures in parentheses are *t*-statistics. *** (**, *) indicates significance at the 1% (5%, 10%) level for two-tailed tests. All variables are defined in Appendix A.

Although the literature on auditor workload suggests that audit partners with a lower workload may achieve higher audit quality (e.g., Lopez and Peters, 2012; Sundgren and Svanström, 2014; Goodwin and Wu, 2016; Gul et al., 2017; Lai et al., 2018; Chen et al., 2020; Christensen et al., 2021), we test whether the change in audit partner workload drives the improvement of audit quality in the Big4 audit firms in our model.

Specifically, we first calculate the firms' average partner workload during the pre-policy period and post-policy period using the partner workload presented in Table 7. Then, we calculate $\Delta BUSY$ by calculating the difference in partner workload between the post-policy period and pre-policy period. For example, for firm A, we calculate the average partner workload for the pre-policy period as follows: we first sum the partners' workload for the years in the pre-policy period (i.e., 2007–2011) and then divide this by the number of years

Table 6
Supply shocks in the audit partner labor market and audit quality.

Panel A: Full Sample

	(1)	(2)
VARIABLES	*RESTATEMENT*	*DA*
BIG4 × POLICY	–0.433**	–0.011**
	(–2.05)	(–2.47)
BIG4	–0.274	0.009**
	(–1.62)	(2.53)
POLICY	0.517***	–0.017***
	(5.23)	(–6.51)
SIZE	–0.012	–0.000
	(–0.61)	(–0.95)
LEV	0.432***	0.011***
	(3.92)	(3.74)
LOSS	0.221***	0.012***
	(3.00)	(5.25)
ROA	–2.026***	–0.160***
	(–5.24)	(–15.21)
TACC	1.069***	0.697***
	(4.90)	(113.05)
MAO	0.231**	0.019***
	(2.39)	(6.33)
SOE	–0.063	–0.001
	(–1.41)	(–0.48)
TENURE_PAR	–0.000	0.001
	(–0.01)	(0.59)
TENURE_FIRM	0.024	0.001*
	(0.74)	(1.74)
CLIENTS_FIRM	–0.063***	–0.000
	(–3.21)	(–0.43)
YEAR FE	INCLUDE	INCLUDE
INDUSTRY FE	INCLUDE	INCLUDE
Constant	–0.754*	0.050***
	(–1.75)	(4.43)
Observations	18,507	8,776
Pseudo R-squared	0.0282	
R-squared		0.635

Panel B: PSM Sample

	(1)	(2)
VARIABLES	*RESTATEMENT*	*DA*
BIG4×POLICY	–0.607*	–0.020***
	(–1.77)	(–2.86)
BIG4	0.006	0.011**
	(0.02)	(2.01)
POLICY	0.525	–0.006
	(1.35)	(–0.58)
SIZE	–0.042	–0.001
	(–0.52)	(–0.49)
LEV	–0.127	–0.016
	(–0.22)	(–1.16)
LOSS	–0.280	0.002
	(–0.72)	(0.18)
ROA	–3.264*	–0.002
	(–1.92)	(–0.04)
TACC	1.962*	0.588***
	(1.96)	(22.17)
MAO	1.794***	0.010
	(3.55)	(0.56)
SOE	–0.226	0.011**

	(–1.28)	(2.54)
TENURE_PAR	–0.074	–0.004
	(–0.39)	(–0.94)
TENURE_FIRM	0.085	0.004
	(0.70)	(1.56)
CLIENTS_FIRM	0.026	0.004
	(0.26)	(1.51)
YEAR FE	INCLUDE	INCLUDE
INDUSTRY FE	INCLUDE	INCLUDE
Constant	1.009	0.035
	(0.49)	(0.58)
Observations	1,558	737
Pseudo R-squared	0.0907	
R-squared		0.537

This table examines the association between supply shocks in the audit partner labor market and audit quality using the following model:
$AuditQuality_{it} = b_0 + b_1 BIG4 \times POLICY + b_2 BIG4 + b_3 POLICY + b_4 Controls_{it} + FE + \varepsilon_i$.
where *Audit Quality* represents restatement (*RESTATEMENT*) and discretionary accruals (*DA*). *BIG4* is a dummy variable coded 1 for the Big4 international audit firms, and 0 otherwise. *POLICY* is a dummy variable coded 1 after the implementation of the Big4 localization policy, and 0 otherwise. Controls include firm size (*SIZE*), leverage (*LEV*), loss indicator (*LOSS*), return on assets (*ROA*), total accruals (*TACC*), modified opinion indicator (*MAO*), state-owned entity (*SOE*), individual auditor tenure (*TENURE_PAR*), audit firm tenure (*TENURE_FIRM*) and audit firm's client number (*CLIENTS_FIRM*); ε is the error term. Figures in parentheses are *t*-statistics. *** (**, *) indicates significance at the 1% (5%, 10%) level for two-tailed tests. All variables are defined in Appendix A.

for the pre-policy period (i.e., five years). The average partner workload of firm A for the post-policy period is calculated in a similar way to that for the pre-policy period using the number of post-policy years. Then, the $\Delta BUSY$ of firm A is the difference between the average partner workload in the post-policy period and the average partner workload in the pre-policy period.

We divide the sample based on the median of $\Delta BUSY$ and re-estimate our audit quality model in the subsamples separately. If the decreased workload is the mechanism for the audit quality improvement, we should observe a greater increase in audit quality in the subsample with a greater reduction in partner workload (i.e., $\Delta BUSY \leq$ MEDIAN) than in the subsample with a lesser reduction in partner workload (i.e., $\Delta BUSY >$ MEDIAN).

Table 8 reports the results. As shown in columns (1) and (2), the coefficients on the interaction terms $BIG4 \times POLICY$ are both negative and significant ($p < 0.05$ and $p < 0.01$, respectively). These results indicate that audit quality increases significantly in the subsample characterized by a greater reduction in partner workload (i.e., $\Delta BUSY \leq$ MEDIAN). In contrast, we find insignificant results for audit quality in the subsample characterized by a lesser reduction in partner workload (i.e., $\Delta BUSY >$ MEDIAN). These results are qualitatively similar when we use 0 as the cutoff for the subsample, as shown in panel B. Together, the evidence indicates that the reduced partner workload resulting from the increased supply of partners is a possible mechanism for audit quality improvement.

6. Conclusion

This study examines whether the increased supply of audit partners leads to client firms switching their audit partners. We study the Big4 localization policy, which requires that Big4 accounting firms promote more CICPA audit partners. In response to this policy, the Big4 firms are more likely to replace senior audit part-

Table 7
Possible mechanism of the effect on audit quality: auditor workload.

VARIABLES	FULL *LN_BUSY*	PSM *LN_BUSY*
BIG4 × POLICY	–0.084*	–0.193***
	(–1.81)	(–3.04)
BIG4	–0.341***	–0.243***
	(–9.05)	(–4.81)
POLICY	–0.134***	–0.135
	(–4.91)	(–1.55)
SIZE	–0.010*	–0.070***
	(–1.89)	(–4.43)
LEV	–0.077**	0.008
	(–2.53)	(0.07)
LOSS	0.001	0.006
	(0.06)	(0.08)
ROA	0.179*	–0.118
	(1.69)	(–0.33)
TACC	–0.083	0.033
	(–1.42)	(0.16)
MAO	–0.105***	–0.124
	(–3.65)	(–0.87)
SOE	–0.099***	0.053
	(–8.44)	(1.40)
TENURE_PAR_PRE	0.028**	0.028
	(2.43)	(0.82)
YEAR FE	INCLUDE	INCLUDE
INDUSTRY FE	INCLUDE	INCLUDE
Constant	1.231***	3.488***
	(10.84)	(7.18)
Observations	18,265	1,720
R-squared	0.040	0.126

This table examines the possible mechanism of the effect on audit quality using the following model:
$LN\_BUSY_{it} = b_0 + b_1 BIG4 \times POLICY + b_2 BIG4 + b_3 POLICY + b_4 Controls_{it} + FE + \varepsilon_i$.
where *LN_BUSY* is the workload of audit partners. *BIG4* is a dummy variable coded 1 for the Big4 international audit firms, and 0 otherwise. *POLICY* is a dummy variable coded 1 after the implementation of the Big4 localization policy, and 0 otherwise. Controls include firm size (*SIZE*), leverage (*LEV*), loss indicator (*LOSS*), return on assets (*ROA*), total accruals (*TACC*), modified opinion indicator (*MAO*), state-owned entity (*SOE*) and auditor tenure (*TENURE_PAR_PRE*) in the prior year; ε is the error term. Figures in parentheses are *t*-statistics. *** (**, *) indicates significance at the 1% (5%, 10%) level for two-tailed tests. All variables are defined in Appendix A.

ners with junior audit partners. This phenomenon is mainly driven by client firms who are charged high audit fees. Generally, audit partners at the beginning of their career (i.e., junior partners) charge relatively low audit fees to attract more clients, whereas senior partners are reluctant to decrease their audit prices due to concerns of price bargaining from other clients and race to the bottom of the audit price with junior audit partners. Together, our results demonstrate that clients are likely to switch from senior to junior partners when the supply of auditors increases and creates greater competitive pressures within Big4 firms.

Overall, this study contributes to the literature on auditor choice and audit partner changes by presenting new evidence on how supply shocks in the audit partner labor market act as important determinants of auditor choice and switching. The findings enrich the understanding of the determinants of auditor choice and provide empirical evidence that will be useful for regulators when deciding on future changes to auditing policies and their potential impacts on audit partner changes and pricing.

Table 8
Possible mechanism of the effect on audit quality.

Panel A: Full Sample

	(1)	(2)	(3)	(4)
	$\Delta BUSY \leq$ MEDIAN		$\Delta BUSY >$ MEDIAN	
VARIABLES	*RESTATEMENT*	*DA*	*RESTATEMENT*	*DA*
BIG4 × POLICY	–0.703**	–0.021***	–0.225	–0.005
	(–2.24)	(–2.94)	(–0.78)	(–0.86)
BIG4	0.064	0.015***	–0.502**	0.005
	(0.25)	(2.59)	(–2.19)	(1.07)
POST	0.677***	–0.013***	0.401***	–0.020***
	(4.54)	(–3.10)	(2.99)	(–5.80)
SIZE	–0.032	–0.000	–0.005	–0.001
	(–1.04)	(–0.47)	(–0.17)	(–0.89)
LEV	0.392**	0.009**	0.430***	0.013***
	(2.42)	(2.03)	(2.84)	(3.30)
LOSS	0.229**	0.016***	0.221**	0.010***
	(2.15)	(4.31)	(2.16)	(3.35)
ROA	–2.019***	–0.180***	–1.949***	–0.142***
	(–3.58)	(–11.52)	(–3.65)	(–9.90)
TACC	1.267***	0.694***	0.922***	0.701***
	(3.97)	(75.09)	(3.06)	(84.39)
MAO	0.127	0.019***	0.336**	0.020***
	(0.90)	(4.11)	(2.51)	(4.77)
SOE	–0.045	–0.002	–0.086	–0.000
	(–0.71)	(–0.93)	(–1.38)	(–0.01)
TENURE_PAR	–0.066	–0.000	0.057	0.001
	(–0.94)	(–0.03)	(0.90)	(0.89)
TENURE_FIRM	–0.033	0.002*	0.049	0.001
	(–0.70)	(1.66)	(1.10)	(1.20)
CLIENTS_FIRM	–0.059**	–0.000	–0.059**	–0.000
	(–1.98)	(–0.05)	(–2.23)	(–0.74)
YEAR FE	INCLUDE	INCLUDE	INCLUDE	INCLUDE
INDUSTRY FE	INCLUDE	INCLUDE	INCLUDE	INCLUDE
Constant	–0.615	0.047***	–0.743	0.051***
	(–0.93)	(2.65)	(–1.30)	(3.48)
Observations	8,271	3,904	10,225	4,872
Pseudo R-squared	0.0324		0.0287	
R-squared		0.638		0.631

Panel B

	(1)	**(2)**	**(3)**	**(4)**
	ΔBUSY≤0		**ΔBUSY>0**	
VARIABLES	***RESTATEMENT***	***DA***	***RESTATEMENT***	***DA***
BIG4×POLICY	–0.695**	–0.015**	–0.130	–0.009
	(–2.40)	(–2.31)	(–0.42)	(–1.38)
BIG4	–0.129	0.013**	–0.415*	0.007
	(–0.56)	(2.32)	(–1.65)	(1.40)
POST	0.702***	–0.014***	0.362**	–0.020***
	(5.15)	(–3.54)	(2.47)	(–5.43)
SIZE	–0.024	–0.000	–0.011	–0.001
	(–0.87)	(–0.39)	(–0.38)	(–1.21)
LEV	0.364**	0.011**	0.497***	0.013***
	(2.44)	(2.57)	(3.00)	(2.90)
LOSS	0.257***	0.013***	0.187*	0.012***
	(2.62)	(4.09)	(1.66)	(3.43)
ROA	–1.826***	–0.177***	–2.088***	–0.137***
	(–3.48)	(–12.18)	(–3.63)	(–8.89)
TACC	1.165***	0.683***	0.980***	0.718***
	(3.92)	(79.95)	(3.02)	(79.96)
MAO	0.144	0.015***	0.339**	0.027***

	(1.13)	(3.65)	(2.27)	(5.74)
SOE	–0.058	–0.002	–0.082	0.000
	(–1.00)	(–1.03)	(–1.20)	(0.15)
TENURE_PAR	–0.049	0.000	0.060	0.001
	(–0.76)	(0.07)	(0.85)	(0.79)
TENURE_FIRM	–0.030	0.001	0.040	0.002
	(–0.69)	(1.02)	(0.82)	(1.39)
CLIENTS_FIRM	–0.047*	–0.000	–0.072**	–0.000
	(–1.73)	(–0.49)	(–2.48)	(–0.03)
YEAR FE	INCLUDE	INCLUDE	INCLUDE	INCLUDE
INDUSTRY FE	INCLUDE	INCLUDE	INCLUDE	INCLUDE
Constant	–0.788	0.046***	–0.530	0.056***
	(–1.30)	(2.82)	(–0.85)	(3.50)
Observations	9,772	4,623	8,725	4,153
Pseudo R-squared	0.0319		0.0286	
R-squared		0.627		0.643

This table examines the possible mechanism of the effect on audit quality using the following model:
$AuditQuality_{it} = b_0 + b_1 BIG4 \times POLICY + b_2 BIG4 + b_3 POLICY + b_4 Controls_{it} + FE + \varepsilon_i$.
where *Audit Quality* represents restatement (*RESTATEMENT*) and discretionary accruals (*DA*). *BIG4* is a dummy variable coded 1 for the Big4 international audit firms, and 0 otherwise. *POLICY* is a dummy variable coded 1 after the implementation of the Big4 localization policy, and 0 otherwise. Controls include firm size (*SIZE*), leverage (*LEV*), loss indicator (*LOSS*), return on assets (*ROA*), total accruals (*TACC*), modified opinion indicator (*MAO*), state-owned entity (*SOE*), individual auditor tenure (*TENURE_PAR*), audit firm tenure (*TENURE_FIRM*) and audit firm's client number (*CLIENTS_FIRM*); ε is the error term. Figures in parentheses are *t*-statistics. *** (**, *) indicates significance at the 1% (5%, 10%) level for two-tailed tests. All variables are defined in Appendix A.

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.

Appendix A. Variable definitions

Name	Definition
BIG4	Dummy variable coded 1 for firm-year observations audited by international Big4 audit firms, and 0 otherwise
POLICY	Coded 1 for financial years after 2012, and 0 otherwise
SWITCH	Coded 1 if there is an auditor switch within the audit firm, and 0 otherwise
OLD_to_NEW	Coded 1 if the current auditor's average CPA registration time is shorter than that of the auditor in the prior year, and 0 otherwise
FEE	Log of audit fees
ABFEE	Abnormal audit fees estimated as the residual of Eq. (3)
SIZE	Logarithm of total assets in year *t*
LEV	Financial leverage, measured as the ratio of debt to total assets
LOSS	Coded 1 for negative net income, and 0 otherwise
ROA	Return on assets, measured as net income over total assets
TACC	Total accruals
MAO	Coded 1 if the audit opinion in the current year is a modified opinion, and 0 otherwise
SOE	Coded 1 if the client is a state-owned entity, and 0 otherwise
EXP_PAR	Log of the sum of individual auditor experience. Experience is calculated as the number of years since the auditor registered as a CICPA-qualified auditor
TENURE_PAR	Log of the sum of individual auditor tenure

TENURE_PAR_PRE	Log of the sum of individual auditor tenure in the prior year
TENURE_FIRM	Audit firm tenure
CLIENTS_FIRM	Log of client numbers of the audit firm
RESTATEMENT	Coded 1 for firm-year observations with restatements, and 0 otherwise
DA	Absolute value of discretionary accruals calculated using the Kothari et al. (2005) method
LN_BUSY	Log of client numbers of the signing auditors

Appendix B. Summary statistics of audit partners

	Before implementation (at the beginning of 2012)	After implementation (at the end of 2017)
	number of partners	number of partners
Big4	405	614
number of CICPA partners	202	495
percentage of CICPA partners	50%	80%
Non-Big4	1,399	2,736
Total	1,804	3,350

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Linguistic specificity and stock price synchronicity

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ABSTRACT

Linguistic specificity effectively reduces barriers to information cognition, increasing the efficiency of information acquisition, integration and processing. Combining the psycholinguistics theory of the concreteness effect with asset-pricing theory, we determine that linguistic specificity in the management discussion and analysis section of a firm's annual reports is negatively associated with stock price synchronicity, particularly in firms with strong external information demand or insufficient information supply. Furthermore, only specificity of the review section leads to a reduction in stock price synchronicity. Mechanism tests show that specificity reduces information processing costs and enhances information credibility. Additionally, proprietary costs are an essential determinant of linguistic specificity adoption. Our findings suggest that linguistic specificity plays an essential role in improving market pricing efficiency.

1. Introduction

An essential function of the capital market is to achieve an effective allocation of resources. Therefore, in addressing the crucial issue of improving the efficiency of resource allocation as proposed by the 15th meeting of the Central Committee of Comprehensive Deepening Reform, how to fully realize price information transmission in the capital market has drawn much attention from practitioners and scholars. Compared with capital markets in developed countries, China's capital market remains confronted with obstacles in information transmission and a lack of necessary guarantee mechanisms of disclosure quality, resulting in severe con-

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straints on the ability of stock prices to reflect the realities of listed firms. On 1 May 2021, the latest revision of the ''Measures for the Administration of Information Disclosure of Listed Firms'' issued by the China Securities Regulatory Commission came into effect. This revision is expected to improve the overall information environment of the capital market in China. Notably, requirements for voluntary disclosure of specific information and principles of understandable disclosure have been added to guide listed firms on the specificity of information disclosure. Whether emphasizing the importance of specificity can alleviate long-standing problems, such as the flexibility of accounting rules, the generalization of information disclosure contents and the use of boilerplate language expressions, has become a key issue in the reform of information disclosure in China's capital market. Overall, practical and theoretical evidence indicates that emphasizing the role of information disclosure quality and characteristics is important for improving resource allocation and information transmission efficiency.

The literature on the linguistic characteristics of listed firms'information disclosures can be divided into two groups, namely readability and emotional characteristics, and mainly explores the impact of these characteristics on the capital market (Lu et al., 2019; Zhou et al., 2019; Durnev and Mangen, 2020). Similar to emotional characteristics, specificity acts as a key grip in analyses of linguistic features. However, few studies focus on the economic consequences of linguistic specificity. Specificity is a linguistic concept that refers to the nature of language in which words refer to something that exists in reality or can be experienced by human senses, reflecting the concreteness or abstractness of language expression (Brysbaert et al., 2014). Some scholars apply linguistic specificity in psychological research, mainly focusing on the effect of specificity on semantic processing. According to Paivio et al. (1968), humans may find sentences with high concreteness ratings (e.g., ''Huawei'') to be more efficient and more effective in transmission, cognition and memory than those with high abstractness ratings (e.g., ''qualified supplier''). This phenomenon is referred to as ''concreteness effects.'' Research on linguistic specificity and concreteness effects has moved away from the pure linguistic paradigm or psychological paradigm and has been integrated into psycholinguistics. It has become one of the most-examined psycholinguistic topics in this newly emerging interdisciplinary field (Pollock, 2018). From a practical perspective, regulators of major capital markets around the world, including China, have developed related guidelines and requirements regarding the specificity of information disclosure. For example, the U. S. Securities and Exchange Commission (SEC) suggested as early as 1998 that ''although it is impossible to eliminate all abstractions from writing, always use a more concrete term when you can'' (SEC, 1998, p. 23), and it required ''risk factor disclosure to be specific to the registrant and exclude generic statements that apply to all or most registrants'' (SEC, 2020, p. 75) in 2020. The 2014 Canadian Business Corporations Act requires all listed firms to make concrete and detailed disclosures of policies and practices regarding the maintenance of gender diversity on boards of directors. Furthermore, the abovementioned ''Measures for the Administration of Information Disclosure of Listed Firms'' in China provides guidance on information disclosure in terms of specificity and elaboration. In addition to the efforts of regulators, emerging literature pays attention to the role of linguistic specificity in information disclosure. The main findings in the literature show that increased specificity in earnings conference call and risk factor disclosures can increase the efficiency and effectiveness of information transmission between companies and investors, leading to positive market reactions in the short term (Hope et al., 2016; Pan et al., 2018). However, few studies examine the long-term economic consequences of linguistic specificity. Meanwhile, as earnings conference call and risk factor disclosures are not mandatory, previous studies are likely to suffer from self-selection bias. Taken together, it is of great theoretical and practical value to examine the effect of linguistic specificity on the long-term pricing efficiency of capital markets based on the unique institutional settings in China.

Using data on China's A-share publicly listed firms from 2003 to 2019, we first conduct a text analysis of the management discussion and analysis (MD&A) section in the firms' annual reports using named entity recognition (NER) machine-learning technology. We then calculate linguistic specificity for each company by year and investigate the relationship between specificity and stock price synchronicity, which is regarded as an effective proxy for pricing efficiency. We find that firms with highly specific information disclosures are less likely than others to exhibit stock price synchronicity. Our channel tests show that linguistic specificity can reduce the cost of information processing and enhance the credibility of disclosures, facilitating firm-level information capitalization into stock prices. The effect of specificity is more pronounced in firms with high external information demand or inadequate information supply than in other firms. Further analysis shows

that when we divide the MD&A section into two parts, only the specificity of the review part has a significant negative effect on stock price synchronicity. Finally, consistent with Huang et al. (2014), we also find that proprietary costs play a vital role in providing specific information disclosures.

We make the following contributions to the literature. First, we combine concreteness effects according to psycholinguistics with information transmission theory and validate this combination in asset pricing. We are also the first to empirically test the relationship between linguistic specificity and stock price synchronicity within the "linguistic characteristics of information—investors' perception and processing of information—changes in capital market pricing efficiency" framework. Previous studies examine the effects of linguistic features (e.g., readability and sincerity) on stock price synchronicity (Bai et al., 2018; Cao, 2019; Wang et al., 2020a) and shed light on the underlying channels. They find that more readable disclosures decrease firm-level stock price synchronicity by lowering the cost of information processing, whereas sincere disclosures enhance information credibility and subsequently improve pricing efficiency. Following the literature, we creatively consider the mechanisms mentioned and provide evidence that linguistic specificity can reduce information processing costs and improve credibility, ultimately leading to less synchronous stock prices. In other words, we construct a unique setting to verify the effect of linguistic specificity on the capital market, complementing the growing research on linguistic features that affect market efficiency.

Second, using cutting-edge machine-learning techniques, we construct a firm idiosyncratic linguistic specificity index based on China's capital market for the first time. Borrowing from studies based on the experiences of developed countries, we successfully apply similar logic developments to emerging markets and extend the budding literature on the economic consequences of unstructured information disclosures.

Third, our findings provide theoretical support for and empirical evidence of the revision and implementation of the "Measures for the Administration of Information Disclosure of Listed Firms" in China. We expect the findings to draw investors' attention to the specificity of narrative disclosures and to be instructive for regulators in initiating policies about the further refinement of information disclosures by listed firms.

2. Related literature and hypotheses

2.1. Literature on stock price synchronicity

Given the pervasiveness of information asymmetry and agency costs, capital markets depend on information to exchange price signals. Intuitively, the effective transmission of information is closely related to the resource allocation efficiency of the entire market (Francis et al., 2004). Based on stock price signals formed by the effective transmission of factual information, investors can formulate investment strategies to meet target returns, which is the key to improving resource allocation efficiency and achieving a Pareto improvement (Durnev et al., 2004). Briefly, the more firm-informative stock prices are, the more rational the market allocation of resources is.

Stock price synchronicity refers to the extent to which stock prices move together. A high degree of synchronicity shows that the stock price contains less idiosyncratic information about the firm, indicating poor information efficiency (Morck et al., 2000; Durnev et al., 2003). Considering that excess synchronicity can significantly inhibit the operation of capital markets, there is extensive literature on the determinants of stock price synchronicity from macro and micro perspectives. According to research, information acquisition and processing costs are important factors driving stock price synchronicity (Piotroski and Wong, 2011). When information is difficult to obtain or process, investors can neither receive nor perceive firm-specific information, thereby causing high synchronicity (Kim and Shi, 2012; Shi and Zhang, 2014). Furthermore, based on textual analysis, recent studies find that more readable financial disclosure is associated with lower stock price co-movement (Lee, 2012; Bai et al., 2019; Cao, 2019), further expanding the role of the information processing cost in synchronicity.

2.2. Literature on linguistic specificity

Both tone (i.e., sentiment) and specificity (i.e., concreteness) are linguistic features essential to ensuring that a message can be effectively delivered. Generally, written (spoken) language is an independent system that con-

tains the writer's (speaker's) subjective experience, external expression and mental activity. Notably, a subjective experience can be interpreted as an individual's internal emotional feelings, better known as linguistic tone. Capital market literature shows that the linguistic tone of listed firms' information disclosures is significantly associated with the cost of capital, future performance and market information efficiency (Feldman et al., 2010; Li, 2010; Xie and Lin, 2015). To our surprise, although the impact of linguistic tone on capital markets has been widely studied in recent years, the link between linguistic specificity and market reactions remains under-researched. As a result, the impact of linguistic specificity is the focus of this study.

Linguistic specificity is a concept that reflects whether human senses and actions can experience nouns, and it is often used to evaluate the concreteness and abstractness of information (Gilhooly and Logie, 1980). Information with high specificity ratings effectively improves the speed and accuracy of information processing for recipients and is also easier to memorize than other information; this phenomenon is referred to as the concreteness effect in psycholinguistics (Paivio, 1991; Kounios and Holcomb, 1994; Wang and Yao, 2012). To subserve the concreteness effect, Paivio (1991) proposes dual-coding theory to explain why processing specific information, including recognition, cognition and recall, is superior to abstract expressions. Dual-coding theory claims that there are two distinct but closely linked cerebral processing systems and that the processing of abstract information only activates the verbal code system of the left cerebral hemisphere. In contrast, specific information additionally accesses the nonverbal code system of the right cerebral hemisphere simultaneously. Furthermore, either the verbal or nonverbal code system can be active without the other, but both systems can also be active in parallel. Hence, theoretically, concrete information is processed by two coding systems approximately twice as fast as abstract information processed by a single coding system (Paivio, 1991).

Recent studies exploring the economic consequences of the linguistic specificity of disclosure by listed firms establish a positive association between specific information and market reactions. Elliott et al. (2015) present experimental evidence that specific disclosure can effectively reduce the psychological distance between investors and listed firms. As a result, investors are more inclined to invest in firms with high specificity in their IPO prospectus. This is the first empirical study that provides evidence of the effect of linguistic specificity on investors' judgments and decisions. Following Elliott et al. (2015), Hope et al. (2016) take advantage of a machine-learning technique to extract concrete nouns in firms' 10-K filings and quantify the degree of linguistic specificity of the firms' narrative risk factor disclosures. By examining returns in a 3-day event window, they document a positive market reaction to specific 10-K filings. Similarly, Pan et al. (2018) use quarterly earnings conference call transcripts as initial samples and find that management's linguistic specificity can lead to positive investor reactions over a narrow window, enhancing the reliability of the study by Hope et al. (2016).

Although the capital market literature generally sheds light on the crucial role of specificity in information disclosures, the effect of linguistic specificity is still under exploration, mainly reflected in partially developed theories and the incomplete empirical framework. Specific disclosures effectively improve investors' performance in terms of information recognition, cognition and recall. However, they can also entail information leakage risks, weakening firms' competitive advantages. Therefore, the research perspective on the economic consequences of linguistic specificity should be extended from short-term firm-specific market reactions to improvements in the long-term efficiency of the market as a whole.

2.3. Hypothesis development

The procedure of investors' information processing can be divided into three parts: information acquisition, information evaluation and information weighting (Maines and McDaniel, 2000). Information acquisition refers to how investors obtain information by reading specific sections of financial reports. Information evaluation refers to investors' assessment of characteristics of the numerical and narrative financial data. Finally, information weighting occurs when investors put weight on different characteristics by cross-comparing sections and trade-offs to ultimately judge firms' performance. We analyze how linguistic specificity affects investors' acquisition and evaluation of information, and we explore its impact on firm-level stock price synchronicity.

First, disclosures with a high level of linguistic specificity may effectively reduce investors' information processing costs and improve evaluation efficiency. Theoretical and experimental evidence supports the mitigating effect of specificity on information processing costs. According to concreteness effects and dual-coding theory,

specific information (concrete nouns) activates the verbal and nonverbal code systems simultaneously, and it can thereby be processed faster than abstract information. Meanwhile, previous studies experimentally document that specific information can be more easily understood and recalled. For example, Paivio (1967) finds that the total number of concrete nouns correctly recalled by participants in a free recall experiment is twice the number of abstract nouns. Kolker and Terwilliger (1981) find that first graders take 60% more time to learn and understand abstract words versus concrete words. In brief, specific disclosure may reduce the cost of information processing, as it is time-saving and easy to remember. Recent psycholinguistic research also confirms the implications of concreteness effects and highlights the role of specificity in increasing information evaluation efficiency. In addition to the verbal code system, specific information excites the nonverbal code system with its imagery content. The greater the intensity of the specific information activation of both systems, the deeper the degree of processing, which ultimately manifests in a more accurate evaluation of the information by the receiver (Paivio, 2013; Segal, 2014). Disclosures with high specificity contain more detailed explanations, thereby making the information easier to understand and absorb (McClelland and Rumelhart, 1985) and reducing the processing costs for investors. When the costs of extracting and understanding the information from financial reports are high, it is challenging to fully reflect the firm-specific information within stock prices (Ball, 1992; Bloomfield, 2002; Hirshleifer and Teoh, 2003). Thus, lower information processing costs effectively reduce firm-level stock price synchronicity (Dong et al., 2016). As such, we argue that firms with more specific disclosures have lower stock price synchronicity.

Second, a high level of linguistic specificity is conducive to enhancing disclosure credibility and centralizing investors' access to information. Valuable and noisy forms of information are intertwined in the stock market, and each investor, as a finite rational individual, needs to decide the level of credibility in this information and the amount of access to information by weighing the costs and benefits. Prior work argues that information with excellent specificity is more detailed and contextualized than abstract information. Therefore, highly specific information is more likely to be evaluated objectively by investors (Semin and Fiedler, 1988; Semin and Fiedler, 1991). Linguistic specificity may also give investors more confidence in their ability to correctly evaluate a firm (Heath and Tversky, 1991; Graham et al., 2009). Overall, information with higher linguistic specificity has greater credibility (Hansen and Wänke, 2010; Larrimore et al., 2011; Toma and D'Angelo, 2015), and high credibility promotes the capitalization of information, thus reducing stock price synchronicity. When firms make more specific disclosures, the richness of information content is adequate to satisfy the extensive and intensive information needs of investors (Hope et al., 2016), which reduces their dependence on different interpretations of the information and amplifies the impact of annual report information on investment decisions. Hence, linguistic specificity may narrow investors' scope to firms' recent disclosures and facilitate prices for firm-level information. Based on these arguments, we propose our primary hypothesis as follows:

H1. *Ceteris paribus*, linguistic specificity is negatively associated with firm-level stock price synchronicity.

Additionally, our underlying assumption is that there is a great demand for firm idiosyncratic information by investors. When the need for information via mandatory disclosures (e.g., annual reports) is urgent, investors are more likely to attach great importance to specific narrative or numerical financial information from the reports. In turn, such information can be priced. On the contrary, if the firm occasionally makes voluntary disclosures, creating an information environment with more minor asymmetry, specific disclosures tend to be less helpful. Based on information supply–demand theory, we expect investors to be more likely to rely on information with high linguistic specificity as information demand increases (Zhong and Liu, 2020; Cheong et al., 2021). In this context, more firm-specific information from the MD&A section can be incorporated in stock prices, reducing the propensity of price co-movement. Using the arguments above, we present our second hypothesis as follows:

H2. *Ceteris paribus*, the negative association between linguistic specificity and stock price synchronicity is more prominent in firms with strong information demand by outsiders or with insufficient information supply.

3. Data and research design

3.1. Sample and data

As our initial sample, we collect the annual financial reports of all A-share listed firms in China from 2003 to 2019. We then calculate the linguistic specificity of the MD&A section in the firms' annual reports by extracting specific entity names using the NER technique, and we empirically investigate the effect of linguistic specificity on firm-level stock price synchronicity. Following previous studies, we exclude 1) financial services firms, 2) special treatment firms, 3) IPO firms, 4) firms with a trading period less than 30 weeks in each fiscal year and 5) firm-year observations with missing information for the control variables. Our final sample includes 30,613 firm-year observations.

All of the annual financial reports are obtained from the CNINF website (cninf.com), and the data on media coverage are retrieved from the Chinese Research Data Services database. Furthermore, we retrieve our financial data and other basic information from the China Stock Market and Accounting Research database. To reduce the influence of outliers, we winsorize all of the continuous variables at the 1% and 99% levels. We include industry fixed effects in addition to year dummy variables to control for the effect of time-related industry patterns, and standard errors are adjusted for clustering at the firm level.

3.2. Variable definitions

3.2.1. Stock price synchronicity

We measure stock price synchronicity consistent with the literature (Morck et al., 2000; Gul et al., 2010; Cai et al., 2021). First, we regress daily firm stock returns on industry value-weighted returns. We then extract R^2 from each regression to calculate the firm-level stock price synchronicity. The formulas are defined as follows:

$$R_{i,t} = \beta_0 + \beta_1 R_{m,t} + \varepsilon_{i,t} \tag{1}$$

$$Synch_{i,t} = \log\left(\frac{R^2_{i,t}}{1 - R^2_{i,t}}\right) \tag{2}$$

where $R_{i,t}$ denotes the returns for firm i on day t, and $R_{m,t}$ denotes the value-weighted returns in industry m on day t. We use "Listed Company Profession Classification Direction (2012)" as the basis for our industry classification. $R^2_{i,t}$ is the coefficient of determination estimated from Eq. (1). Higher values of *Synch* indicate that a lower degree of firm idiosyncratic information is incorporated in the stock prices.

3.2.2. Linguistic specificity

Following Hope et al. (2016), we use the NER technique, a machine-learning approach, to compute linguistic specificity (*Specificity*) in the MD&A section. NER is a natural language processing technique used to recognize entities with specific meaning in text and is an essential and fundamental tool for information extraction, syntactic analysis and machine translation. The primary function of NER is to identify and extract three main categories (i.e., entity, time and numbers) and seven subcategories (i.e., people, institution, place, time, date, currency and percentage) of named entities within texts. Thus, the NER technique allows for the scientific extraction of relevant words indicating time, place, institution and number in the MD&A section.

We construct *Specificity* using the following four steps: 1) content extraction, 2) word-cut and sentence segmentation, 3) NER and 4) index calculation. Specifically, we first download all of the annual reports of A-share public companies from the CNINF website and convert PDF documents into TXT format. We then use regular expressions[1] to extract the MD&A section in each financial report and remove all of the stop words. Next, we divide sentences in the MD&A section by punctuations and conjunctions. To keep the original information as complete as possible, we introduce a Chinese lexical analysis model to finish word segmen-

[1] The regular expression is a logical formula for string manipulation that uses a predefined set of characters and combinations to form a "regular string." The regular string can also be used to retrieve and replace text that matches a particular pattern.

tation, joint part-of-speech tagging and NER tasks, combined with 16 common sentence segmentation symbols. Furthermore, we adopt Baidu's deep learning Chinese lexical analysis tool to extract words that have at least one of the following meanings and are no less than 2 bytes, sentence by sentence: 1) time and date, 2) location, 3) organization and 4) monetary amount and percentage. Finally, we use Eq. (3) to calculate *Specificity*, which equals the number of words belonging to the four abovementioned categories divided by the total number of words in the MD&A section:

$$Specificity_{i,t} = \frac{Time_{i,t} + Loc_{i,t} + Org_{i,t} + Num_{i,t}}{Totalwordsof MD\&A_{i,t}} \times 100\% \tag{3}$$

where $Time_{i,t}$, $Loc_{i,t}$, $Org_{i,t}$ and $Num_{i,t}$ denote the number of words indicating times and dates, location, organization and money values and quantitative values in percentages, respectively. The denominator is the number of all words in the MD&A section.

3.2.3. Information demand versus supply

To test the moderating role of information demand versus supply, we use supply chain concentration as a proxy for information demand by outsiders and use growth ability to capture the supply of information. Firms with a concentrated supply chain are more likely to exchange information with suppliers or clients through private channels, which seem to be more immediate and cost-saving (Raman and Shahrur, 2008). Given the substitution relationship between public and private information disclosure (Ball et al., 2000; Biddle and Hilary, 2006), firms with a concentrated supply chain prefer to disclose information in private ways. Consequently, the publicly disclosed information available does not adequately meet investors' needs, and the cost of information acquisition for outsiders increases. In brief, the demand for information is stronger for firms with higher supply chain concentration than for other firms (Crawford et al., 2020). Firms with a good chance of growth tend to disclose information more actively, as it is beneficial to make potential investors aware of impressive progress and promising prospects. More importantly, voluntary public disclosure effectively reduces information asymmetry and thus assists firms in satisfying their financing needs (Bushman and Smith, 2001; Verrecchia, 2001). Overall, great corporate growth ability is associated with sufficient information supply (Khurana et al., 2006).

In terms of measuring information demand, following Tang et al. (2009) and Wang et al. (2020b), we use supplier concentration (*UpCC*) and customer concentration (*DownCC*) to measure the extent to which investors demand firm idiosyncratic information. *UpCC* (*DownCC*) is the ratio of purchases (sales) from the top five suppliers (customers) to total purchases (sales) for the year. The degree of information supply is measured by the sales growth rate (*SalesG*) and the return on net worth growth rate (*RoeG*).

3.2.4. Control variables

We control a group of known determinants of stock price synchronicity as suggested by the literature. We include firm size (*Size*), financial leverage (*Lev*), the market-to-book ratio (*Mb*), return on assets (*Roa*), the credibility of the auditing firm (*Big4*), managerial ownership (*Mngshare*), the shareholding ratio of the largest shareholder (*Top1*), the annual stock turnover rate (*Turnover*), the proportion of independent directors (*Independent*), listed year (*Age*), readability (*Readability*) and the net linguistic tone of the MD&A section (*Tone*). Variable definitions are presented in Table 1.

4. Research design

To test the effect of linguistic specificity on stock price synchronicity, we follow the literature (Gul et al., 2010) and use the following regression model. A negative α_1 indicates the mitigating effect of linguistic specificity on synchronicity.

$$Synch_{i,t+1} = \alpha_0 + \alpha_1 Specificity_{i,t} + Controls_{i,t} + \sum Year + \sum Industry + \varepsilon_{i,t} \tag{4}$$

To investigate the moderating role of information demand versus supply, we add the degree of information demand/supply and the related interactive items into the baseline model as follows:

Table 1
Variable definitions.

Variable	Definition
Synch	The logarithmic transformation of R^2 for the market model in Eq. (1), computed as shown in Eq. (2).
Specificity	The number of name entities/total words in the MD&A section, as shown in Eq. (3).
Size	The natural logarithm of total assets.
Lev	Total liabilities divided by total assets.
Mb	The market-to-book ratio of equity, calculated as the market value of equity divided by the book value of equity.
Roa	Net income scaled by total assets.
Big4	A binary variable that equals 1 if the firm is audited by one of the Big 4 audit firms and 0 otherwise.
Age	The natural logarithm of the listed years.
Turnover	The average daily stock turnover within a fiscal year.
Mngshare	The number of shares held by management scaled by the number of total shares.
Top1	The number of shares held by the largest shareholder scaled by the number of total shares.
Independent	The ratio of independent directors on the board.
Readability	The average word density value of each sentence in the MD&A section.
Tone	(Number of positive words – number of negative words)/total words in the MD&A section.
DownCC	Total sales income from the top five customers scaled by total sales income.
UpCC	Total purchasing cost from the top five suppliers scaled by total purchasing cost.
SalesG	The total revenue growth rate.
RoeG	The return on equity growth rate.

$$Synch_{i,t+1} = \beta_0 + \beta_1 Specificity_{i,t} + \beta_2 SupDem_{i,t} + \beta_3 Specificity_{i,t} \times SupDem_{i,t} + Controls_{i,t} + \sum Year + \sum Industry + \varepsilon_{i,t} \quad (5)$$

where *SupDem* denotes one of the abovementioned proxies for the degree of information demand (i.e., *DownCC* or *UpCC*) and the degree of information supply (i.e., *SalesG* or *RoeG*).

5. Empirical results

5.1. Summary statistics

Table 2 presents a statistical summary of the sample. For *Synch*, the mean is –0.822, the minimum (maximum) value is –3.654 (0.830) and the standard deviation is 1.019, indicating that stock price synchronization varies widely among the sample firms. Meanwhile, the linguistic specificity measure (*Specificity*) has a mean of 9.518 and a median value of 4.353. Notably, its maximum value (22.762) is around six times its minimum value

Table 2
Summary statistics.

Variable	Obs.	Min.	Max.	Mean	Median	S.D.
Synch	30,613	–3.654	0.830	–0.822	–0.673	1.019
Specificity	30,613	3.791	22.762	9.518	7.885	4.777
Size	30,613	20.013	25.049	21.980	21.815	1.203
Lev	30,613	0.083	0.833	0.446	0.448	0.200
Mb	30,613	0.944	5.455	1.866	1.507	1.013
Roa	30,613	–0.119	0.165	0.041	0.037	0.053
Big4	30,613	0.000	1.000	0.059	0.000	0.235
Mngshare	30,613	0.000	0.615	0.103	0.000	0.180
Top1	30,613	0.114	0.690	0.356	0.335	0.150
Turnover	30,613	0.003	0.085	0.025	0.019	0.020
Independent	30,613	0.308	0.500	0.368	0.333	0.048
Age	30,613	1.000	23.000	9.374	8.000	6.365
Readability	30,613	14.593	42.593	22.784	19.963	4.239
Tone	30,613	0.091	0.483	0.298	0.299	0.093

(3.791). The descriptive results of *Specificity* show that this measure is suitable for subsequent analysis, as there are apparent contrasts among the sample, providing essential support for our subsequent analysis.

5.2. Empirical results

5.2.1. Tests of H1

Table 3 reports the results of Eq. (4). No control variables are included in Column (1). In Column (2), we add control variables and control for both year and industry fixed effects. The results in Columns (1) and (2) show that *Specificity* has a significant mitigating effect on firm-level synchronicity in the next period. In addition, to rule out the alternative explanation that the specificity or abstractness of disclosure is a fixed writing style rather than a deliberate choice (Lehavy et al., 2011; Kravet and Muslu, 2013), we re-estimate the regression of Eq. (4) using the firm fixed effects model and report the results in Column (3). The coefficient of *Specificity* remains significantly negative at the 1% level.

Table 3
Impact of social trust on stock price synchronicity.

	Dependent variable:$Synch_{t+1}$		
	(1)	(2)	(3)
Specificity	–0.014***	–0.005***	–0.004**
	(–11.46)	(–2.65)	(–2.18)
Size		0.136***	0.242***
		(15.56)	(16.35)
Lev		–0.407***	–0.468***
		(–10.40)	(–8.47)
Mb		–0.086***	0.014
		(–10.11)	(1.50)
Roa		0.513***	0.618***
		(4.10)	(4.22)
Big4		–0.097***	0.041
		(–3.10)	(0.85)
Mngshare		–0.351***	–0.294***
		(–8.33)	(–2.91)
Top1		–0.163***	–0.267***
		(–3.84)	(–3.05)
Turnover		3.163***	5.190***
		(9.08)	(12.71)
Independent		–0.200*	–0.055
		(–1.71)	(–0.35)
Age		0.009***	–0.020
		(7.15)	(–1.05)
Readability		0.012***	0.004
		(4.65)	(1.10)
Tone		0.151**	0.088
		(2.12)	(1.02)
Constant	–0.690***	–3.257***	–5.712***
	(–53.21)	(–16.97)	(–15.32)
Year & Industry Fixed Effects	No	Yes	No
Year & Firm Fixed Effects	No	No	Yes
Observations	30,613	30,613	30,488
Adjusted R^2	0.004	0.342	0.391

Note: ***, ** and * denote significance at 1%, 5% and 10%, respectively. The t-statistics are shown in brackets. Standard errors are adjusted for clustering at the firm level.

5.2.2. Tests of H2

In this section, we test H2, which predicts the effect of *Specificity* on stock price synchronicity to be more pronounced for firms with a high degree of information demand by outsiders or insufficient information sup-

Table 4
Moderating effect of information demand versus supply.

	Dependent variable:$Synch_{t+1}$			
	Information demand		Information supply	
	(1) Customer concentration	(2) Supplier concentration	(3) Sales growth rate	(4) Roe growth rate
*Specificity*DownCC*	–0.016***			
	(–3.19)			
*Specificity*UpCC*		–0.013**		
		(–2.17)		
*Specificity*SalesG*			0.003***	
			(3.05)	
*Specificity*RoeG*				0.013***
				(2.91)
Specificity	–0.003*	–0.002	–0.005***	–0.005***
	(–1.76)	(–1.00)	(–2.62)	(–2.59)
DownCC	0.173***			
	(6.08)			
UpCC		0.103***		
		(3.05)		
SalesG			–0.013***	
			(–2.77)	
RoeG				0.001
				(0.06)
Size	0.128***	0.112***	0.136***	0.136***
	(13.96)	(11.33)	(15.50)	(15.55)
Lev	–0.415***	–0.430***	–0.405***	–0.410***
	(–10.12)	(–9.33)	(–10.35)	(–10.48)
Mb	–0.083***	–0.078***	–0.085***	–0.086***
	(–9.40)	(–8.14)	(–10.01)	(–10.02)
Roa	0.478***	0.556***	0.514***	0.478***
	(3.68)	(3.86)	(4.09)	(3.67)
Big4	–0.090***	–0.093**	–0.098***	–0.096***
	(–2.77)	(–2.57)	(–3.13)	(–3.09)
Mngshare	–0.356***	–0.281***	–0.349***	–0.349***
	(–8.28)	(–6.14)	(–8.30)	(–8.30)
Top1	–0.154***	–0.158***	–0.161***	–0.164***
	(–3.54)	(–3.23)	(–3.79)	(–3.84)
Turnover	3.338***	3.240***	3.192***	3.174***
	(9.24)	(7.99)	(9.17)	(9.12)
Independent	–0.224*	–0.342**	–0.194*	–0.198*
	(–1.84)	(–2.54)	(–1.66)	(–1.69)
Age	0.010***	0.010***	0.009***	0.009***
	(7.13)	(6.96)	(7.22)	(7.16)
Readability	0.013***	0.014***	0.012***	0.012***
	(4.61)	(4.26)	(4.52)	(4.62)
Tone	0.170**	0.212**	0.145**	0.145**
	(2.28)	(2.47)	(2.03)	(2.04)
Constant	–3.055***	–2.720***	–3.253***	–3.258***
	(–15.17)	(–12.49)	(–16.97)	(–16.96)
Year & Industry Fixed Effects	Yes	Yes	Yes	Yes
Observations	27,738	21,396	30,561	30,561
Adjusted R^2	0.342	0.315	0.342	0.342

Note: ***, ** and * denote significance at 1%, 5% and 10%, respectively. The t-statistics are shown in brackets. Standard errors are adjusted for clustering at the firm level.

ply. In Columns (1) and (2) of Table 4, the coefficients of *Specificity*DownCC* and *Specificity*UpCC* are significantly negative, suggesting that the impact of specificity is stronger for firms with less public disclosure. In Columns (3) and (4), the coefficients of *Specificity*SalesG* and *Specificity*RoeG* are positive and significant at the 1% level, indicating that the impact of *Specificity* is less pronounced for firms in the growth stage, which have a strong desire to disclose information voluntarily. In sum, H2 is confirmed by the findings in Table 4.

6. Additional analyses

We argue that specific information disclosure can reduce investors' information processing costs and enhance disclosure credibility, which results in lower stock price co-movements. We provide direct empirical evidence to support the underlying economic mechanisms. In addition, we divide the MD&A section into two sub-sections, namely the preview section and the review section, and we investigate whether there are differences between these sections. Finally, following Hope et al. (2016), we test whether lower proprietary costs are associated with more specific information disclosure in the MD&A section, complementing literature about the determinants of linguistic specificity.

6.1. Economic mechanisms

6.1.1. The channel of information processing cost

As discussed in Section 2.3, more specific information disclosure may mitigate investors' processing costs and cause more firm idiosyncratic information to be incorporated into the stock price, thus reducing firms' stock price synchronicity in the future. The literature finds that information intermediaries can significantly affect investors' cognition and memory of firm-specific information by actively seeking and interpreting information disclosed by listed firms to external investors. For example, financial analysts and news media have professional capabilities and channel advantages in information collection, verification, integration and digestion (Miller, 2006; Dyck et al., 2008; Bushee et al., 2010). Consequently, they can effectively reduce investors' information processing costs (Fang and Peress, 2009; Drake et al., 2014). Briefly, the participation of information intermediaries makes it easier for ordinary investors to understand the information disclosed by listed firms. As a result, in Table 5, we use the number of following analysts (*Analysts*) and the frequency of media coverage (*Media*) as proxies for the cost of information processing, as firms that attract more analysts or new media tend to exhibit lower information processing costs. In Columns (1) and (2), the coefficients of *Specificity*Analysts* and *Specificity*Media* are significantly positive, supporting our argument that information processing cost is a channel through which lower stock price synchronicity can be obtained.

6.1.2. The channel of information credibility

Aside from the information processing cost, another channel, namely enhancement of information credibility, may explain the reduction of firm-level stock price co-movements. Credibility continues to improve as specific disclosures increase and more firm-specific information is capitalized into the stock price, leading to lower stock price synchronicity. As the trustworthiness of disclosures can rarely be determined in advance, we alternatively use the regional trust culture as a proxy for firms' information credibility (Pevzner et al., 2015; Qiu et al., 2020). Following Dai et al. (2019) and Yu et al. (2020), we first extract data on deadbeat borrowers from the Supreme People's Court of China using web scraping with Python and calculate the provincial proportion of deadbeat borrowers (*Untrusted*). The higher the value of *Untrusted*, the more prevalent are debt defaults within the region, indicating that a clear majority of firms operating in such dishonest environments tend to disclose untruthful information. We also use the county-level proportion of deadbeat borrowers (*Untrusted_R*) to accurately capture the variation in environmental credibility. In Columns (1) and (2) of Table 6, the coefficients of *Specificity*Untrusted* and *Specificity*Untrusted_R* are significantly negative, supporting our conjecture about the economic mechanism of information credibility. Investors tend to lack confidence in disclosures from firms operating in enhancement with low trustworthiness. Hence, by enhancing the credibility of information, *Specificity* increases the degree to which firm idiosyncratic information is incorporated into the stock price, leading to lower synchronicity.

Table 5
Mechanism: Information processing cost.

	Dependent variable:$Synch_{t+1}$	
	(1) Following analysts	(2) Media coverage
*Specificity*Analysts*	0.002**	
	(2.49)	
*Specificity*Media*		0.001*
		(1.68)
Specificity	–0.004**	–0.005***
	(–2.29)	(–2.62)
Analysts	–0.035***	
	(–5.04)	
Media		–0.019***
		(–3.25)
Size	0.155***	0.148***
	(16.02)	(15.79)
Lev	–0.414***	–0.411***
	(–10.66)	(–10.48)
Mb	–0.078***	–0.082***
	(–8.94)	(–9.57)
Roa	0.719***	0.533***
	(5.63)	(4.25)
Big4	–0.098***	–0.092***
	(–3.16)	(–2.94)
Mngshare	–0.329***	–0.355***
	(–7.87)	(–8.41)
Top1	–0.174***	–0.173***
	(–4.12)	(–4.04)
Turnover	3.084***	3.207***
	(8.87)	(9.05)
Independent	–0.212*	–0.168
	(–1.82)	(–1.42)
Age	0.008***	0.009***
	(6.06)	(7.09)
Readability	0.012***	0.012***
	(4.42)	(4.41)
Tone	0.191***	0.143**
	(2.67)	(2.00)
Constant	–3.660***	–3.484***
	(–17.38)	(–17.19)
Year & Industry Fixed Effects	Yes	Yes
Observations	30,613	30,290
Adjusted R^2	0.343	0.343

Note: ***, ** and * denote significance at 1%, 5% and 10%, respectively. The t-statistics are shown in brackets. Standard errors are adjusted for clustering at the firm level.

6.2. Further analyses

6.2.1. Specificity of review section versus preview section

Above, we investigate how the linguistic specificity of the MD&A section of a firm's annual report affects stock price synchronicity. As prior work suggests that the MD&A section is composed of preview and review sections (Meng et al., 2017), we further examine whether the effects of these sections differ. The review section mainly introduces, explains and illustrates the operating activities and performance of a firm, and its primary function is to disseminate information about the firm from the past fiscal year to investors. In contrast, the

Table 6
Mechanism: Information credibility.

	Dependent variable:$Synch_{t+1}$	
	(1) Province-level social trust	(2) County-level social trust
*Specificity*Untrusted*	–0.015***	
	(–3.13)	
*Specificity*Untrusted_R*		–0.030**
		(–2.35)
Specificity	–0.004***	–0.005**
	(–2.76)	(–2.35)
Untrusted	1.135***	
	(4.90)	
Untrusted_R		1.338***
		(5.40)
Size	0.131***	0.128***
	(14.46)	(14.37)
Lev	–0.417***	–0.418***
	(–10.63)	(–10.67)
Mb	–0.091***	–0.092***
	(–10.60)	(–10.66)
Roa	0.565***	0.573***
	(4.50)	(4.56)
Big4	–0.096***	–0.096***
	(–3.05)	(–3.04)
Mngshare	–0.344***	–0.343***
	(–8.16)	(–8.14)
Top1	–0.166***	–0.164***
	(–3.90)	(–3.85)
Turnover	3.401***	3.463***
	(9.64)	(9.78)
Independent	–0.203*	–0.203*
	(–1.73)	(–1.73)
Age	0.008***	0.008***
	(6.34)	(6.22)
Readability	0.164**	0.164**
	(2.30)	(2.29)
Tone	1.223***	1.220***
	(4.55)	(4.54)
Constant	–3.070***	–3.063***
	(–14.98)	(–14.95)
Year & Industry Fixed Effects	Yes	Yes
Observations	30,611	30,611
Adjusted R^2	0.343	0.343

Note: ***, ** and * denote significance at 1%, 5% and 10%, respectively. The t-statistics are shown in brackets. Standard errors are adjusted for clustering at the firm level.

preview section covers market trends and systematic risks within the entire sector and the firm's development strategies and management objectives, focusing more narrowly on forward-looking and industry-level information.

The information in the review section can be regarded as a supplement to and an interpretation of the numerical financial data in the annual reports. When the review section is characterized with high linguistic specificity, investors can rely on such specific information to deepen their comprehension of the firm's perfor-

mance over the past year. In addition, as it describes and explains the firm's actual operation performance, the information disclosed in the review section is more objective and verifiable, and investors are more likely to trust such audited financial information and related narrative interpretation. Hence, stock price movements can reflect more of the firm's idiosyncratic information when the review section's disclosure is more specific. However, the preview section concentrates on industry-level prospects and risks. As a result, industry-wide information is more likely to be capitalized into stock prices when the linguistic specificity of the preview section is high. In other words, even if the preview section discloses specific information, it cannot effectively reduce firm-level stock price synchronicity.

In Table 7, we estimate the effects of the specificity of the review and preview sections separately. In Columns (1) and (2), the results indicate that the effect of the specificity of the review section still holds with the industry or firm fixed effects model. In contrast, in Columns (3) and (4), the impact of the specificity of the preview section disappears. We find that only the specificity of the MD&A review section acts to lower stock price co-movements.

Table 7
Further analyses: Effect of linguistic specificity in the review section versus the preview section.

	Dependent variable:$Synch_{t+1}$			
	Review section		Preview section	
	(1)	(2)	(3)	(4)
Specificity_Review	–0.006***	–0.006***		
	(–3.06)	(–2.72)		
Specificity_Preview			–0.003	–0.001
			(–1.12)	(–1.28)
Size	0.134***	0.243***	0.133***	0.241***
	(15.61)	(16.45)	(15.53)	(16.25)
Lev	–0.416***	–0.476***	–0.417***	–0.478***
	(–10.68)	(–8.63)	(–10.70)	(–8.67)
Mb	–0.088***	0.014	–0.088***	0.013
	(–10.30)	(1.49)	(–10.38)	(1.44)
Roa	0.597***	0.652***	0.599***	0.642***
	(4.85)	(4.58)	(4.86)	(4.51)
Big4	–0.104***	0.042	–0.103***	0.042
	(–3.32)	(0.88)	(–3.28)	(0.89)
Mngshare	–0.350***	–0.291***	–0.350***	–0.290***
	(–8.34)	(–2.87)	(–8.34)	(–2.86)
Top1	–0.163***	–0.266***	–0.159***	–0.265***
	(–3.83)	(–3.04)	(–3.75)	(–3.03)
Turnover	3.156***	5.163***	3.157***	5.163***
	(9.09)	(12.67)	(9.09)	(12.66)
Independent	–0.205*	–0.054	–0.204*	–0.050
	(–1.75)	(–0.34)	(–1.74)	(–0.32)
Age	0.009***	–0.021	0.009***	–0.021
	(7.19)	(–1.12)	(7.02)	(–1.11)
Readability	0.012***	0.042***	0.012***	0.042***
	(4.67)	(3.32)	(4.41)	(3.31)
Tone	0.159**	0.191***	0.157**	0.191***
	(2.23)	(2.67)	(2.20)	(2.63)
Constant	–3.350***	–5.751***	–3.340***	–5.744***
	(–17.63)	(–15.50)	(–17.58)	(–15.46)
Year & Industry Fixed Effects	Yes	No	Yes	No
Year & Firm Fixed Effects	No	Yes	No	Yes
Observations	30,613	30,383	30,613	30,383
Adjusted R^2	0.343	0.392	0.341	0.391

Note: ***, ** and * denote significance at 1%, 5% and 10%, respectively. The t-statistics are shown in brackets. Standard errors are adjusted for clustering at the firm level.

6.2.2. Proprietary cost as a determinant of specificity

Our examination of the economic consequences of linguistic specificity shows that not all public firms tend to disclose specific information. In contrast, some narrative disclosures in the MD&A section can be considered broad and generic. Therefore, it is necessary to determine the critical determinants of disclosure specificity.

The literature mainly theorizes about information disclosure behavior based on proprietary cost theory. Proprietary cost is the potential negative cost of disclosure to the firm, which must be mindful when making disclosure decisions (Verrecchia, 1983). Recent studies show that an increase in proprietary costs can decrease proprietary disclosure (Kim et al., 2021). The three following proprietary costs may be associated with specific disclosures. First, the cost of losing key customers. Specific disclosure of the names of major customers can make it easier for competitors to obtain information about a firm's customers, and they may snatch customers through vertical mergers and price negotiations (Darrough and Stoughton, 1990). Second, the cost of losing competitive advantage. Competitors may assess a firm's capacity and cost of production through firm-specific disclosures and take targeted suppressive actions to put the firm at a competitive disadvantage (Wagenhofer, 1990). Third, the cost of inferior reputation spillover. A firm may endure reputational damage when its customers, whose names are explicitly given, are accused of financial fraud (Kale and Shahrur, 2007). In summary, we argue that proprietary costs can be an essential determinant of linguistic specificity and are negatively associated with linguistic specificity.

Following previous studies, we use industry sales concentration and excess earnings to measure the proprietary cost of corporate disclosure. Concentrated sales (*PC_Concentration*) are associated with imperfect competition, and the proprietary costs for firms in a sector with highly concentrated sales are low, as the position of monopolies is almost unassailable (Gelb, 2000). *PC_Concentration* is calculated as the total sales of the top four firms over the total sales of the industry. Berger and Hann (2007) find that proprietary costs are higher for firms with excess earnings. Motivated by their findings, we also use excess earnings to measure proprietary costs. Excess earnings (*PC_Abnormal*) is defined as the difference between a firm's annual return on total assets (ROA) and the median value of ROA within the sector. We estimate the impact of proprietary costs on *Specificity* and present the results in Table 8. In Columns (1) and (2), the coefficients of the proprietary cost measures (*PC_Concentration* and *PC_Abnormal*) are significantly negative, indicating that firms with high proprietary costs are less likely to disclose specific information, thereby supporting our argument.

7. Robustness checks

Although we document the mitigating effect of *Specificity* on stock price synchronicity, the results may be subject to endogeneity arising from reverse causality, omitted variables and measurement error. First, prior work suggests that managers tend to adjust their disclosure strategies in response to market reactions (Zuo, 2013; Muslu et al., 2015) so that the linguistic specificity of disclosures and stock price synchronicity may be endogenously determined. We adopt the instrumental variable (IV) approach to alleviate this concern. Second, our regression estimates may be biased when relevant variables are omitted. As a result, we implement a falsification test to further address concerns surrounding omitted variable endogeneity. Third, due to the complexity of Chinese expressions, the NER technique used may not accurately capture words and sentences that represent specific disclosure. Furthermore, we perform a battery of robustness checks, including alternative measures of *Specificity* and stock price synchronicity and the propensity score matching (PSM) method, to mitigate challenges from measurement errors.

7.1. IV approach

In line with Zeng et al. (2018) and Meng et al. (2019), we use the year-industry (*Ind_Specificity*) and year-province (*Pro_Specificity*) average of linguistic specificity as IVs for *Specificity*. The literature suggests that financial practices are more similar for firms in the same province (Jha, 2019) due to the relatively close geographical distance. Thus, we assume that the average level of *Specificity* within a region or a sector is positively associated with a firm's idiosyncratic specific disclosures.

Table 8
Further analyses: Effect of proprietary costs on linguistic specificity.

	Dependent variable:$Specificity_{t+1}$	
	(1)	(2)
PC_Concentration	–0.387***	
	(–2.99)	
PC_Abnormal		–0.878***
		(–4.27)
Size	0.130***	0.116***
	(8.24)	(7.08)
Lev	–0.056	–0.057
	(–0.83)	(–0.51)
Mb	0.021***	0.020
	(2.61)	(1.63)
Roa	0.013***	0.011***
	(6.70)	(5.54)
Big4	0.054	0.055
	(0.89)	(0.90)
Mngshare	0.202***	0.175**
	(2.83)	(2.44)
Top1	–0.539***	–0.569***
	(–6.10)	(–6.42)
Turnover	–0.823	–0.855
	(–1.55)	(–1.60)
Independent	0.129	0.174
	(0.60)	(0.81)
Age	–0.000	–0.000
	(–0.12)	(–0.08)
Readability	–6.442***	–6.567***
	(–11.82)	(–12.01)
Tone	–0.965***	–1.068***
	(–6.95)	(–7.56)
Constant	0.625*	1.023***
	(1.70)	(2.73)
Year & Industry Fixed Effects	Yes	Yes
Observations	30,611	30,611
Adjusted R^2	0.268	0.269

Note: ***, ** and * denote significance at 1%, 5% and 10%, respectively. The t-statistics are shown in brackets. Standard errors are adjusted for clustering at the firm level.

Table 9 presents the estimation results of the IV approach. Consistent with our prediction, our IVs (*Ind_Specificity* and *Pro_Specificity*) are positive and statistically significant in Columns (1) and (3). The second-stage results of the IV estimations with stock price synchronicity are reported in Columns (2) and (4). As the coefficients are negatively significant, the results obtained from the baseline regression are reaffirmed. Notably, to address the concern about weak identification of the instrument, we further calculate the Cragg–Donald Wald F-statistics, which exceed 10, rejecting the null hypothesis that the instrument is weak. Overall, our results are robust after alleviating the endogeneity concern of reverse causality.

7.2. Falsification test

Following the literature (Altonji et al., 2005; Christensen et al., 2016; Ljungqvist et al., 2017), we conduct a falsification test to further address the potential bias induced by omitted variables. The falsification test regresses part of the outcome variable associated with the observed determinants of suspected confounders (here: *Specificity*) on the treatment variable (here: firm-specific stock price synchronicity in the future). Compared with the estimated treatment effect in the baseline test, a tiny coefficient of the primary independent vari-

Table 9
Robustness checks: IV approach.

	IV: Industry-average *Specificity*		IV: Province-average *Specificity*	
	First stage	Second stage	First stage	Second stage
	$Specificity_t$	$Synch_{t+1}$	$Specificity_t$	$Synch_{t+1}$
Specificity		–0.286***		–0.323**
		(–3.05)		(–2.54)
Ind_ Specificity	0.203***			
	(3.21)			
Pro_ Specificity			0.155**	
			(2.54)	
Size	0.445***	0.262***	0.445***	0.278***
	(12.07)	(6.11)	(12.08)	(4.85)
Lev	0.080	–0.385***	0.077	–0.382***
	(0.45)	(–8.35)	(0.43)	(–7.75)
Mb	0.064**	–0.068***	0.064**	–0.066***
	(2.19)	(–6.28)	(2.19)	(–5.23)
Roa	2.062***	1.095***	2.068***	1.173***
	(4.05)	(4.40)	(4.07)	(3.77)
Big4	0.065	–0.079**	0.065	–0.077**
	(0.44)	(–2.43)	(0.44)	(–2.18)
Mngshare	–0.011	–0.353***	–0.010	–0.352***
	(–0.06)	(–7.38)	(–0.06)	(–6.97)
Top1	–0.851***	–0.402***	–0.848***	–0.433***
	(–4.25)	(–4.31)	(–4.24)	(–3.64)
Turnover	–1.082	2.856***	–1.048	2.823***
	(–0.82)	(6.32)	(–0.79)	(5.82)
Independent	0.266	–0.126	0.266	–0.118
	(0.52)	(–0.87)	(0.52)	(–0.76)
Age	–0.001	0.009***	–0.001	0.009***
	(–0.15)	(6.11)	(–0.18)	(5.74)
Readability	–0.013	0.009**	–0.013	0.008**
	(–0.98)	(2.40)	(–1.00)	(2.08)
Tone	–5.634***	–1.435***	–5.644***	–1.642**
	(–16.84)	(–2.67)	(–16.87)	(–2.28)
Constant	0.213***	0.238***	0.234***	0.161***
	(16.18)	(17.65)	(7.89)	(13.18)
Year & Industry Fixed Effects	Yes	Yes	Yes	Yes
Observations	30,589	30,589	30,603	30,603
Adjusted R^2	0.647	–0.843[1]	0.647	–1.086
Cragg–Donald Wald F		20.474		13.214

Note: ***, ** and * denote significance at 1%, 5% and 10%, respectively. The t-statistics are shown in brackets. Standard errors are adjusted for clustering at the firm level.
[1]Sribney et al. (2011) find that in two-stage least squares (2SLS) and three-stage least squares, R^2 may be negative (i.e., RSS > TSS) but does not have any effect on model evaluation. Sribney, W., Wiggins, V., & Drukker, D. (2011). Negative and missing R-squared for 2SLS/IV. Stata Corp.

able in the falsification test indicates that the baseline treatment effect is less likely to reflect unobserved confounders. Following Hope et al. (2016), we use analyst forecast bias (*Ferror*), the number of subsidiaries (*Segments*), stock return volatility (*Std_Ret*), earnings volatility (*Std_Roa*), research and development disclosure (*Innovation*), textual similarity (*Similar*) and length of the MD&A section (*Length*) as known determinants of linguistic specificity. We first regress firm-level stock price synchronicity on the abovementioned variables and obtain the estimated value of stock price synchronicity. Then, we regress the predicted values of synchronicity on *Specificity* and other controls, as shown in Eq. (4). In Column (3) of Table 10, the coefficient of *Specificity* is small and statistically insignificant in the falsification test. Hence, the results obtained from the falsification test show that the selection bias on omitted variables is not severe within the primary research design.

Table 10
Robustness checks: Falsification test.

	Dependent variable:$Synch_{t+1}$		Dependent variable:$\widehat{Synch}_{t+1}$
	(1)	(2)	(3)
Specificity	–0.006*		–0.000
	(–3.01)		(–1.48)
Ferror	0.068	–0.001	
	(0.52)	(–0.01)	
Segments	–0.013*	0.075*	
	(–1.69)	(6.74)	
Std_Ret	–0.022	0.691***	
	(–0.16)	(5.41)	
Std_Roa	–0.986***	–0.884***	
	(–5.73)	(–4.55)	
Innovation	–1.103	6.800**	
	(–0.51)	(2.23)	
Similar	–10.051*	–11.606*	
	(–1.85)	(–1.79)	
Length	–0.019	–0.015	
	(–1.44)	(–1.09)	
Other Control Variables	Yes	No	Yes
Year & Industry Fixed Effects	Yes	Yes	Yes
Observations	28,262	27,867	28,262
Adjusted R^2	0.344	0.383	0.299

Note: ***, ** and * denote significance at 1%, 5% and 10%, respectively. The t-statistics are shown in brackets. Standard errors are adjusted for clustering at the firm level. Other control variables are same with the controls in baseline regression.

7.3. Alternative measures of linguistic specificity and synchronicity

We mainly follow the approach of Hope et al. (2016) to construct our explanatory variable (*Specificity*) in our baseline regressions. However, the disclosure of specific information, such as dates, organizations and names, may be perceived as compliance with relevant regulatory requirements (e.g., "Public Offering of Securities of the Company Information Disclosure Content and Format Bulletin No. 2") rather than as a disclosure strategy. As such, we need an alternative method to rebuild our explanatory variable. Inspired by Hoberg and Phillips (2016), we construct an economic activity dictionary and then use the NER technique to identify and extract words related to actual corporate economic activities (e.g., for agricultural firms, the words representing their economic activities may include "cultivation," "production," "corn," "transportation," "hedging" and "futures"). We use the number of extracted words divided by the number of de-duplicated economic activity words (*Specificity_New*) as our alternative measure of linguistic specificity; thus, *Specificity_New* reflects the average recognition density of the economic activity dictionary in the MD&A section. The higher the recognition density, the more specific is the description of economic activities. Meanwhile, as different industry classification standards affect the calculations of synchronicity, we re-estimate firm-level stock price synchronicity (*Synch_New*) after replacing the classification standards with the 2001 version of industry classification. We repeat our baseline regression using alternative measures of the dependent and independent variables separately. In Columns (1) and (3) of Table 11, both the coefficients of *Specificity_New* and *Specificity* are negatively significant, and the results still hold with firm fixed effects controlled, as reported in Columns (2) and (4).

7.4. Different sample observation periods

Since the accounting standards in China were significantly revised in 2007, the content and format of financial reports have changed considerably. The disclosure requirements for listed firms were also changed in 2012. As a result, we need to examine whether our primary findings might be affected by such changes. Thus, we

Table 11
Robustness checks: Alternative measures of linguistic specificity and synchronicity.

	Dependent variable:$Synch_{t+1}$		Dependent variable:$Synch\_New_{t+1}$	
	(1)	(2)	(3)	(4)
Specificity_New	–0.034***	–0.022**		
	(–3.91)	(–2.11)		
Specificity			–0.004***	–0.004**
			(–2.59)	(–2.35)
Size	0.135***	0.245***	0.155***	0.227***
	(15.58)	(16.32)	(19.36)	(17.37)
Lev	–0.423***	–0.482***	–0.465***	–0.410***
	(–10.87)	(–8.74)	(–13.37)	(–8.60)
Mb	–0.087***	0.013	–0.038***	0.023***
	(–10.23)	(1.46)	(–5.18)	(2.95)
Roa	0.588***	0.648***	0.823***	0.939***
	(4.76)	(4.56)	(7.54)	(7.94)
Big4	–0.108***	0.043	–0.094***	0.026
	(–3.43)	(0.90)	(–3.23)	(0.61)
Mngshare	–0.338***	–0.283***	–0.224***	–0.147*
	(–8.04)	(–2.80)	(–5.76)	(–1.67)
Top1	–0.157***	–0.265***	–0.171***	–0.265***
	(–3.71)	(–3.03)	(–4.36)	(–3.36)
Turnover	3.171***	5.160***	2.957***	5.014***
	(9.13)	(12.65)	(9.55)	(14.66)
Independent	–0.206*	–0.055	–0.074	0.083
	(–1.76)	(–0.35)	(–0.67)	(0.59)
Age	0.009***	–0.022	0.005***	–0.053***
	(6.64)	(–1.16)	(3.83)	(–3.33)
Readability	0.013***	0.004	–0.051***	–0.017***
	(4.46)	(1.12)	(–3.33)	(–3.44)
Tone	0.150**	0.087	–0.302***	–0.101**
	(2.30)	(1.04)	(–2.59)	(–2.36)
Constant	–3.336***	–5.759***	–3.519***	–4.792***
	(–17.53)	(–15.51)	(–19.70)	(–14.73)
Year & Industry Fixed Effects	Yes	No	Yes	No
Year & Firm Fixed Effects	No	Yes	No	Yes
Observations	30,613	30,488	30,613	30,488
Adjusted R^2	0.340	0.392	0.289	0.363

Note: ***, ** and * denote significance at 1%, 5% and 10%, respectively. The t-statistics are shown in brackets. Standard errors are adjusted for clustering at the firm level.

divide our sample into pre- and post-periods of change using 2007 as the cut-off year. The regression results for the sub-samples are reported in Columns (1) and (2) of Table 12. Similarly, we also separate the initial sample at 2012. The regression results are reported in Columns (3) and (4). The negative association between *Specificity* and synchronicity still holds, indicating that our results remain robust after considering the effects of changes in regulation.

7.5. PSM

Considering the limitations of existing models in dealing with endogeneity issues, we utilize PSM analysis to address the endogeneity concerns further, as suggested by Xie and Lin (2015). Using a propensity score-matched sample allows us to directly compare sample firms with higher and lower levels of linguistic specificity in their disclosures when the characteristics of other observable dimensions are similar. Consequently, we can

Table 12
Robustness checks: Different sample observation periods.

	Dependent variable:$Synch_{t+1}$			
	Change in accounting standards		Change in disclosure requirements	
	(1) 2003–2006	(2) 2007–2019	(3) 2003–2011	(4) 2012–2019
Specificity	–0.007**	–0.005**	–0.005**	–0.004*
	(–2.33)	(–2.44)	(–2.46)	(–1.76)
Size	–0.000	0.132***	0.105***	0.130***
	(–0.01)	(18.75)	(12.04)	(14.75)
Lev	–0.401***	–0.383***	–0.449***	–0.363***
	(–5.59)	(–10.71)	(–10.08)	(–8.25)
Mb	–0.616***	–0.078***	–0.177***	–0.062***
	(–15.93)	(–11.83)	(–17.13)	(–7.76)
Roa	1.917***	0.435***	0.534***	0.591***
	(7.55)	(3.68)	(3.48)	(4.09)
Big4	–0.144***	–0.091***	–0.161***	–0.065**
	(–3.31)	(–3.68)	(–5.60)	(–2.11)
Mngshare	–2.912***	–3.140***	–2.438***	–3.644***
	(–2.61)	(–5.56)	(–3.24)	(–5.40)
Top1	–0.165	–0.291***	–0.343***	–0.295***
	(–0.89)	(–7.99)	(–5.31)	(–6.93)
Turnover	–0.191***	–0.180***	–0.205***	–0.187***
	(–2.64)	(–4.66)	(–4.42)	(–3.92)
Independent	–0.173	–0.183*	0.266*	–0.348***
	(–0.61)	(–1.68)	(1.71)	(–2.65)
Age	0.008**	0.008***	0.008***	0.008***
	(2.14)	(7.29)	(4.25)	(6.21)
Readability	0.008*	0.013***	0.013***	0.012***
	(1.71)	(4.65)	(4.11)	(3.67)
Tone	0.251**	0.116	0.156**	0.160*
	(2.14)	(1.60)	(1.98)	(1.73)
Constant	0.439	–3.687***	–2.128***	–3.715***
	(1.28)	(–22.89)	(–10.76)	(–18.53)
Year & Industry Fixed Effects	Yes	Yes	Yes	Yes
Observations	4,336	26,277	11,061	19,552
Adjusted R^2	0.154	0.355	0.235	0.311
Difference		$\chi^2 = 0.50$ (p = 0.478)		$\chi^2 = 0.03$ (p = 0.852)

Note: ***, ** and * denote significance at 1%, 5% and 10%, respectively. The t-statistics are shown in brackets. Standard errors are adjusted for clustering at the firm level.

more precisely attribute any observed effects to *Specificity* rather than to other observable characteristics. Following Serfling (2014), we first divide our sample into three groups according to the *Specificity* value, and the middle tercile samples are eliminated to create a sharp contrast in the matching process. Subsequently, each observation with a higher value of *Specificity* is matched with another observation in the same sector with a lower value of *Specificity*. The procedure is based on one-to-one nearest neighbor matching using all of the controls in Eq. (4). The balancing of the covariates is presented in Panel A of Table 13. With the exception of *Mngshare*, there are no statistically significant differences in the covariates between the treatment and control groups after matching. The regression results using 1:1 and 1:2 nearest neighbor matching with industry fixed effects are reported in Columns (1) and (3), respectively, of Panel B of Table 13. The coefficients of *Specificity* are statistically significant at the 5% level, as presented in Columns (1) and (3). Furthermore, in Columns (2) and (4), the results continue to hold even when the regressions are re-estimated with the firm fixed effects model using the propensity score-matched sample. Collectively, the results indicate that observable heterogeneity bias does not significantly affect our primary findings.

Table 13
Endogeneity issues: PSM.

Panel A: Balancing the covariates between the treatment and control groups of the post-PSM procedure

	1:1 nearest-neighbor matching		
	Treatment	Control	t-value
Size	22.22	22.23	–0.55
Lev	0.45	0.45	–0.38
Mb	1.70	1.71	–1.37
Roa	0.04	0.04	–0.24
Big4	0.07	0.07	–0.86
Mngshare	0.11	0.10	3.14
Top1	0.35	0.35	–0.26
Turnover	0.02	0.02	–0.62
Independent	0.37	0.37	–1.35
Age	10.13	10.16	–0.33
Readability	22.25	22.30	–1.50
Tone	0.29	0.29	1.41

Panel B: Regression results using the PSM procedure

	Dependent variable:$Synch_{t+1}$			
	1:1 nearest-neighbor matching		1:2 nearest-neighbor matching	
Specificity	–0.004**	–0.006**	–0.005**	–0.005**
	(–2.03)	(–2.37)	(–2.46)	(–2.19)
Size	0.139***	0.261***	0.139***	0.245***
	(12.72)	(13.03)	(14.09)	(14.22)
Lev	–0.456***	–0.470***	–0.405***	–0.432***
	(–9.03)	(–5.83)	(–8.80)	(–6.26)
Mb	–0.111***	–0.001	–0.101***	0.000
	(–9.81)	(–0.08)	(–9.91)	(0.01)
Roa	0.789***	0.999***	0.765***	0.977***
	(4.93)	(4.84)	(5.24)	(5.40)
Big4	–0.136***	–0.060	–0.103***	–0.035
	(–3.59)	(–0.99)	(–2.96)	(–0.64)
Mngshare	–0.365***	–0.421***	–0.340***	–0.285**
	(–6.84)	(–2.99)	(–6.96)	(–2.30)
Top1	–0.146***	–0.272**	–0.186***	–0.325***
	(–2.73)	(–2.21)	(–3.80)	(–3.02)
Turnover	3.126***	6.024***	3.010***	5.433***
	(6.72)	(9.43)	(7.24)	(10.12)
Independent	–0.333**	–0.384*	–0.249*	–0.188
	(–2.20)	(–1.67)	(–1.82)	(–0.96)
Age	0.009***	–0.011	0.009***	–0.009
	(5.61)	(–0.48)	(6.18)	(–0.45)
Readability	–1.515**	–0.480	–2.083***	–1.330*
	(–2.06)	(–0.55)	(–3.11)	(–1.74)
Tone	0.014***	0.006	0.014***	0.004
	(4.32)	(1.38)	(4.70)	(1.08)
Constant	0.007	–0.151	0.062	–0.049
	(0.08)	(–1.31)	(0.75)	(–0.48)
Year & Industry Fixed Effects	Yes	No	Yes	No
Year & Firm Fixed Effects	No	Yes	No	Yes
Observations	16,864	16,657	21,044	20,875
Adjusted R^2	0.290	0.343	0.307	0.359

Note: ***, ** and * denote significance at 1%, 5% and 10%, respectively. The t-statistics are shown in brackets. Standard errors are adjusted for clustering at the firm level.

8. Conclusion

By constructing a novel measure of linguistic specificity for the Chinese language using the NER technique, we examine and provide evidence supporting the mitigating effect of specific information disclosure on stock price synchronicity, which is more pronounced for firms with less information supply or a stronger demand for information by outsiders. Furthermore, our supplementary analysis shows that reducing information processing costs and enhancing information credibility may underlie the negative association between linguistic specificity and stock price co-movements. We also find that this effect of *Specificity* only occurs in the MD&A review section, rather than the preview section. Finally, we show that proprietary costs are a dominant factor in curbing specific disclosures.

This study has three important implications for scholars, investors and regulators. For scholars, we creatively apply concreteness effects theory from psycholinguistics to capital markets and extend the boundaries of research on linguistic characteristics. For investors, we reveal new possibilities for evaluating narrative disclosures, giving them a simple but effective approach to gauging firm-specific pricing efficiency. For regulators, we offer theoretical support and practical experience for the revision and implementation of more specific information disclosure. Subsequent policy formulations should make more of an effort to reduce generic and boilerplate information, promoting the prosperity and efficiency of the capital markets in China.

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.

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Product market competition and the disclosure of supply chain information

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ABSTRACT

We investigate how product market competition affects corporate voluntary disclosure decisions, specifically regarding supply-chain information. Our results, based on a sample of manufacturing companies listed in China from 2010 to 2016, show that companies in more competitive industries disclose less customer/supplier information. The main results stand through several robustness tests. Further analyses show that the negative relationship between product market competitiveness and supply-chain information disclosure is stronger when the disclosure contains more incremental information and when competitors are more capable of gaining competitive advantage using the disclosed information. Our study contributes to the understanding of both the relationship between product market competition and voluntary disclosure decisions and the regulation of information disclosure to build a transparent capital market.

1. Introduction

After decades of rapid growth, the capital market in China now plays an increasingly prominent role in China's social and economic development. President Xi Jinping emphasized the goal of building a healthy capital market in the report of the 19th Communist Party of China (CPC) National Congress. The chairman of the China Securities Regulatory Commission (CSRC), Yi Huiman, also pointed out that the foremost duty of the CSRC is to build a "regulated and transparent" capital market to better promote China's high-quality economic development. The disclosure of financial information is an essential ingredient of a well-functioning

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capital market, (Darrough, 1993; Liu et al., 2013). In recent years, competition between companies has gradually evolved into competition between firms' supply chains (Tang, 2009), and as a result, suppliers and customers have become crucial strategic resources able to significantly influence firms' growth (Fisher, 1997; Christopher and Ryals, 1999). Accordingly, a listed company's customer and supplier information provides valuable information for external investors to assess its firm value.

For this reason, the CSRC has increased its efforts to encourage corporations to disclose supply-chain information. Specifically, the CSRC issued The Standards Concerning the Contents and Formats of Information Disclosure by Companies Offering Securities to the Public No.2 — Contents and Formats of Annual Reports (2007 Revision) and required listed companies to disclose the total amount they purchase from their top five suppliers and sell to their top five customers as well as the ratio of those numbers to their annual aggregated purchases and sales. Moreover, the CSRC encourages listed firms to disclose the identities of their top five suppliers and customers as well as the ratio of the amount they purchase from and sell to each of them to the firms' annual aggregated purchases and sales. In practice, however, companies are often reluctant to disclose such information. For example, in our sample period of 2010 to 2016, only 21% of Chinese listed manufacturing companies disclosed the identities of and proportions of purchases attributable to their top five suppliers, and only 36% disclosed the identities of and proportions of sales attributable to their top five customers. Similarly, Ellis et al. (2012) find that U.S. listed companies often fail to meet the Securities and Exchange Commission's (SEC's) requirements of disclosing detailed information about important customers. To explain this under-disclosure, our paper examines the factors affecting firms' supply-chain information disclosure decisions and determines the possible working mechanisms. Our study not only helps to deepen the understanding of the supply-chain information disclosure practices of Chinese A-share listed companies but also explores the determinants of firms' voluntary disclosure. Moreover, this paper contributes information that is critical to capital market regulators.

Supply chain information is a key issue in both the academic and practical worlds. However, past research mostly focuses on the economic consequences of supplier–customer relationships (proxied by the level of concentration) for companies and their stakeholders, including cash holdings (Itzkowitz, 2013), auditor choice (Zhang et al., 2012), the cost of equity capital (Chen et al., 2015; Dhaliwal et al., 2016) and the cost of debt (Campello and Gao, 2017; Cai and Zhu 2020). Recently, security regulatory authorities around the world have begun to encourage listed firms to disclose detailed information about their major suppliers and customers. Researchers find that the incremental information embodied in the identity of companies' major suppliers and customers and in information regarding transactions between the companies and those suppliers and customers helps companies to adjust their production behavior and thereby mitigate the "long whip effect" (Yang et al., 2020), improve the accuracy of analyst forecasts (Guan et al., 2015; Pandit et al., 2011), reduce the uncertainty of new issuances of shares (Johnson et al., 2010) and help investors to better understand the predictability of returns between economically linked firms (Cohen and Frazzini, 2008; Menzly and Ozbas, 2010). In addition, Cen et al. (2017) show that supply-chain information diffusion speed drives investors' customer momentum strategies, affects the price feedback effect on corporate investment decisions and enhances supply-chain coordination. To summarize, although certain studies investigate how companies choose their level of supply-chain information disclosure (Li and Wang, 2016) and the role played by proprietary cost (Ellis et al., 2012; Li et al., 2018), most of the literature concentrates on the economic consequences of supply-chain information disclosure, and little is known about the causal relationship between market factors and supply-chain information disclosure.

Theoretically, companies have a strong incentive to fully reveal all of their private information to reduce information asymmetry and gain capital-market benefits (Grossman, 1981; Milgrom, 1981). In practice, however, the extent of voluntary disclosure varies greatly across firms. Previous studies show that agency cost, litigation risk and proprietary costs may influence corporations' disclosure decisions and lead them to reduce voluntary disclosures (Healy and Palepu, 2001; Luo and Zhu, 2010; Ellis et al. 2012; Wang and Yu, 2014).

Product market competition may exert a key influence on the disclosure of supply-chain information, which is closely related to companies' operations. Firms facing greater competition may choose to disclose more supply-chain information to improve their information environment and reduce the cost of capital (Yi et al., 2010). Furthermore, intense competition may also encourage firms to announce their high-quality

suppliers and customers to deliver credible threats to potential competitors (Johnson et al., 2010). Thus, intense product market competition may encourage corporations to disclose more supply-chain information.

However, a firm's supply-chain information may be observed and used by current and potential competitors to decrease the firm's competitive advantage, raising proprietary costs (Bhattacharya and Ritter, 1983; Foster, 1986; Darrough, 1993). Therefore, companies in highly competitive industries are more concerned about losing their competitive advantage and more reluctant to release private information than those in less competitive industries (Clinch and Verrecchia, 1997; Huang et al., 2017). In the unique institutional background of China's transforming economy, due to the imperfect protection of property rights (Fang et al., 2017), companies in highly competitive industries generally face the serious risk of being deprived of corporate resources by their competition (Wu et al., 2012). Unlike other voluntarily disclosed information, such as social responsibility information, a company's supply-chain information is closely related to its operations and is therefore likely to be used by competitors to imitate the company's strategies or to steal its corporate resources (Ellis et al., 2012). As a result, firms facing fierce competition tend to limit their disclosure of supply-chain information to avoid high proprietary costs.

Based on these contradicting predictions, the impact of product market competition on companies' supply-chain information disclosure decisions remains an empirical question. Therefore, this paper empirically examines the relationship between product market competition and corporate supply-chain information disclosure decisions, using a sample of Chinese A-share manufacturing company observations from 2010 to 2016. Our results show that companies in highly competitive industries choose to disclose less supply-chain information than those in less competitive industries. These main results are robust to several robustness tests, including a difference-in-differences (DID) regression using large reductions in China import tariff rates as an exogenous shock to the level of competition. Further tests show that the influence of product market competition on supply-chain information disclosure is more pronounced when there is more incremental information contained in the information (i.e., for companies in worse information environments) and when the information is more likely to be used by competitors to obtain a competitive advantage (i.e., for non–state owned companies, companies with cost leadership strategies and lower levels of product differentiation and companies in worse legal environments), which is consistent with the proprietary cost argument.

Our research makes several contributions. First, this study adds new evidence to the long-running debate on the relationship between product market competition and voluntary corporate disclosure (Verrecchia, 1983, 1990; Darrough and Stoughton, 1990; Ren and Wang, 2019). Previous studies in this area mainly focus on the voluntary disclosure of social responsibility reports (Zhang, 2012), management forecasts (Li, 2010; Ma, Lianfu et al., 2013; Huang et al., 2017) and corporate press releases (Burks et al., 2018). As compared to these kinds of information, supply-chain information is more closely linked to firms' operations (Ellis et al., 2012) and is therefore more likely to be exploited by competitors. Therefore, it is intuitive that decisions regarding the disclosure of supply-chain information are more affected by the level of product market competition than decisions to disclose other kinds of information.

Moreover, due to China's stage of economic development, its legal environment and its imperfect protection of property rights, the role of product market competition in shaping a company's supply-chain information disclosure in its capital market likely differs from that in developed markets. For instance, Ellis et al. (2012) find that U.S. firms in less competitive industries are more likely to conceal the identities of their major customers. Ellis et al. (2012) argue that firms in less competitive industries are more likely to enjoy a monopoly; therefore, their detailed supply-chain information is more valuable. In other words, the propriety cost of their supply-chain information is higher. Under these circumstances, product market competition is positively correlated to the disclosure of customer and supplier information. The results in our study, however, show the opposite. Using data on Chinese firms, we find a negative relationship between product market competition and supply-chain information disclosure. The seemingly contradicting results may be explained by the relative lack of property rights in China (Fang et al., 2017). This institutional background, combined with the relatively low industry concentration in China, increases companies' risk of being deprived of valuable corporate resources by their competitors. In this context, intense competition increases the proprietary costs associated with supply-chain information disclosure and thus decreases the level of disclosure. Our study also takes advantage of China's unique ownership and legal environment to examine how product market competition affects firms' disclosure decisions through proprietary cost. In summary, the research perspective and

background of this study provide novel evidence to the long-standing debate concerning the relationship between competition and voluntary disclosure.

Second, our study contributes to the growing attention paid to supply-chain information disclosure decisions. Previous studies in this area mainly focus on the economic consequences of supply-chain information disclosure for companies and their stakeholders (Guan et al., 2015; Cohen and Frazzini, 2008; Johnson et al., 2010; Menzly and Ozbas, 2010; Pandit et al., 2011; Itzkowitz, 2013; Yang et al. 2020). Only two papers discuss the determinants of supply-chain information disclosure decisions from the aspect of proprietary costs (Ellis et al., 2012; Li et al., 2018). However, both papers use product market competition as a proxy for proprietary cost and fail to fully explore the impact of market competition. In fact, market competition may influence supply-chain information disclosure not only through proprietary cost but also through increased financial pressure and market discipline (Chen et al., 2015; Jiang et al., 2017). If the latter impact dominates the former, then companies in markets with higher competition have an incentive to increase their supply-chain information disclosure to ease their financial constraints. Given these two possible outcomes, how product market competition affects corporate supply-chain information disclosure remains an open question. Furthermore, unlike the SEC's mandatory disclosure requirement[1] in the U. S., the CSRC only requires listed firms to disclose their total annual transaction amount and the total proportion attributable to their top five customers and suppliers and encourages listed firms to voluntarily disclose the identity and transaction amount of each major customer and supplier. Under China's non-mandatory disclosure requirements, the level of supply-chain information disclosure better reflects a company's reporting strategy, which helps us to understand the impact of product market competition on corporations' disclosure choices. Against this background, this paper provides an in-depth analysis of the factors influencing supply-chain information disclosure from the perspective of product market competition and explores the underlying mechanism, thus complementing previous research on supply-chain information disclosure.

Third, our study alleviates the problem of measuring the level of product market competition noted by Ali et al. (2008). Previous studies mainly use the data of publicly traded firms to score the degree of product market competition and concentration (Verrecchia and Weber, 2006; Li, 2010; Yi, 2010). This method is problematic in that it excludes private firms, which may account for a nonnegligible percentage of industry sales; thus, this method harms the accuracy of competition measures (Ali et al., 2008; Zhou and Tang, 2015). To this end, we use the data of both publicly traded and privately held firms to construct our industry concentration measures. Moreover, we use the large reductions in China's import tariff rates as an exogenous shock to market competition and adopt a DID analysis to address the endogeny concern. We also conduct robustness tests with alternative proxies for product market competition.

Finally, our study has practical implications for both investors and capital market authorities. Given that supply-chain information provides valuable information helpful to external investors in assessing firm value (Chen Jun et al., 2015; Dhaliwal et al., 2016), the CSRC increased regulation of the disclosure of supply-chain information, encouraging listed companies to publicize their detailed supply-chain information. However, as pointed out above, the current disclosure quality in China is inadequate. Ellis et al. (2012) also find that the customer information provided by listed companies in the U.S. fails to meet the SEC's requirements. Our paper attempts to explain the phenomenon of under-disclosure from the perspective of product market competition. Our findings could help regulators to perfect regulatory means to improve the quality of supply-chain information disclosure.

The remainder of this paper is organized as follows. Section 2 discusses the theoretical framework and develops testable hypotheses. Section 3 describes the data and the main variables. Section 4 presents the empirical results. Section 5 concludes the paper.

[1] In the U.S., SEC Reg. S-K requires publicly traded firms to report the sales to and identity of any customer that comprises more than 10% of a firm's consolidated revenues, if losing that customer would have a material, adverse effect on the company.

2. Hypothesis development

Determining a firm's level of supply-chain information disclosure is one of the most important voluntary corporate disclosure decisions. On the one hand, detailed customer and supplier information may reduce information asymmetry and bring a series of capital market gains, such as lower capital costs, a higher stock price, more liquidity and more efficient asset pricing (Healy and Palepu, 2001; Balakrishnan et al., 2014). On the other hand, providing detailed supply-chain information has a potential downside arising from the fact that, compared with purely financial information, supply-chain information is more closely related to companies' real operations, especially the charateristics of their customers and suppliers (Ellis et al., 2012). In other words, customer and supplier information is a trade secret. While such disclosure improves the corporate information environment (Li and Wang, 2016), reduces financial costs (Chen et al., 2015; Cai and Zhu, 2020) and large customers could play an identification role for companies (Johnson et al., 2010), detailed supply-chain information may also be observed by current and potential competitors and used against the disclosing companies, leading to considerable proprietary costs (Ellis et al., 2012; Wang and Yu, 2014). Therefore, the decision to disclose supply-chain information is the result of weighing the pros and cons of such disclosure. Based on previous studies, we believe that product market competition plays a critical role in this cost–benefit analysis.

First, companies are exposed to greater capital pressure and threats of bankruptcy in more competitive industries (Schmidt, 1997). In this environment, a firm's customer and supplier information provides valuable information concerning the concentration, quality and stability of the firm's customers and suppliers, helping external investors to assess the present and future value of the firm as well its risk (Gosman et al., 2004; Chen et al., 2015). Therefore, companies facing fierce competition have strong incentives to release higher quality supply-chain information to reduce information asymmetry and decrease capital costs (Yi et al., 2010). Furthermore, companies in more competitive industries are more motivated to act strategically to distinguish themselves from others, such as by disclosing high-quality customers to prove the quality of its revenue (Johnson et al., 2010). For these reasons, product market competition may increase the disclosure of supply-chain information.

Second, competitors in competitive industries are more likely than those in monopoly industries to obtain disclosing companies' private information and adjust their strategies accordingly to gain a competitive advantage. Particularly in the context of China's transitional economy and due to its highly decentralized industrial structure, there is fierce competition among a great number of companies of similar scale and offering similar products (Wu et al., 2012). Furthermore, as property protection in China is relatively underdeveloped (Fang et al., 2017), companies in competitive industries make use of others' private information to mimic their business strategies, to launch price wars and to conduct competition for resources, leading to substantial proprietary costs for the disclosing companies.

Companies' supply-chain information is considered to be "material information" related more closely to their real operations (Ellis et la., 2012), as it includes critical trade secrets such as customer demand, production preference and product-pricing strategies (ASIS International, 2002). Therefore, customer and supplier information is more likely to be imitated and used by market rivals than other information, causing more significant proprietary costs for disclosing firms by three specific mechanisms. First, market rivals may use disclosed supplier and customer information to obtain or infer a company's existing production capacity, operating costs, market demand, gross profit margins and other private information and adjust their own production output and prices accordingly or imitate products to weaken the disclosing firms' competitive advantage (Clinch and Verrecchia, 1997). Second, when the disclosing firm is a participant in a competitive industry rather than a monopoly, its market rivals may use detailed supply-chain information to compete for strategic resources such as valuable suppliers and customers, meaning that disclosing firms face a greater threat of customer and supplier loss (Darrough and Stoughton, 1990; Wagenhofer, 1990). Third, when the market concentration is low and industry competition is intense, supplier and customer bargaining power is greater and transformation costs are lower. Under these conditions, while supply-chain information helps corporate competitors to compete for resources, it also increases bargaining power and decreases transformation costs for both suppliers and customers, thus worsening the hold-up problems caused by suppliers and customers

(Baiman and Rajan, 2002). Given these three mechanisms, product market competition may also decrease the disclosure of supply-chain information.

Therefore, given that product market competition may either promote or inhibit corporate supply-chain information disclosure, we form the following hypotheses:

H1a: Product market competition is positively correlated with supply-chain information disclosure.

H1b: Product market competition is negatively correlated with supply-chain information disclosure.

3. Data and main variables

3.1. Data source and sample selection

Our sample consists of all Chinese listed manufacturing firms from 2000 to 2016. We collect product market competition data from the China Stock Market and Accounting Research (CSMAR) China Industry Business Performance Database. We collect supply chain data from the Chinese Research Data Service (CNRDS) Supply Chain Research Data (SCRD) database. We obtain stock return and financial data from the CSMAR database. Tariff rates data are obtained from the Trade Analysis and Information System (TRAINS).

Following previous studies, we remove financial firms and firms with supply-chain information labeled as "Confidential unit."[2] We further exclude firms with missing or incomplete data. The final sample consists of 9,854 firm-year observations. To reduce the influence of outliers, we winsorize all of the continuous variables at the 1st and 99th percentiles.

3.2. Main variable definitions

3.2.1. Product market competition

Our primary measure of product market competition is the Herfindahl–Hirschman Index (HHI). HHI is defined as the sum of squared market shares for all firms in the same industry. The market share of a firm is the ratio of the firm's sales to the entire industry's sales. A higher HHI indicates a more concentrated industry and thus lower product market competition. HHI is one of the most commonly used measures for the following reasons. First, HHI gives more weight to larger enterprises; thus, it can meaningfully reflect the size of and dominant power among companies. Second, HHI comprehensively reflects the number and relative size of enterprises, improves the differentiation of research samples and thus better depicts market competition (Liu et al., 2003). To make the measure more intuitive, we calculate (1 – HHI)*100 (*Competition*) to proxy for competition. A higher *Competition* value reflects a higher level of product market competition.

Previous studies on product competition often use listed firm data from the U.S. Compustat database to construct a measure of industry concentration. However, as pointed out by Ali et al. (2008), an absence of private firms in the computation of HHI makes it a biased estimate of competition. Zhou and Tang (2015) also point out that as private companies often account for a significant proportion of industry sales, industry competition variables based on an industrial enterprise database are superior to those based solely on listed company data. Therefore, following Ali et al. (2014) and Jiang et al. (2015), we use China's National Bureau of Statistics (NBS) data to estimate our product market competition measure, as this database includes private firms as well as listed firms. Specifically, the NBS database includes all manufacturing firms with sales greater than 5 million RMB (during most of our sample period, 8 RMB equaled about US$1). A comprehensive list of firms reduces listing bias in measuring product market competition. As these data are only available before 2013, we derive the HHI measure after 2013 based on the change in HHI trend from 2011 to 2013.

3.2.2. Supply chain information disclosure

We adopt the following two measures of supply chain disclosure: supplier information disclosure and customer information disclosure. Supplier-specific disclosure (*DumSupply*) equals 1 if a company discloses

[2] Confidential units are often mandated not to disclose supply chain information due to industry characteristics (e.g., the arms industry) and thus are excluded.

information specific to at least one supplier, including the identity, transaction amounts and proportion of purchases attributable to that supplier, and 0 otherwise. Similarly, customer-specific disclosure (*DumCustom*) equals 1 if the firm discloses information specific to at least one customer, including the identity, transaction amounts and proportion of sales attributable to that customer, and 0 otherwise.

3.2.3. Control variables

Following the literature (e.g., Ellis et al., 2012; Jiang et al., 2015), we include several control variables, including firm size (*Size*), financial leverage (*Lev*), operating performance (*ROA*), Tobin's Q (*TobinQ*), state-owned enterprise (SOE) indicator (*SOE*), ownership of the largest shareholder (*top1*), CEO–chair duality (*Dual*), board size (*Bsize*), proportion of independent directors (*Indep*), research and development (R&D) disclosure information (*Dum_Rd*) and intangible assets (*Intang*). Industry and year dummies are also included in the analyses. Detailed variable definitions are provided in Table 1.

3.3. Model specification

We examine the relationship between product market competition and corporate supply-chain information disclosure with the following model:

$$Disclosure_{i,t} = \alpha + \beta * Competition_{i,t-1} + \gamma * Control_{i,t-1} + \varepsilon_{i,t} \quad (1)$$

We use supplier-specific information disclosure (*DumSupply*) and customer-specific information disclosure (*DumCustom*) as our two measurements of supply information disclosure ($Disclosure_{i,t}$). $Competition_{i,\ t\text{-}1}$ is our key independent variable; its measurement is described above. Control $_{i,\ t\text{-}1}$ includes firm-specific control variables, industry dummies and year dummies, as mentioned above. All of the independent variables (except for industry and year dummies) are lagged by 1 year to mitigate endogeneity concerns.

Table 1
Variable definitions.

Variable	Description	Definition
DumSupply	Supplier-specific information disclosure	Indicator that equals 1 if the firm discloses information specific to least one supplier, including identity, transaction amounts and proportion of total purchases attributable to that supplier, and 0 otherwise
DumCustom	Customer-specific information disclosure	Indicator that equals 1 if the firm discloses information specific to at least one customer, including identity, transaction amounts and proportion of total sales attributable to that customer, and 0 otherwise
Competition	Product market competition	(1-HHI)*100, HHI is defined as the sum of squared market shares for all firms in the same industry. The market share of a firm is the ratio of the firm's sales to the sales of the entire industry.
Size	Firm size	Log (firm assets)
Lev	Firm leverage	Ratio of total liabilities to total assets
ROA	Operating performance	Ratio of net operating income to total assets
TobinQ	Tobin's Q	Ratio of the sum of market value of tradable shares and book value of non-tradable shares to the book value of total assets at the beginning of the year
Dum_Rd	R&D information disclosure	Indicator that equals 1 if the firm discloses R&D information, and 0 otherwise
Intang	Intangible assets investment	Ratio of net intangible assets to total assets
SOE	Enterprise property	Indicator that equals 1 if the firm's ultimate controlling shareholders are state entities, and 0 otherwise
Top1	Top1 ownership	Ownership of the largest shareholder
Dual	CEO-Chair duality	Indicator that equals 1 if the CEO is also the board chair, and 0 otherwise
BSize	Board size	Log (total number of directors on the board)
Indep	Proportion of independent directors	Ratio of the number of independent directors to the total number of directors on the board

4. Empirical results

4.1. Summary statistics

Table 2 presents the summary statistics of our main variables. Panel A shows that 20.9% of our sample disclosed supplier-specific information and 36.1% of our sample disclosed customer-specific information, suggesting that the level of supply-chain information disclosure is is low in general. The mean (median) value of competition is 0.997 (0.998), indicating that compared with the level of industry competition in the U.S.[3], the product market competition is rather intense in China. The values of our control variables are consistent with those reported in previous studies.

Panel B of Table 2 provides preliminary results on the relation between product market competition and supply-chain information disclosure. Specifically, we split the full sample along the median HHI value and compare the mean values of *DumSupply* (*DumCustom*) in the low-HHI group and the high-HHI group. As shown in Panel B, the mean *DumSupply* (*DumCustom*) in the high-HHI subsample is 19.5% (34%) and the mean *DumSupply* (*DumCustom*) in the low-HHI subsample is 23.3% (39.9%). The difference between these two mean values is significant at the 1% level. The results indicate that product market competition is negatively correlated with supply-chain information disclosure.

4.2. Main regression results

We use model 1 to empirically test the relation between product market competition and supply-chain information disclosure. The dependent variables in columns (1) and (3) and columns (2) and (4) are supplier-specific and customer-specific information disclosure, respectively. Columns (3) and (4) include industry dummy variables to control for potential industry fixed effects.

As shown in Table 3, the coefficient on *Competition* is –0.262 and is significant at the 5% level in column (1), whereas the coefficient value is –0.415 and is significant at the 1% level in column (2), suggesting that competition discourages the disclosure of supplier-specific and customer-specific information. These results remain robust after we control for industry fixed effect in columns (3) and (4). Overall, the results in Table 3 show that firms in highly competitive industries tend to disclose less supply-chain information.

4.3. Addressing endogeneity concerns

Next, we address two endogeneity concerns. First, the negative relation between competition and supply-chain information disclosure may be driven by reverse causality or by a latent variable (Arya and Mittendorf, 2007; Ali et al., 2014; Lang and Sul, 2014). To address this concern, we first use an exogenous shock to market competition. Second, our findings may be driven by omitted time-invariant, firm-specific variables. To alleviate this concern, we regress the change in supply-chain information disclosure on the change in competition.

4.3.1. A quasi-natural experiment: Large reductions in industry import tariff rates

Considering the endogenous nature of competition, several studies attempt to use exogenous shocks to the intensity of product market competition to mitigate endogeneity concerns. For example, Bhojraj et al. (2004) take the gradual deregulation of the U.S. electric power industry as a series of exogenous shocks to industry competition; Huang et al. (2017) take the decline of U.S. import tariffs as an exogenous event that increases the product market competition; and Burks et al. (2018) use the implementation of the Interstate Banking and Branch Efficiency Act, which deregulates the interstate branches of the U.S. banking industry, as an exogenous shock to competition in the banking sector. Following previous studies (Fresard, 2010; Valta, 2012; Huang et al., 2017; Jiang et al., 2015), we use large reductions in industry import tariff rates in China as exogenous shocks to competition, and we use a DID model to examine the relationship between product market competition and supply-chain information disclosure. As the unexpected, large reductions in industry import

[3] As Zheng et al. (2021) note, the mean (median) level of competition (HHI) is 0.276(0.174) for U.S. firms.

Table 2
Summary statistics.

Variable	N	Mean	Median	Sd	Min	Max
DumSupply	9854	0.209	0	0.406	0	1
DumCustom	9854	0.361	0	0.48	0	1
Competition	9854	99.7	99.8	4	98.2	100
Size	9854	21.85	21.69	1.23	19.24	25.67
Lev	9854	0.441	0.434	0.22	0.049	1.05
ROA	9854	0.048	0.039	0.076	−0.183	0.372
TobinQ	9854	2.706	2.079	2.007	0.882	13.134
Dum_Rd	9854	0.744	1	0.437	0	1
Intang	9854	0.051	0.038	0.048	0	0.282
SOE	9854	0.433	0	0.495	0	1
Top1	9854	0.356	0.338	0.148	0.091	0.749
Dual	9854	0.241	0	0.428	0	1
Bsize	9854	2.272	2.303	0.174	1.792	2.773
Indep	9854	0.37	0.333	0.052	0.308	0.571
Variable	**High competition**		**Low competition**		**Mean Diff.**	
DumSupply	6239	0.195	3615	0.233		−0.038***
DumCustom	6239	0.34	3615	0.399		−0.060**

Note: *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

Table 3
Competition and supply-chain information disclosure: Main results.

Variable	(1) DumSupply	(2) DumCustom	(3) DumSupply	(4) DumCustom
Competition	–0.262**	–0.415***	–0.345***	–0.289***
	(–2.56)	(–4.40)	(–3.05)	(–2.67)
Size	–0.176***	–0.132***	–0.171***	–0.122***
	(–3.31)	(–3.00)	(–3.12)	(–2.70)
Lev	0.565**	0.579***	0.518**	0.581***
	(2.53)	(3.08)	(2.34)	(3.08)
ROA	–0.276	0.168	–0.242	0.132
	(–0.53)	(0.38)	(–0.45)	(0.29)
TobinQ	–0.044*	–0.046**	–0.014	–0.034
	(–1.90)	(–2.19)	(–0.61)	(–1.54)
Dum_Rd	–0.375***	–0.376***	–0.205	–0.237**
	(–3.04)	(–4.08)	(–1.58)	(–2.52)
Intang	2.406***	1.844**	1.979**	1.539*
	(2.85)	(2.44)	(2.11)	(1.88)
SOE	0.008	0.124	–0.028	0.092
	(0.07)	(1.38)	(–0.25)	(1.00)
Top1	0.380	0.311	0.214	0.184
	(1.21)	(1.20)	(0.66)	(0.69)
Dual	–0.107	–0.098	–0.087	–0.078
	(–1.13)	(–1.20)	(–0.92)	(–0.94)
Bsize	0.197	0.315	0.018	0.240
	(0.61)	(1.21)	(0.06)	(0.91)
Indep	–2.438***	–0.669	–2.476***	–0.678
	(–2.68)	(–0.91)	(–2.62)	(–0.89)
Intercept	26.983**	43.155***	35.670***	31.137***
	(2.58)	(4.54)	(3.12)	(2.88)
Year Fixed	Yes	Yes	Yes	Yes
Industry Fixed	No	No	Yes	Yes
N	9854	9854	9854	9854
Pseudo R^2	0.060	0.067	0.082	0.082

Note: Numbers in parentheses are t-statistics based on standard errors clustered by firm. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

tariff rates lowered the barriers faced by foreign-based firms, they increased competition within the industry (Bernard et al., 2006). Tariff changes are mainly triggered by global economic and political forces and bilateral (or multilateral) trade agreements and are less likely to be affected by corporate supply-chain information disclosure (Huang et al., 2017).

Following Huang et al. (2017), for each industry-year, we define a significantly large import tariff rate cut as an exogenous shock to competition. Specifically, we first obtain the HS-2002 hex quantile product-level AD valorem import tariff rates from UNCTAD's TRAINS system.[4] Second, we merge the HS-2002 hex quantile product into the four-digit industry code of the international standard industry classification (ISIC) (Revision 3) according to the comparison table released by the United Nations Statistics Division, then we calculate the average tariff rate of the industry. Third, we match this average tariff rate with the CIC two-digit industry code to obtain the double-digit, national economy, industry-level import tariff rate. Finally, we define a significantly large, unexpected import tariff rate cut ($Post\_Reduction_{i,t}$) as a reduction that is at least three times the average import tariff rate reduction for the industry over our sample period.

Next, we use a DID regression to establish the causal relation between competition and supply-chain information disclosure with the following model:

$$Disclosure_{i,t} = \alpha + \beta Post\_Reduction_{i,t} + \gamma * Control_{i,t-1} + \varepsilon_{i,j} \quad (2)$$

We use supplier-specific information disclosure (*DumSupply*) and customer-specific information disclosure (*DumCustom*) as our measures for supply information disclosure (*Disclosureit*). $Post\_Reduction_{i,t}$ is an indicator variable that equals 1 if a firm is in an industry that experienced a large, unexpected tariff reduction by year t, and 0 otherwise. Control *i, t-1* includes firm-specific control variables, industry dummies and year dummies in line with model (1).

The results are reported in Table 4. In columns (1) and (3), we control for industry fixed effects and year fixed effects. In columns (2) and (4), we control for firm fixed and year fixed effects. The coefficients of *Post_Reduction* are all negative and significant at the 5% level, indicating that a large reduction in import tariff rates may lead companies in affected industries to disclose less information about their supply chains. The DID models alleviate concerns of potential reverse causality and help to establish the causality between industry competition and corporate disclosure.

4.3.2. Change model

To ensure that our results are not driven by omitted variable bias, we follow previous studies (Jiang et al., 2015; Jiang et al., 2017) by regressing the year-to-year change in suppler-specific information disclosure (*ΔDumSupply*) and customer-specific information disclosure (*ΔDumCustom*) on the year-to-year change of the measure of product market competition (*ΔCompetition*). Table 5 presents the results of this change model.

Table 5, columns (1) and (2) show that the coefficients of *ΔCompetition* are all negative, suggesting that companies disclose less supply-chain information after large declines in industry concentration. These findings are consistent with our main results.

4.4. Additional tests

The results presented above suggest that companies in highly competitive industries disclose less supply-chain information. In this section, we test the role played by proprietary cost. Ali et al. (2014) point out that proprietary cost is determined by the following two factors: whether information disclosed by a company may provide incremental information to competitors and whether competitors may take advantage of this information at the expense of the disclosing firms. To explore the effect of proprietary costs, we test these two pathways separately. First, we use information asymmetry to proxy for incremental information contained in supply-chain information. Then, we use ownership, operation strategy, and legal environment to proxy for rivals' ability to use supply-chain information for competitive advantage.

[4] As the import tariff rate data are only available before 2014, we replace the import tariff data after 2014 with the data from 2014. We also remove the sample after 2014 and find that the results are robust.

Table 4
Competition and supply-chain information disclosure: DID model.

Variable	(1) DumSupply	(2) DumSupply	(3) DumCustom	(4) DumCustom
Post_Reduction	–0.522**	–0.737**	–0.178**	–0.315**
	(–2.00)	(–2.34)	(–1.99)	(–2.18)
Size	–0.180***	–0.177	–0.121**	–0.166
	(–2.92)	(–1.29)	(–2.32)	(–1.45)
Lev	0.581**	0.725	0.556**	0.193
	(2.30)	(1.64)	(2.53)	(0.50)
ROA	0.241	0.691	0.108	1.295
	(0.34)	(0.68)	(0.17)	(1.64)
TobinQ	–0.015	–0.012	–0.010	0.018
	(–0.52)	(–0.28)	(–0.39)	(0.49)
Dum_Rd	–0.091	–0.099	–0.084	–0.014
	(–0.80)	(–0.68)	(–0.89)	(–0.12)
InTang	1.536**	0.310	1.467*	–0.208
	(2.23)	(0.28)	(1.93)	(–0.20)
SOE	0.017	0.364	0.086	0.473*
	(0.13)	(1.07)	(0.79)	(1.67)
Top1	0.296	1.680**	0.213	0.292
	(0.85)	(2.18)	(0.74)	(0.40)
Dual	–0.009	0.022	–0.078	0.066
	(–0.09)	(0.13)	(–0.81)	(0.47)
BSize	0.064	–0.643	0.227	0.365
	(0.18)	(–1.01)	(0.78)	(0.71)
Indep	–3.027***	–3.665**	–1.326	0.321
	(–2.96)	(–2.42)	(–1.61)	(0.26)
Intercept	1.882		2.302*	
	(1.23)		(1.81)	
Firm Fixed	No	Yes	No	Yes
Year Fixed	Yes	Yes	Yes	Yes
Industry Fixed	Yes	No	Yes	No
N	7244	3419	7244	4608
Pseudo R^2	0.064	0.192	0.069	0.183

Note: Numbers in parentheses are t-statistics based on standard errors clustered by firm. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

4.4.1. Incremental information of supply-chain information: Information environment

We first examine the influence of incremental information. As stated by Berger and Hann (2007), incremental information in private information is determined by the public market information available to competitors. When the information environment of a company is relatively transparent, meaning that outsiders may obtain private information through open market channels, then supply-chain information disclosure releases little incremental information and proprietary cost is low. Conversely, in less transparent information environments, supply-chain information disclosure conveys more incremental information and proprietary cost is higher. Therefore, we expect that a more transparent information environment weakens the negative correlation between competition and supply-chain information disclosure.

Previous studies document that the media are an important source of information in the public market. For example, press releases on firms' business operation help to reduce information asymmetry. Competitors therefore rely on the media to obtain companies' supply-chain information (Mullainathan and Shleifer, 2005; Graham et al., 2005). Securities analysts have alternate sources of firms' private information, namely, personal contact with executives, on-site investigations, telephone interviews and other personal channels. Analysts are thus in a position to improve the efficiency of information analysis and pass information to the market through analyst reports, thereby reducing information asymmetry (Amiram et al., 2016; Son et al., 2016). We therefore use variables representing companies' news coverage (*Media*) and analyst following

Table 5
Competition and supply-chain information disclosure: Change model.

Variable	(1) ΔDumSupply	(2) ΔDumCustom
ΔCompetition	–0.258*	–0.325**
	(–1.66)	(–2.28)
ΔSize	0.570***	0.338***
	(5.70)	(3.87)
ΔLev	–0.283	0.147
	(–0.79)	(0.49)
ΔROA	–0.539	0.279
	(–0.90)	(0.60)
ΔTobinQ	0.114***	0.006
	(4.57)	(0.24)
ΔDum_Rd	–0.109	0.098
	(–1.20)	(1.17)
ΔIntang	–1.557	–0.242
	(–1.20)	(–0.22)
ΔSOE	–0.135	0.016
	(–0.56)	(0.07)
ΔTop1	0.871	0.986*
	(1.49)	(1.80)
ΔDual	–0.311***	0.000
	(–2.83)	(0.00)
ΔBSize	–0.271	–0.027
	(–0.70)	(–0.08)
ΔIndep	–2.018**	–1.297
	(–2.23)	(–1.61)
Intercept	–2.536***	–1.521***
	(–21.05)	(–9.86)
Year Fixed	Yes	Yes
Industry Fixed	Yes	Yes
N	9773	9773
Pseudo R^2	0.071	0.035

Note: Numbers in parentheses are t-statistics based on standard errors clustered by firm. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

(*Analyst*) to measure the relevant information environments to examine how incremental information provided in supply-chain information affects the relationship between competition and disclosure.

For empirical testing purposes, we include the interaction term between the variables *Competition* and *Media* (*Competition*Media*) and between the variables *Competition* and *Analyst* (*Competition*Analyst*) and use them as key explanatory independent variables in regression models. Shown in columns (1) and (3) of Table 6, the coefficients of *Competition*Media* are significantly positive, and in columns (2) and (4), the coefficients of *Competition*Analyst* are also shown to be significantly positive. All of these results show that a more transparent information environment is associated with lower proprietary costs and a weaker relationship between competition and supply-chain information disclosure.

4.4.2. Ability of competitors to obtain a competitive advantage using disclosed supply-chain information

We use ownership, operation strategy and legal environment to capture competitors' ability to obtain a competitive advantage using disclosed supply-chain information.

First, we study how ownership affects companies' supply chain information disclosure decisions. Compared with private enterprises, SOEs receive more financial and political government support; enjoy more conveniences in terms of obtaining sales channels, operating licenses and product pricing; and have closer natural ties with the government. These competitive advantages are difficult for non-SOE competitors to imitate (Shleifer and Vishny, 1994; Kong et al., 2013). This means that even if an SOE's competitors have access to the firm's supply-chain information, they have little ability to challenge the firm's competitive advantage.

Table 6
Competition and supply-chain information disclosure: Information environment.

Variable	(1)	(2)	(3)	(4)
	Media attention		Analyst attention	
	DumSupply	DumCustom	DumSupply	DumCustom
*Competition*Media*	0.168**	0.115*		
	(2.43)	(1.68)		
*Competition*Analyst*			0.113*	0.172***
			(1.94)	(3.36)
Competition	–0.560***	–0.318**	–0.344**	–0.540***
	(–3.59)	(–2.11)	(–2.27)	(–4.02)
Media	–16.717**	–11.482*		
	(–2.43)	(–1.68)		
Analyst			–11.375*	–17.260***
			(–1.96)	(–3.38)
Size	–0.075	–0.128***	–0.101*	–0.074
	(–1.39)	(–2.74)	(–1.76)	(–1.52)
Lev	0.412*	0.539***	0.459**	0.476**
	(1.86)	(2.86)	(2.08)	(2.51)
ROA	–0.996*	–0.042	0.217	0.361
	(–1.95)	(–0.10)	(0.43)	(0.82)
TobinQ	–0.000	–0.040*	–0.023	–0.029
	(–0.01)	(–1.87)	(–1.00)	(–1.35)
Dum_Rd	0.111	–0.223**	–0.178	–0.193**
	(0.96)	(–2.39)	(–1.38)	(–2.08)
Intang	1.714**	1.476*	1.849**	1.564*
	(1.98)	(1.83)	(2.12)	(1.95)
SOE	–0.080	0.086	–0.075	0.066
	(–0.73)	(0.93)	(–0.68)	(0.72)
Top1	0.103	0.261	0.337	0.270
	(0.33)	(1.00)	(1.07)	(1.04)
Dual	–0.098	–0.089	–0.077	–0.073
	(–1.03)	(–1.08)	(–0.80)	(–0.88)
BSize	–0.070	0.192	0.127	0.199
	(–0.23)	(0.74)	(0.40)	(0.76)
Indep	–2.488***	–0.838	–2.601***	–0.869
	(–2.72)	(–1.11)	(–2.80)	(–1.15)
Intercept	50.316***	34.221***	34.508**	55.300***
	(4.80)	(3.44)	(2.27)	(4.11)
Year Fixed	Yes	Yes	Yes	Yes
Industry Fixed	Yes	Yes	Yes	Yes
N	9854	9854	9854	9854
Pseudo R^2	0.053	0.077	0.071	0.079

Note: Numbers in parentheses are t-statistics based on standard errors clustered by firm. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

Therefore, we expect SOEs in highly competitive industries to experience lower proprietary costs associated with information disclosure and thus to disclose more supply-chain information than their private enterprise counterparts. Based on this assumption, we include the interaction term between *Competition* and *SOE* (an indicator that takes the value of 1 if the firm's ultimate controlling shareholders are state entities, and 0 otherwise). The coefficients of *Competition*SOE*, presented in Table 7, are all significantly positive, indicating that SOEs are more likely to disclose supply-chain information in highly competitive industries than their non-SOE counterparts.

Second, we study how operation strategy affects companies' supply chain information disclosure decisions. According to previous studies, corporate operation strategies may be categorized as either product-differentiation strategies or cost-leadership strategies. Companies that adopt a product differentiation strategy are less substitutable and more difficult for competitors to imitate and therefore encounter low proprietary

Table 7
Competition and supply-chain information disclosure: Ownership.

Variable	(1) DumSupply	(2) DumCustom
*Competition*SOE*	0.394**	0.166*
	(2.51)	(1.65)
Competition	–0.337**	–0.233***
	(–2.50)	(–2.61)
Size	–0.184***	–0.133***
	(–3.27)	(–4.73)
Lev	0.502**	0.539***
	(2.12)	(4.01)
ROA	–0.331	0.116
	(–0.50)	(0.25)
TobinQ	–0.041	–0.044**
	(–1.48)	(–2.46)
Dum_Rd	–0.223*	–0.217***
	(–1.73)	(–3.22)
Intang	1.116	1.260***
	(1.63)	(2.90)
SOE	–39.359**	–16.474
	(–2.51)	(–1.64)
Top1	0.336	0.237
	(1.07)	(1.49)
Dual	–0.092	–0.089
	(–0.96)	(–1.61)
BSize	0.128	0.207
	(0.41)	(1.35)
Indep	–2.524***	–0.729
	(–2.83)	(–1.51)
Intercept	35.248***	25.642***
	(2.61)	(2.86)
Year Fixed	Yes	Yes
Industry Fixed	Yes	Yes
N	9854	9854
Pseudo R^2	0.068	0.076

Note: Numbers in parentheses are t-statistics based on standard errors clustered by firm. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

costs resulting from information disclosure (Bhojraj et al., 2004). For companies adopting a cost-leadership strategy, however, supply-chain information contains business secrets, such as pricing strategies and gross profit margins, that represent cost-leading advantages. As a result, these companies' supply-chain information is easily imitated or exploited by competitors and the proprietary costs resulting from supply-chain information disclosure is high. Therefore, it is expected that companies with product-differentiation strategies (cost-leadership strategies) are less (more) likely to be affected by product market competition due to lower (higher) proprietary costs.

Following Duanmu et al. (2018), we first use each firm's ratio of 'total sales minus production costs' to total sales to measure its *cost-leadership* variable. We then use the industry median *cost-leadership* to adjust firm level *cost-leadership* measure and obtain an *adjusted cost-leadership value*. Next, we standardize each firm's *adjusted cost-leadership value* with the extreme value of industry *adjusted cost-leadership value* to obtain *Clcc*. A higher *Clcc* value indicates a stronger cost-leadership strategy.[5] We use each firm's ratio of advertising expense to total sales to measure its *product-differentiation*. We then use the industry median *product-differentiation* to adjust firm level *product-differentiation* measure and obtain an *adjusted product-differentiation value.* Next, we standardize each firm's *adjusted product-differentiation value* with the extreme value of industry *adjusted*

[5] $\text{Clcc} = \frac{CL - median(CL)}{range(CL - median(CL))}$

Table 8
Competition and supply-chain information disclosure: Operation strategy.

Variable	(1)	(2)	(3)	(4)
	Product-differentiation strategy		Cost-leadership strategy	
	DumSupply	DumCustom	DumSupply	DumCustom
*Competition*Dfcc*	0.416***	0.324**		
	(3.18)	(2.18)		
*Competition*Clcc*			–0.026*	–0.042***
			(–1.81)	(–3.01)
Competition	–0.412***	–0.311**	–0.132	–0.273***
	(–3.72)	(–2.49)	(–1.50)	(–4.63)
Dfcc	–41.571***	–32.448**		
	(–3.19)	(–2.19)		
Clcc			2.647*	4.155***
			(1.82)	(3.01)
Size	–0.132***	–0.193***	–0.137***	–0.107***
	(–2.92)	(–3.51)	(–3.00)	(–3.45)
Lev	0.504***	0.523**	0.532***	0.406***
	(2.63)	(2.34)	(2.83)	(2.89)
ROA	0.123	–0.282	–0.078	–0.934**
	(0.23)	(–0.45)	(–0.17)	(–2.27)
TobinQ	–0.041*	–0.045*	–0.041*	0.001
	(–1.84)	(–1.78)	(–1.79)	(0.04)
Dum_Rd	–0.208**	–0.197	–0.232**	0.144*
	(–2.24)	(–1.52)	(–2.49)	(1.80)
Intang	1.275*	1.132*	1.280*	1.175***
	(1.75)	(1.66)	(1.77)	(2.76)
SOE	0.095	–0.023	0.095	–0.063
	(1.03)	(–0.21)	(1.03)	(–1.01)
Top1	0.235	0.323	0.223	0.054
	(0.91)	(1.03)	(0.86)	(0.29)
Dual	–0.083	–0.090	–0.095	–0.098
	(–1.00)	(–0.93)	(–1.15)	(–1.52)
BSize	0.225	0.145	0.228	–0.062
	(0.88)	(0.46)	(0.89)	(–0.34)
Indep	–0.717	–2.536***	–0.768	–2.559***
	(–0.98)	(–2.82)	(–1.05)	(–4.44)
Intercept	43.398***	32.893***	15.631*	29.111***
	(3.90)	(2.60)	(1.78)	(4.84)
Year Fixed	Yes	Yes	Yes	Yes
Industry Fixed	Yes	Yes	Yes	Yes
N	9854	9854	9854	9854
Pseudo R^2	0.077	0.068	0.075	0.047

Note: Numbers in parentheses are t-statistics based on standard errors clustered by firm. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

product-differentiation value to obtain *Dfcc*. A higher *Dfcc* value indicates a stronger product-difference strategy.[6] Next, we interact *Competition* with *Clcc* and *Competition* with *Dfcc*. The results, presented in column (1) of Table 8, show that the coefficient of *Competition*Dfcc* is significantly positive, indicating that the higher the degree of product differentiation, the weaker the negative relationship between industry competition and supply-chain information disclosure. The results, presented in column (2) of Table 8, show that the coefficient of *Competition*Clcc* is significantly negative, suggesting that the stronger the competitive advantage gained by a company through its cost-leadership strategy, the more pronounced the negative relationship between industry competition and supply-chain information disclosure.

[6] $\text{Dfcc} = \frac{DF - median(DF)}{range(DF - median(DF))}$

Table 9
Competition and supply-chain information disclosure: Legal environment.

Variable	(1) DumSupply	(2) DumCustom
*Competition*Law*	0.034**	0.042**
	(2.02)	(2.49)
Law	–3.404**	–4.223**
	(–2.05)	(–2.52)
Competition	–0.865***	–0.674***
	(–3.63)	(–3.30)
Size	–0.090	–0.117*
	(–1.58)	(–1.88)
Lev	0.353*	0.488***
	(1.77)	(3.21)
ROA	–1.256**	0.061
	(–2.24)	(0.12)
TobinQ	0.001	–0.038*
	(0.03)	(–1.76)
Dum_Rd	0.244	–0.189
	(1.43)	(–1.45)
Intang	1.628*	1.439*
	(1.71)	(1.91)
SOE	–0.181*	0.018
	(–1.78)	(0.30)
Top1	0.144	0.326
	(0.43)	(1.13)
Dual	–0.082	–0.077
	(–0.98)	(–1.26)
BSize	–0.095	0.200
	(–0.35)	(0.78)
Indep	–2.686***	–0.986*
	(–3.80)	(–1.94)
Intercept	87.849***	69.493***
	(3.72)	(3.41)
Year Fixed	Yes	Yes
Industry Fixed	Yes	Yes
N	9854	9854
Pseudo R^2	0.058	0.081

Note: Numbers in parentheses are t-statistics based on standard errors clustered by firm. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

Third, we study how legal environment affects companies' supply chain information disclosure decisions. In a poorer legal environment, as characterized by relatively weak property rights protection, the supply-chain information disclosed by a company facing intense competition is more likely to be used by improper means by its competitors, who then infringe on the disclosing firm's interests (Guo et al., 2004). Therefore, in such a legal environment, we expect companies in highly competitive industries to disclose less supply-chain information. The legal environment measurement index (*Law*) adopted in this study is taken from Wang et al. (2017).[7] The higher the index score, the better the legal environment. We include the interaction term of *Competition* and *Law* in our main model and report the results in Table 9. As shown, the coefficient of *Competition*Law* is significantly positive, suggesting that when the legal environment is poor, companies are less likely to disclose supply-chain information.

[7] Please note that, as the law index data is only available before 2014, following Long and Li (2016) and Wang and Jiang (2020), we first derive the law index measure after 2014 (i.e., 2015 and 2016) based on the law index change trend in the three years from 2012 to 2014. To test robustness, we also follow Wang et al. (2015) and delete the sample and replace the law index data after 2014 with the average law index data from 2012 to 2014. The results remain unchanged.

Table 10
Robustness tests: Alternative proxies for product market competition.

Variable	(1) DumSupply	(2) DumCustom	(3) DumSupply	(4) DumCustom	(5) DumSupply	(6) DumCustom	(7) DumSupply	(8) DumCustom
MCR4	–3.026***	–2.234***						
	(–3.45)	(–2.64)						
Lerner_Index			0.037*	0.031**				
			(1.68)	(2.28)				
Abprofit_Persistence					0.153***	0.101**		
					(2.64)	(2.03)		
Similarity							–0.569**	–0.461*
							(–2.00)	(–1.92)
Size	–0.171***	–0.122***	–0.250***	–0.146***	–0.217***	–0.117***	–0.240***	–0.135***
	(–3.12)	(–2.69)	(–9.65)	(–4.01)	(–8.72)	(–5.64)	(–5.47)	(–3.71)
Lev	0.518**	0.581***	0.470***	0.271*	0.557***	0.276***	0.551***	0.23
	(2.34)	(3.07)	(4.01)	(1.73)	(4.99)	(2.80)	(3.00)	(1.43)
ROA	–0.240	0.133	(0.02)	(0.01)	–0.028*	(0.01)	(0.19)	(0.14)
	(–0.45)	(0.29)	(–1.31)	(–0.56)	(–1.95)	(–0.61)	(–0.46)	(–0.39)
TobinQ	–0.014	–0.033	(0.14)	(0.35)	(0.08)	(0.35)	(0.03)	(0.02)
	(–0.58)	(–1.52)	(–0.35)	(–0.78)	(–0.21)	(–1.05)	(–1.60)	(–1.00)
Dum_Rd	–0.205	–0.239**	(0.07)	–0.134*	–0.131**	–0.133***	(0.03)	(0.12)
	(–1.58)	(–2.54)	(–1.01)	(–1.74)	(–2.43)	(–2.95)	(–0.33)	(–1.56)
InTang	1.986**	1.546*	0.890**	0.74	1.317***	0.933***	0.80	0.63
	(2.12)	(1.89)	(2.23)	(1.24)	(3.60)	(2.84)	(1.28)	(1.13)
SOE	–0.029	0.092	0.07	0.154**	0.08	0.191***	0.04	0.176**
	(–0.25)	(1.00)	(1.32)	(2.07)	(1.64)	(4.60)	(0.40)	(2.37)
Top1	0.213	0.184	(0.00)	(0.08)	0.14	0.02	0.07	(0.05)
	(0.66)	(0.69)	(–0.01)	(–0.36)	(0.92)	(0.14)	(0.27)	(–0.22)
Dual	–0.087	–0.078	(0.05)	(0.07)	(0.06)	–0.080*	(0.07)	(0.10)
	(–0.91)	(–0.94)	(–0.83)	(–1.00)	(–1.21)	(–1.75)	(–0.85)	(–1.36)
BSize	0.021	0.240	0.21	0.14	0.272*	0.261**	0.14	0.14
	(0.06)	(0.91)	(1.37)	(0.67)	(1.84)	(2.13)	(0.55)	(0.66)
Indep	–2.465***	–0.677	–2.089***	(0.74)	–1.981***	(0.48)	–2.410***	(0.98)
	(–2.61)	(–0.89)	(–4.37)	(–1.23)	(–4.27)	(–1.24)	(–3.08)	(–1.54)
Intercept	4.236***	4.441***	1.597**	2.239**	1.268**	1.443***	2.183*	2.447***
	(2.58)	(3.36)	(2.43)	(2.56)	(2.09)	(2.94)	(1.95)	(2.70)
Year Fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	9854	9854	14531.00	14531.00	14538.00	14538.00	14212.00	14212.00
Pseudo R^2	0.082	0.082	0.07	0.07	0.06	0.05	0.07	0.06

Note: Numbers in parentheses are t-statistics based on standard errors clustered by firm. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

4.5. Robustness test

4.5.1. Alternative proxies for product market competition

We use alternative proxies for product market competition, including the concentration ratio of the four largest firms in the industry (*CR4*), the Lerner index, abnormal earnings persistence and a text index of product market competition. Specifically, (1) the higher the market share of the four largest firms (*CR4*), the lower the competition. To construct a measure of intuitive acceptance, we use (1 - *CR4*) (*MCR4*) instead of *CR4*. The higher the *MCR4* value, the higher the product market competition. (2) The Lerner index represents a company's pricing power in the industry. The lower the Lerner index, the weaker the company's pricing power in the industry and the higher the product market competition.[8] (3) The higher the abnormal earnings persistence in an industry, the more difficult it is for the industry to retain abnormal earnings and the higher the

[8] Following Peress (2010), we define the Lerner index as the ratio of total sales minus operating costs, selling expenses and administrative expenses to total sales.

Table 11
Robustness tests: Fixed effect model.

Variable	(1) DumSupply	(2) DumCustom
Competition	–0.593***	–0.400***
	(–3.95)	(–3.20)
Size	–0.226*	–0.215**
	(–1.78)	(–2.09)
Lev	0.923**	0.367
	(2.38)	(1.08)
ROA	0.096	1.509***
	(0.14)	(2.71)
TobinQ	–0.011	–0.013
	(–0.32)	(–0.46)
Dum_Rd	0.121	0.080
	(0.76)	(0.67)
InTang	1.741	0.798
	(1.24)	(0.67)
SOE	0.069	0.174
	(0.23)	(0.71)
Top1	1.695**	0.244
	(2.28)	(0.38)
Dual	0.079	–0.001
	(0.51)	(–0.01)
BSize	0.028	0.716
	(0.05)	(1.57)
Indep	–3.966***	0.485
	(–2.77)	(0.42)
Year Fixed	Yes	Yes
Firm Fixed	Yes	Yes
N	4232	5822
Pseudo R^2	0.208	0.192

Note: Numbers in parentheses are t-statistics based on standard errors clustered by firm. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

product market competition.[9] (4) We also measure competition by measuring the similarity of product description text in the annual reports of companies in the same industry (Ren and Wang, 2019). The more similar a company's product description is to that of other companies, the higher the product market competition.[10]

The results, presented in Table 10, show that firms with higher competition (i.e., higher *MCR4*, lower Lerner index, lower abnormal earnings persistence, higher similarity of product description text) are less likely to disclose supply-chain information. Both robustness results are consistent with our hypothesis.

4.5.2. Fixed effect model

We run regressions with a fixed effect model. The inclusion of firm fixed effects in regression models helps to control for time-invariant, firm-specific characteristics. As is shown in Table 11, our results are robust to the inclusion of firm fixed effects.

[9] Following Ellis (2012), we define abnormal earnings as a company's return on assets minus the industry's average return on assets. We use the correlation between the industry's current abnormal surplus and the industry's abnormal surplus from the previous year to measure the persistence of the industry's abnormal surplus.

[10] Following Ren and Wang (2019), we define *Similarity* as the average similarity of product and business vocabulary among companies in the same industry. The results remain unchanged. The textual data of this article are obtained from the WinGo (text structure) text database (www.wingodata.cn).

Table 12
Robust tests: Alternative methods of addressing missing *Competition* values.

Variable	Using the Competition value in 2013		Using the average Competition value from 2011 to 2013		Deleting the sample after 2013	
	(1) DumSupply	(2) DumCustom	(3) DumSupply	(4) DumCustom	(5) DumSupply	(6) DumCustom
Competition	–0.521***	–0.422***	–0.481***	–0.326**	–0.508***	–0.493***
	(–3.55)	(–3.00)	(–3.88)	(–2.22)	(–3.56)	(–3.45)
Size	–0.172***	–0.123***	–0.174***	–0.131***	–0.165***	–0.120**
	(–3.14)	(–2.72)	(–3.15)	(–2.87)	(–2.83)	(–2.48)
Lev	0.520**	0.582***	0.524**	0.576***	0.834***	0.850***
	(2.35)	(3.08)	(2.37)	(3.06)	(3.31)	(4.02)
ROA	–0.241	0.133	–0.260	0.125	0.539	0.837
	(–0.45)	(0.29)	(–0.48)	(0.28)	(0.72)	(1.32)
TobinQ	–0.015	–0.034	–0.016	–0.033	–0.021	–0.048*
	(–0.65)	(–1.56)	(–0.69)	(–1.52)	(–0.64)	(–1.80)
Dum_Rd	–0.202	–0.234**	–0.193	–0.200**	–0.167	–0.167*
	(–1.55)	(–2.48)	(–1.48)	(–2.10)	(–1.12)	(–1.67)
Intang	1.975**	1.538*	1.996**	1.634**	1.688*	1.192
	(2.11)	(1.88)	(2.13)	(2.00)	(1.65)	(1.39)
SOE	–0.029	0.091	–0.030	0.074	–0.023	0.075
	(–0.26)	(0.98)	(–0.27)	(0.80)	(–0.19)	(0.76)
Top1	0.213	0.184	0.205	0.176	0.400	0.332
	(0.66)	(0.69)	(0.64)	(0.66)	(1.14)	(1.16)
Dual	–0.087	–0.078	–0.085	–0.080	–0.074	–0.031
	(–0.91)	(–0.94)	(–0.89)	(–0.97)	(–0.65)	(–0.34)
BSize	0.015	0.237	–0.008	0.195	–0.221	0.123
	(0.05)	(0.90)	(–0.02)	(0.74)	(–0.62)	(0.44)
Indep	–2.474***	–0.675	–2.503***	–0.671	–3.141***	–0.787
	(–2.62)	(–0.89)	(–2.65)	(–0.88)	(–2.95)	(–0.96)
Intercept	53.342***	44.454***	49.291***	34.637**	52.251***	51.511***
	(3.61)	(3.17)	(3.93)	(2.35)	(3.63)	(3.61)
Year Fixed	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed	Yes	Yes	Yes	Yes	Yes	Yes
N	9854	9854	9854	9854	6596	6596
Pseudo R^2	0.082	0.083	0.082	0.084	0.105	0.063

Note: Numbers in parentheses are t-statistics based on standard errors clustered by firm. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

4.5.3. Alternative methods of addressing missing competition values

In the results reported above, we derive the competition measure after 2013 based on the competition trend during the three years from 2011 to 2013. As *Competition* is our key variable, we use other methods to supplement the missing data as a robustness check and present the results in Table 12. First, we replace the value for the *Competition* variable after 2013 with the value for the *Competition* variable in 2013 and present the results in columns (1) and (2). Second, we replace the *Competition* value after 2013 with the average competition value from 2011 to 2013, presenting the results in columns (3) and (4). Third, we delete the samples after 2013, showing the results in columns (5) and (6). These results show that the coefficient of *Competition* are all positively significant, suggesting that the previous results are not affected by the methods used to address missing *Competition* values.

5. Conclusion

The importance of supply-chain information to corporations and to the capital market information environment is well recognized by both practitioners and academic scholars, yet empirical study of the determinants of corporate supply-chain information disclosure decisions is very limited. This study aims to fill the

gap by investigating the impact of product market competition, an important external environmental factor, on the level of supply-chain information disclosure by listed companies. Our results show that intense market competition significantly reduces the level of supply-chain information disclosure. These findings are robust to a battery of robustness tests, including a DID regression using large reductions in China import tariff rates as exogenous shocks to the level of competition and change model analysis. We also provide evidence that the proprietary cost channels drive the negative relation between product market competition and supply-chain information disclosure. We find that that when supply-chain information disclosure reveals more incremental information (firms in an opaque information environment) and when competitors are more capable of using supply-chain information disclosure to gain a competitive advantage (for disclosing firms that are not state owned, that gain a strong competitive advantage through product cost leadership strategies, that gain a weak competitive advantage through a product-differentiation strategy and that are located in an underdeveloped legal environment), the proprietary cost of supply-chain information disclosure is higher, making the effect of market competition in curbing the supply-chain information disclosure more pronounced. Our findings not only expand the theoretical framework underlying supply-chain information research but also enrich the literature on competition and voluntary disclosure.

This study has important practical implications. In recent years, China's regulators have endeavored to strengthen the supply-chain information disclosure requirements for listed companies, encouraging them to disclose the identities of their top five suppliers and customers along with the ratio of their purchases from each supplier and sales to each customer to their aggregated annual purchases and sales. In practice, however, companies are often reluctant to disclose such information. Against this background and given our results, we suggest that regulators must not only strengthen disclosure requirements but also create a favorable environment for disclosure. The improvement of property rights protection, promotion of a contractual culture and guidance toward healthy competition in industry can mitigate the negative impact of proprietary costs on information disclosure, thus leading to positive interactions between the product market and the capital market.

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.

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Tax credit rating and corporate innovation decisions

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ABSTRACT

The tax credit rating mechanism was formally implemented in 2014. As an important tax collection and management innovation, it has attracted the attention of regulatory authorities and scholars. Different from the literature that directly examines corporate tax compliance, we focus on the impact of tax credit rating implementation on corporate research and development (R&D) investment decisions. Using listed companies' data from 2014 to 2019, we find that companies with higher tax credit ratings invest more in innovation, because the system helps managers identify R&D opportunities, alleviates corporate financing constraints and reduces agency costs. We confirm that tax credit ratings have manifold impacts on corporate information environments and business decisions, with better ratings positively affecting firms' business decisions. This discovery can inform tax policy reform, encourage corporate innovation and construct social credit systems.

1. Introduction

Taxation is the main source of income in most countries (Musgrave, 1959). The payment of taxes reduces the profits retained by enterprises, which implies that firms naturally have a strong motivation for tax avoidance and even tax evasion. The ability of the government to effectively collect taxes is important as it not only conveys the effectiveness of the functional performance of the government, but it also reveals the concentrated expression of national governance capabilities, especially for transitional countries (Brautigam et al., 2008). To this end, various countries are constantly improving their tax collection and management systems. Current tax collection and management methods mainly comprise the compulsory and incentive systems. The compulsory system commonly uses tax inspection and punishment, wherein the government investigates and punishes

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corporate tax evasion, tax fraud, tax arrears and other non-compliance behaviors to increase the cost of tax non-compliance and ultimately act as a deterrent. The incentive system commonly increases the income from tax compliance and ultimately achieves a win–win effect by classifying management *ex ante* with corresponding rewards and penalties (Sun et al., 2019; Li et al., 2020). Theoretically, the tax collection and management method of tax inspection-punishment restricts corporate tax evasion, tax avoidance and other non-compliance behaviors through clear legislation and strict law enforcement, which increases the cost of corporate tax violations. However, its supervisory and management role manifests as actually seizing and penalizing taxpaying companies rather than as simply deterring them. As a result, the tax collection and management method of tax inspection-punishment has limited audiences as it only restrains taxpayers from violating regulations without significantly affecting a firm's original tax-compliance; it even negatively affects a firm's normal production and business activities (Devos, 2004; Pan et al., 2013; Mohdali et al., 2014). In practice, to identify the increasingly hidden tax violations by enterprises, the tax inspection and punishment method relies on sound laws, regulations and multiple strict and complicated inspection procedures, which increase the tax collection costs borne by regulatory agencies. Taxpaying companies must provide a large amount of tax information to facilitate taxation review, thereby increasing the organization cost of the company. Meanwhile, excessive law enforcement hinders normal corporate business activities due to the excessive occupation of resources. In particular, when the economy is under great downward pressure and remains relatively difficult, the tax collection and management method of tax inspection and punishment cannot meet the requirements advocated by the government to simplify administration, delegate power and reduce the burden on enterprises, which are important for stimulating the vitality of market entities and improving the efficiency of resource allocation. As highlighted in many economic work conferences and government reports by the Party Central Committee, it is necessary to deepen system reforms, reduce the burden on enterprises through tax and fee reductions and encourage the green, efficient and sustainable development of enterprises. Classification and reward tax collection and management is a major means of innovating regulatory methods. Exploring the economic consequences of these efforts, especially on corporate decision-making, has important theoretical and practical significance.

The deepening of market-oriented reforms has increased the value of the role of corporate credit and the business environment in economic development. Issued by the State Council in 2014, the "Notice of the State Council on Printing and Distributing the Planning Outline for the Construction of the Social Credit System (2014–2020)" clarified the direction and measures for the construction of the social credit system, and the "Administrative Measures for Tax Credit Ratings (Trial)" issued by the State Administration of Taxation is a useful measure in this direction as it aims to standardize tax credit management, promote taxpayers' integrity and self-discipline and improve tax law compliance by providing incentives and guidance in advance. Specifically, the State Administration of Taxation evaluates all taxpaying companies based on historical credit, internal tax and external information every year and scores companies based on the above indicators. If the companies score >90 points, then they are rated as A-level taxpayers; these levels effectively capture tax compliance by enterprises and supplement the shortcomings that, in the past, could only be evaluated from the perspective of tax violations. Meanwhile, the State Administration of Taxation, together with the People's Bank of China, the Ministry of Land and Resources, the General Administration of Customs, the State Administration for Industry and Commerce, the State-Owned Assets Supervision and Administration Commission and other ministries jointly implemented the "Memorandum of Cooperation on the Implementation of Joint Disciplinary Methods for Major Tax Violation Cases" in 2016 and the "Memorandum of Cooperation on the Implementation of Joint Incentive Methods for A-level Taxpayers" in 2015, with the aim of improving tax compliance by enterprises through the reward and punishment mechanism based on classified management. To implement preferential policies for A-level taxpayers and avoid the negative impacts of lower ratings, taxpaying companies have the motivation to improve the information reporting system and pay taxes in accordance with existing laws and regulations. Moreover, tax credit ratings have an important signaling effect due to the impact of the tax regulatory authority (Sun et al., 2019). Studies find that the implementation of a tax credit ratings system stimulates the enthusiasm of corporate tax compliance through positive incentives, reduces the organization costs of various economic activities for enterprises and mutually benefits both the government and enterprises (Sun et al., 2019; Tao et al., 2019; Li et al., 2020). From a long-term perspective, we examine whether incentive-based tax collection and management policies can help companies obtain

resources and facilitate their future development or whether they occupy too many corporate resources and hinder the long-term planning of companies. Although tax compliance increases corporate costs, can it also benefit companies' long-term development? Specifically, we examine the impact of tax credit ratings on corporate research and development (R&D) investment.

R&D is a powerful weapon that helps companies survive in a complex and changeable international market. It is also the fundamental driving force of national development, especially during the coronavirus disease 2019 outbreak. The 2020 government work report clearly emphasizes the need to achieve major breakthroughs in key areas. R&D investment is characterized by high investment risk, delayed return and strong information asymmetry, implying that it fluctuates greatly across various corporate investments. Feasible innovation projects, sufficient innovation resources and approval from managers are important factors that affect corporate innovation investment. Studies find that higher information quality, smaller financing constraints and lower agency costs can increase corporate innovation (Li and Song, 2010; Brown et al., 2012; Foucault and Fresard, 2014). To stimulate enthusiasm for innovation, the government uses policy guidance, financial support, talent introduction and other means, thereby effectively solving the practical problems of enterprise innovation and profoundly affecting the will of the state and corporate decision-making (Xie et al., 2009; Hunt and Gauthier, 2010; Yu et al., 2016; Bloom et al., 2019). In this context, we examine whether innovative taxation supervision methods cater to the needs of the government and enterprises to achieve the "double innovation" of system reforms and firms' R&D, which can help comprehensively evaluate policy effects and determine possible incentives for innovation.

We select 2014–2019 non-financial A-share listed companies as samples to examine the impact of tax credit ratings on corporate innovation investment decisions. We find that tax credit ratings significantly increase corporate innovation investment. We also find that a higher tax credit rating indicates better internal information collection and transmission, which helps managers more accurately identify R&D projects. A higher tax credit rating not only grants direct financial funds and bank loans to the enterprise, but it also implies that the company's internal information system is complete. The improvement in information quality reduces information asymmetry, attracts external investors and jointly alleviates financial constraints. Moreover, tax credit ratings can restrict and supervise managers, ensure the effectiveness of executive compensation incentives and alleviate the principal-agent problem. After using a change model, the propensity score matching (PSM) method and the PSM-difference-in-differences (DID) method to alleviate the endogeneity problem, the above results remain valid. Cross-sectional tests further confirm that tax credit ratings ease information asymmetry, reduce agency costs and complement compulsory tax policies with incremental contributions, thereby improving corporate tax compliance and inspiring corporate enthusiasm for innovation.

The contributions of this study are reflected in the following aspects. First, we add to research on the economic consequences of tax credit ratings. To evaluate the effect of tax policy implementation, it is necessary to pay attention to the impact of policy implementation on corporate decision-making in addition to corporate tax compliance. From the perspective of corporate innovation, we find that the implementation of tax credit ratings helps the long-term development of enterprises. However, the tax credit rating system differs from the original tax violation penalties in that it is an incentive-based tax supervision mechanism. At present, relatively few studies focus on this innovative supervision method, with most studies concentrating on the short-term impact on enterprises (Sun et al., 2019; Li et al., 2020). Although Ye et al. (2021) study the impact of incentive supervision on corporate innovation, they use an event study and only explore one channel that affects innovation. Our study effectively complements research in this field from a long-term perspective by examining cumulative effects and more comprehensively analyzing the policy effects of tax credit ratings.

Second, we extend the study of the economic consequences of tax compliance. Previous studies mostly evaluate corporate tax violations from the perspective of tax punishment and examine the negative consequences of excessive tax avoidance from the perspective of tax planning (Desai et al., 2007; Kim et al., 2011; Liu and Ye, 2013). However, this method can only identify companies that have violated regulations. In addition, the rationality of tax avoidance is difficult to accurately measure. The tax credit rating is available for all taxpayers and represents the degree of tax compliance, which can be used to describe the research problem more meticulously and accurately. We also focus on the impact of policy implementation on the long-term development of enterprises, which supplements the conclusions of research in related fields.

Third, we enrich research on the determinants of corporate innovation. Innovation is the source of an enterprise's core competitiveness and the internal driving force of a country's economic development. For a long time, it has been a hot issue discussed in the theoretical and practical circles, especially in the context of economic globalization. Breaking technical barriers is not only key to corporate profitability but also a powerful weapon for economic and political negotiations. Given China's comprehensive poverty alleviation plan, stimulation of the innovative vitality of enterprises and rational regulation of the economy are significant topics of focus for the government. From the perspective of tax system reform, this study has practical significance and policy reference value, as we examine the impacts of tax credit ratings on corporate innovation investment and meticulously analyze the role of tax credit ratings in searching for and implementing R&D projects.

The remainder of this paper is organized as follows. Section 2 reviews the literature and develops the research hypothesis. Section 3 describes the research design and sample selection process. Section 4 presents the empirical results: main results, robustness tests, endogeneity tests, channel tests and cross-sectional tests. Section 5 concludes the paper.

2. Literature review and hypothesis development

2.1. Economic consequences of tax administration

Due to the compulsory and gratuitous nature of taxation, enterprises have strong incentives to avoid or even evade taxation. As the most important source of a country's income, the ability of the government to effectively collect taxes is critical; it not only conveys the effectiveness of the functional performance of the government, but also reveals the concentrated expression of national governance capabilities (Brautigam et al., 2008). To protect national taxation schemes, the government has introduced a number of tax collection and management systems to regulate the taxpaying behaviors of enterprises in an "enhanced and vigorous manner." Current tax collection and management methods mainly comprise compulsory and incentive methods. The compulsory method uses *ex post* tax inspections to investigate and deal with non-compliance behaviors, such as tax evasion, tax fraud and tax arrears, to increase the cost of tax non-compliance and ultimately act as a deterrent. The incentive method uses *ex ante* classified management, supplemented by corresponding reward and punishment mechanisms, to increase the income of tax compliance and ultimately achieve a win–win effect (Sun et al., 2019; Li et al., 2020). Compulsory taxation supervision reviews the taxation results of enterprises *ex post* and penalizes violations by enterprises, which deters taxation behaviors in the future; many studies confirm the effectiveness of such disciplinary methods in inhibiting corporate tax avoidance violations. Jiang (2013) studies the consequences of tax collection and management from the perspective of stock price crush risks, based on the study of Kim et al. (2011), and finds that compulsory tax collection and management improves corporate governance, restrains managers' aggressive tax avoidance behaviors and eventually reduces firms' stock price crush risks. Zhang and Zhu (2015) conduct a study from the perspective of investment efficiency and find that tax administration reduces the degree of corporate tax avoidance and improves investment efficiency. Li and Xu (2013) show that strict tax collection and management curb the illegal tax avoidance effect of political connections. Meanwhile, compulsory tax collection and management standardizes managers' decision-making. From the perspective of agency problems, compulsory tax collection and management system reduces firms' related transactions, major shareholder interest encroachments and agency costs (Dyck and Zingales, 2004; Desai et al., 2007; Zeng and Zhang, 2009; Xu et al., 2011). Ye and Liu (2011) find that tax collection and management increases the cost of corporate upward earnings management, thereby reducing corporate earnings management behaviors. From the perspective of other stakeholders, Guedhami and Pittman (2008) find that the strengthening of tax collection and management increases the confidence of creditors in business operations and reduces corporate bond interest rates. Pan et al. (2013) further verify this conclusion with Chinese data and find that stronger tax collection and management reduces the cost and increases the scale of debt, effectively alleviating corporate financial constraints.

With the continuous reform of tax supervision methods, incentive-based tax collection and management enhances corporate tax compliance and provides "double dividends" to the government and enterprises through *ex ante* guidance. Alm et al. (1992) verify that the reward mechanism promotes tax compliance.

Feld and Frey (2007) and Bazart and Pickhardt (2011) further find that the reward mechanism supplements the punishment mechanism, thus increasing the internal source of corporate tax compliance. However, relatively few studies focus on the impact of incentive tax regulation on enterprises. Sun et al. (2019) investigate the impact of flexible taxation supervision and find that the improvement of tax credit ratings helps enterprises obtain large-scale credit financing at lower costs, which implies that flexible taxation supervision provides incentives by improving corporate reputation and alleviating corporate financing constraints. Li et al. (2020) further distinguish the reward and punishment mechanisms of flexible tax supervision and find that such mechanisms can promote corporate tax compliance, improve corporate performance and have spillover effects that benefit both the government and enterprises.

2.2. Determinants of corporate innovation investment

R&D is an important investment decision for companies. The advent of new products and technologies helps companies surpass technical barriers, gain or maintain competitive advantages amid fierce market competition and enhance their long-term profitability. However, the input and output of corporate innovation are relatively volatile because innovation investment is characterized by high information asymmetry, high investment risk and delayed return. Only when the innovation project is of high quality and accurately identified, material and financial resources for R&D are sufficiently procured and the implementation is effectively supervised can facilitate innovation investment and yield positive results.

Financial constraints and agency problems are important factors that affect corporate innovation decisions. From the perspective of financial constraints, studies show that it is difficult to obtain stable external financing. Therefore, R&D activities mainly rely on internal funds, especially for companies in the early stages of development (Himmelberg and Petersen, 1994; Brown et al., 2009). The reasons for this are as follows. First, R&D investments require large-scale financing with long periods of capital occupation. Second, due to the high uncertainty of R&D output, the success of R&D and the market recognition of innovation output cannot be controlled in advance. Third, the information asymmetry of innovation projects may cause adverse selection and moral hazards. To protect proprietary technology, companies disclose less R&D-related information and as a result, external stakeholders have relatively little information on such activities (Liu et al., 2015), making it difficult for investors to evaluate the expected returns and stabilize investments (Hall, 2002). As the shortage of funds precludes meeting the demand for innovation, the R&D capabilities of enterprises are limited, which ultimately damages the development of the national economy (Zhang et al., 2012). Benfratello et al. (2008) and Brown et al. (2009) find that the development of the banking industry and the entry of venture capital can prompt corporate R&D investments. Brown et al. (2012) find that the development of financial markets can ease corporate financial constraints, which, in turn, increases corporate innovation. Ma et al. (2014) find that stable external financing channels, measured by the size of credit line and whether or not companies obtain bank credit, help companies increase their innovation investment. The conclusion of these studies further confirm that more financing stimulates firms' innovation investment.

From the perspective of the principal-agent problem, business owners pay attention to long-term development of firms and therefore do not hesitate to increase R&D investment to consolidate or enhance a company's market position through the advent of new technologies and products. When faced with short-term performance pressures, managers always do everything possible to increase short-term returns, weaken the execution of long-term plans formulated by shareholders and reduce innovation investment to maximize personal benefits. Therefore, effective incentives and supervision for managers are important requirements for corporate innovation (Balkin et al., 2000). Several studies discuss the impact of managers' incentives on R&D from the perspectives of executives' monetary compensation (Li and Song, 2010), equity incentives (Bizjak et al., 1993) and incentive structures (Mehran, 1995). These studies find that increasing salaries improves the rationality of managers' R&D decision-making and that the adoption of equity incentives has a positive effect. Tolerance of managers' short-term failures and affirmation of long-term values can prompt them to increase innovation investment (Manso, 2011). Larger shareholdings by institutional investors, more analyst following and the employment of higher-level auditors with stronger information acquisition and analysis capabilities can help rationally elevate the decision-making quality of managers, strengthen external

supervision, effectively restrain managers' short-sighted behaviors and promote corporate innovation (Chung and Kallapur, 2003; Cheng, 2006; Chen et al., 2017).

As innovation is the internal driving force of economic growth, the government also mobilizes corporate enthusiasm for innovation through policy support and financial appropriations. For one thing, the government supplements the resources needed for innovation. First, the government subsidies, "national team" shareholding and direct financial investments alleviate the financial pressures within enterprises and thereby increasing corporate R&D investments (Xie et al., 2009; Yu and Fang, 2020). Second, the implementation of policies, such as the opening of high-speed rail and the introduction of talents, enriches the supply of materials and human resources, which, in turn, strengthens corporate innovation capabilities (Hunt and Gauthier, 2010; Chen et al., 2019). The government also regulates the behaviors of corporate insiders through administrative regulations to ensure the effective implementation of innovation, protects the exclusiveness of innovation output through legislative procedures (e.g., patent protection) and enhances the innovation enthusiasm of enterprises (Yu et al., 2016; Bloom et al., 2019). In addition, tax policy regulations and tax system reforms also make tax avoidance motivation as the starting point of corporate innovation. Li et al. (2016) focus on the tax discounts of high-tech enterprises and find that tax discounts improve corporate innovation performance by increasing innovation investment and that tax discounts act as a tax shield. Yu et al. (2019) focus on the economic consequences of the implementation of the Environmental Protection Tax Law and find that the collection of environmental taxes encourages companies to increase green innovation and reduce pollution, thereby increasing firms' long-term value.

2.3. Impact of tax credit ratings on corporate innovation investment

Following "Tax Credit Management (Trial)," the State Administration of Taxation evaluates all taxpaying companies based on historical credit, internal tax and external information every calendar year from October 2014 onward. The assessment covers the entire process, from firms' economic operations to external information reporting. The internal information reflects the taxation basis and tax avoidance doubts, including recurring indicators, such as tax-related information declaration, tax payment, registration and account books, invoices and tax control equipment, and non-recurring indicators, such as tax audit information. Historical credit and external information reflect the overall credit status of enterprises and are mutually verified using information provided by banks and other administrative departments. Based on the above indicators, an enterprise is designated as an A-level taxpayer if it has a score of 90 or more. The assessment result of the tax credit rating reflects the overall quality of a company's information reporting system, effectively measures its tax compliance and supplements any previous evaluation shortcomings from the perspective of tax violations. The State Administration of Taxation, together with the People's Bank of China, the Ministry of Land and Resources, the General Administration of Customs, the State Administration for Industry and Commerce, the State-Owned Assets Supervision and Administration Commission and other ministries, implemented the "Memorandum of Cooperation on the Implementation of Joint Disciplinary Methods for Major Tax Violation Cases" in 2015 and the "Memorandum of Cooperation on the Implementation of Joint Incentive Methods for A-level Taxpayers" in 2016, with the aim of improving tax compliance by enterprises through the reward and punishment mechanism based on classified management. Specifically, A-level taxpaying enterprises receive appropriate preferential treatment in terms of bank credit, land qualification and government procurement, with the government reducing unnecessary tax reviews and interventions for these companies. However, taxpaying companies that commit major violations are directly judged as D-level in the tax credit rating and issued joint punishments, such as the restriction of consumption and prohibition of leaving the country and the right to use government land. To obtain better tax credit ratings, companies must improve their internal information collection and processing systems, which not only increases the number and quality of managers' information sources but also reduces the information asymmetry between insiders and external investors, thereby facilitating a supervision role for external stakeholders and restricting the decision-making abilities of managers. In addition, various policy benefits of higher tax credit ratings and endorsements from tax authorities ease the financial constraints of enterprises, ultimately affecting a firm's actual business decision-making processes. As detailed in this study, we focus on the impact on corporate R&D investments.

First, a higher tax credit rating indicates better collection and transmission of internal information, which helps managers identify R&D projects more accurately. Tax credit ratings measure the compliance of voucher management, tax declaration and tax payment, all of which comprehensively evaluate whether professionals can complete tax-related work accurately and in a timely manner, and examine the process from the occurrence of economic business to the payment of related taxes and from the review results of regulatory agencies to the process of corporate rectification. A better tax reporting system implies that the processing and bottom-up transmission system of information is more efficient so that the quality of the information is better (Sun et al., 2019), which can help in the identification and implementation of innovation projects. On the one hand, the improvement of the quality of tax information has a positive spillover effect on other internal information reporting and external information disclosures (Dorantes et al., 2013; Samuels, 2021). The effective integration of internal and external information improves the overall quality of useful information for managers' decision-making, thereby helping managers identify better investment opportunities, accurately predict future returns (Bushman and Smith, 2001) and improve investment efficiency (Chen et al., 2011). However, low-quality information leads to excessive investment (McNichols and Stubben, 2008). With respect to innovation investment, high-quality and sufficient information can alleviate the information asymmetry problem of R&D innovation, thus helping managers identify R&D projects with long-term benefits and make wiser decisions (Huang et al., 2020). On the other hand, the improvement of the tax information reporting system has additional spillover effects on other information reporting systems because the generation of tax information is based on the accurate measurement of various production and operation activities of a company, which requires information integration from various departments and businesses; thus, a better tax credit rating indicates that a company has a dynamic and efficient information exchange and coordination system. Corporate innovation also involves communication and collaboration between different functional departments and employees (Ostergaard et al., 2011). Therefore, the establishment, improvement and integration of the internal information system can reduce the cost of negotiation and the possibility of decision failure (Park, 2018), which again helps managers identify projects with development potential and lead their teams toward innovation goals.

Second, the tax credit rating can alleviate financial constraints, thereby promoting corporate innovation. A high tax credit rating directly brings external financing to an enterprise because A-level taxpayers have priority in fiscal fund arrangement and certain financial subsidies specifically supplement funds needed for innovation. Moreover, as their ratings are recorded in the basic database of financial credit information as good credit records, it is easier for A-level taxpayers to obtain bank loans. Financial funds and bank loans require less short-term income than equity financing and are more likely to be used for corporate innovation. The tax credit rating is implemented by the State Administration of Taxation and the evaluation process refers to historical information and current internal and external information, all of which comprehensively evaluates the credit status of the enterprise. This strict tax supervision significantly improves the reputation of A-level taxpayers. Upon receiving such positive signals, external investors increase their trust in these companies, thereby helping A-level taxpayers obtain external financing (Ye et al., 2010; Sun et al., 2019). Furthermore, tax credit ratings encourage taxpayers to complete their information systems and improve information quality, thereby indirectly alleviating firms' financial constraints. The tax credit rating is one of the important aspects of the social credit system and tax compliance serves as an important reference for banks, customs and other departments when they evaluate enterprises. A-level taxpayers not only enjoy priority in tax services and management, such as receipt of invoices and export tax rebates, but also obtain convenient waivers in environmental protection permits, land bidding and import and export declarations; therefore, enterprises have the motivation to optimize and improve internal information processing and provide accurate and timely information to regulatory agencies (Li et al., 2020). The overall improvement of the internal information system not only improves the quality of tax information but also has a spillover effect on other types of information disclosed by the company, which reduces the information asymmetry between external investors and corporate insiders; thus, investors increases their willingness to invest, thereby reducing the required risk compensation and easing financial constraints (Hall, 2002; Ma, 2017).

Finally, tax credit ratings alleviate the agency problem and ensure the implementation of innovation projects. Due to the separation of ownership and control rights of modern enterprises, managers have the motivation to maximize personal income by damaging the value of firms. Through strict punishment and supervision, tax credit ratings can limit managers' opportunistic behaviors, prompt managers to make scien-

tific decisions and alleviate the principal-agent problem. On the one hand, the tax credit rating system increases the penalties for violations. Companies with tax avoidance doubts, such as false tax-related information declarations, are directly rated as D-level. On the other hand, the public nature of tax credit ratings reveals strictly censored corporate tax and external information, which can help information users obtain information, facilitate the supervision role of external and internal stakeholders and prevent executives from plundering the wealth of shareholders or creditors (Fama and Jensen, 1983). Therefore, managers are more likely to make decisions that are beneficial to the long-term development of the company. Further, the principal-agent problem, which is more related to innovation investment, occurs due to delayed returns for large amounts of short-term investment. Managers may sacrifice the long-term benefits of R&D investment in light of future career development opportunities and personal salaries that are linked to earnings performance. Studies point out that the boards of directors fully consider the impact of innovation expenditure on corporate short-term performance when designing executive compensation contracts. In the case of manager retirement and decreasing or negative earnings by a company, the relationship between executive compensation and R&D investment is significantly positive. By directly linking salaries with R&D expenditure, managers are encouraged to actively innovate (Cheng, 2004), thereby alleviating the principal-agent problem. However, the effectiveness of this incentive mechanism depends on the accurate accounting of R&D expenditure. The tax credit rating system guarantees that the accounting treatment of innovation expenditure is complied with and accurately disclosed due to improvements in internal control. On the one hand, companies have the motivation to strengthen their tax bases and standardize information processing and transmission procedures in order to access the convenience of better tax credit rating systems; this implies that companies accurately report their R&D expenditure so that they meet the high measurement and confirmation requirements of R&D expenditure for accounting treatments. On the other hand, the tax credit rating system examines the compliance of enterprises that obtain tax subsidies, whereas R&D expenditure involves a number of preferential tax policies that are closely related to the collection and refund of taxes and fees. R&D expenditure significantly affects the calculation of tax payables, with higher tax compliance by enterprises indicating that R&D expenditure is effectively measured, which, in turn, improves the transparency of information related to corporate innovation, helps the board of directors evaluate managers' real efforts, reduces possible salary reductions for or even the dismissal of managers due to short-term performance failures (Bushman and Smith, 2001) and eventually enhances managers' incentives to innovate (Manso, 2011; Zhong, 2018).

Based on the above analysis, our hypothesis is stated formally as follows:

Hypothesis. *Ceteris paribus*, companies with an A-level tax credit rating have higher innovation investment.

However, theoretically, tax credit ratings may not affect corporate innovation. On the one hand, tax compliance implies that the level of corporate tax avoidance is reduced and that companies therefore share more profits with the government. The payment of taxes affects the cash flow of the company, resulting in a shortage of funds for the supply of innovation and further increasing financial constraints. On the other hand, incorporating the tax credit rating into the social credit system implies that corporate tax violations will incur more serious consequences. It is difficult for companies to carry out earnings management through simple means, such as manipulating accruals. Therefore, they use real earnings management to escape monitoring, with the reduction of innovation input being one of the methods of increasing short-term returns. The above effects also make our research topic a question that mandates empirical testing.

3. Research design and sample selection

3.1. Model specification

According to previous studies (Chen et al., 2019; Sun et al., 2019), we construct the following regression model to test the impacts of corporate tax credit rating on innovation investment:

$$\begin{aligned} RD/TA = {} & \alpha + \beta_1 * \ TAXCREDIT \ + \beta_2 * \ LNTA \ + \beta_3 * \ LEV \ + \beta_4 * \ QUICK + \beta_5 * CASH \\ & + \beta_6 * \ COCF \ + \beta_7 * \ ROA \ + \beta_8 * \ BM + \beta_9 * \ BH + \beta_{10} * \ PRIVATE \ + \beta_{11} \\ & * \ OWNERSHIP \ + \beta_{12} * \ BIG10 + \beta_{13} * \ MAO \ + \beta_{14} * \ MINDEX \\ & + \sum INDUSTRY \ + \sum YEAR \end{aligned} \quad (1)$$

The dependent variable *RD/TA* is the ratio of R&D investment to total assets in year *T + 1* and the independent variable *TAXCREDIT* is the tax credit rating of the listed company evaluated by the State Administration of Taxation. When a company has an A-level tax credit rating in year *T*, *TAXCREDIT* equals 1, and 0 otherwise. The higher the tax credit rating is, the better the corporate tax compliance is (Li et al., 2020). Drawing on previous studies, we control other variables that may affect corporate innovation investment, such as the liquidity of funds (*QUICK*, *CASH*, *COCF*), profitability (*ROA*), the character of the ultimate controller (*PRIVATE*) and the top 10 audit firms (*BIG10*). We also include the fixed effects of industry and year. To eliminate the influence of extreme values on the regression results, we winsorize all of the variables by 1%. See Table 1 for the definitions of the main variables used in this study.

3.2. Data and sample selection

In view of the implementation of "Tax Credit Management (Trial)" on 1 October 2014, the data period for the tax credit rating is from 2014 to 2018. As the innovation variable in the research model is in the T + 1 period, the data period of the innovation variable is 2015–2019 and that of other firm-level control variables is 2014–2018. We obtain data on firms' tax ratings from the official website of the State Administration of

Table 1
Main variable definitions.

	Symbol	Name	Definition
Dependent Variables	*RD/TA*	R&D Investment	The ratio of R&D investment to total assets in year *T + 1*
Independent Variables	*TAXCREDIT*	Excellent Tax Credit	Binary indicator that equals 1 if the tax credit rating of the listed company is A
Control Variables	*LNTA*	Firm Size	Log (Total asset)
	LEV	Leverage	Total debt/Total assets
	QUICK	Quick Ratio	Current assets-inventory/Current liabilities
	CASH	Cash Holdings	Monetary funds/Total assets
	COCF	Operating Cash Flow	Operating cash flow/total assets
	ROA	Return on Assets	Profit/Total assets
	BM	Book to Market Ratio	The ratio of the book value of total assets to the market value
	BH	B/H Share	Binary indicator that equals 1 if the company has B/H shares
	PRIVATE	Ultimate controller	Binary indicator that equals 1 if the ultimate controller is private
	OWNERSHIP	Control	Ultimate controller's shareholding/Total shares
	BIG10	Big 10 Audit Firm	Binary indicator that equals 1 if the auditor is from the top 10 firms in audit income
	MAO	Modified Audit Opinion	Binary indicator that equals 1 if the annual report is issued by the auditor with an unqualified opinion, with highlighted matters, a qualified opinion or a negative opinion or if an opinion cannot be expressed
	MINDEX	Marketization Index	Marketization index, sorted by decile (Fan et al., 2011)
	INDUSTRY	Industry Dummy Variables	Binary indicator that equals 1 if the firm belongs to a certain industry
	YEAR	Year Dummy Variable	Binary indicator that equals 1 if the observation belongs to a certain year

Taxation. The remaining data are obtained from the China Stock Market and Accounting Research Database. We exclude missing data from our sample and ultimately obtain 12,578 firm-year observations.

Descriptive statistics are shown in Table 2. Corporate R&D investment accounts for a small proportion of total assets, with a sample average of 1.5% and a median of 1%, indicating that the proportion of R&D investment by listed companies is generally low. The average value of the tax credit rating is 0.453, which means that 45.3% of the companies have an A-level tax rating, and the standard deviation is 0.498, indicating that the tax ratings of the companies in our sample are quite different. The average proportion of private enterprises (*PRIVATE*) is 0.648 and the average shareholding ratio of major shareholders (*OWNERSHIP*) is 0.363, indicating that there are more private companies in the sample, that the ultimate controllers hold a higher proportion of shares and that the ownership structure is more concentrated. The average proportion of the top 10 audit firms (*BIG10*) is 0.460, which means that 46% of companies use the top 10 audit firms for auditing, and the average of *MAO* is 0.042, indicating that very few companies in the sample are issued modified opinions.

The correlation matrix is shown in Table 3. The upper right of the main diagonal of Table 3 shows the Spearman correlation coefficients and the lower left shows the Pearson correlation coefficients. The Pearson correlation coefficient between the main independent variable *TAXCREDIT* and the dependent variable *RD/TA* is 0.145 (the Spearman correlation coefficient is 0.192), and the sign and significance of the coefficients are consistent with our expectations (i.e., a good tax credit rating promotes corporate innovation investment), but the above correlation coefficient does not control other variables. Therefore, we use the regression analysis below for more stringent testing.

4. Empirical results

4.1. Main results

The relationship between tax credit rating and corporate innovation is shown in Table 4. The first column shows the regression results using the full sample with industry and year fix effects. The coefficient of the independent variable *TAXCREDIT* is 0.003, which is significantly positive at the 1% level and indicates that listed companies with an A-level tax credit rating invest more in R&D and that a good tax reporting system reflects a better information environment that is conducive to managers identifying R&D projects and securing financing. Incentive tax supervision also reduces agency costs and restricts the opportunistic behaviors of managers. The accurate identification and effective implementation of innovative projects and the decline of resource constraints can help companies increase R&D investment. The second column is a sample of companies with positive R&D investment. The coefficient of the independent variable *TAXCREDIT* is 0.002, which is signif-

Table 2
Descriptive statistics.

	N	Mean	STD	P25	Median	P75
RD/TA	12,578	0.015	0.018	0.001	0.010	0.023
TAXCREDIT	12,578	0.453	0.498	0	0	1
LNTA	12,578	22.269	1.297	21.374	22.120	23.010
LEV	12,578	0.438	0.210	0.270	0.426	0.591
QUICK	12,578	1.754	1.924	0.718	1.165	1.975
CASH	12,578	0.166	0.115	0.086	0.136	0.215
COCF	12,578	0.041	0.071	0.003	0.041	0.083
ROA	12,578	0.048	0.053	0.019	0.043	0.073
BM	12,578	0.418	0.307	0.207	0.338	0.537
BH	12,578	0.055	0.227	0	0	0
PRIVATE	12,578	0.648	0.478	0	1	1
OWNERSHIP	12,578	0.363	0.154	0.245	0.345	0.467
BIG10	12,578	0.460	0.498	0	0	1
MAO	12,578	0.042	0.200	0	0	0
MINDEX	12,578	8.185	1.704	7	9.080	9.630

STD: standard deviation; P25: 25th percentile; P75: 75th percentile.

Table 3
Correlation matrix.

	RD/TA	*TAXCREDIT*	*LNTA*	*LEV*	*QUICK*	*CASH*	*COCF*	*ROA*
RD/TA	1	0.192***	−0.232***	−0.281***	0.324***	0.120***	0.099***	0.258***
TAXCREDIT	0.145***	1	0.015*	−0.104***	0.093***	0.027***	0.076***	0.141***
LNTA	−0.203***	0.016*	1	0.498***	−0.421***	−0.145***	0.058***	0.046***
LEV	−0.239***	−0.113***	0.480***	1	−0.793***	−0.244***	−0.164***	−0.241***
QUICK	0.175***	0.043***	−0.342***	−0.633***	1	0.483***	0.072***	0.241***
CASH	0.113***	0.013	−0.162***	−0.266***	0.411***	1	0.124***	0.119***
COCF	0.107***	0.077***	0.063***	−0.174***	0.055***	0.133***	1	0.451***
ROA	0.225***	0.141***	0.060***	−0.273***	0.138***	0.122***	0.458***	1
BM	−0.164***	0.056***	0.601***	0.180***	−0.181***	−0.160***	0.007	−0.037***
BH	−0.085***	−0.017*	0.270***	0.101***	−0.081***	−0.031***	0.029***	−0.050***
PRIVATE	0.199***	0.036***	−0.356***	−0.258***	0.182***	0.038***	−0.028***	0.152***
OWNERSHIP	−0.035***	0.026***	0.172***	−0.011	0.015*	0.040***	0.138***	0.183***
BIG10	−0.011	−0.025***	0.134***	0.073***	−0.031***	0.008	0.035***	0.002
MAO	−0.053***	−0.084***	−0.109***	0.168***	−0.055***	−0.052***	−0.116***	−0.218***
MINDEX	0.159***	0.085***	−0.032***	−0.100***	0.050***	0.044***	0.019**	0.106***

	BM	*BH*	*PRIVATE*	*OWNERSHIP*	*BIG10*	*MAO*	*MINDEX*
RD/TA	−0.134***	−0.098***	0.256***	−0.002	−0.019**	−0.100***	0.190***
TAXCREDIT	0.078***	−0.017*	0.036***	0.030***	−0.025***	−0.084***	0.094***
LNTA	0.583***	0.211***	−0.343***	0.134***	0.107***	−0.096***	−0.059***
LEV	0.159***	0.105***	−0.260***	−0.010	0.073***	0.141***	−0.102***
QUICK	−0.201***	−0.103***	0.261***	0.014	−0.051***	−0.108***	0.119***
CASH	−0.154***	−0.031***	0.041***	0.037***	−0.000	−0.085***	0.052***
COCF	0.008	0.035***	−0.031***	0.137***	0.036***	−0.109***	0.039***
ROA	−0.021**	−0.053***	0.168***	0.178***	−0.005	−0.190***	0.119***
BM	1	0.188***	−0.273***	0.054***	0.050***	−0.128***	−0.044***
BH	0.250***	1	−0.199***	0.018**	0.179***	−0.015*	0.047***
PRIVATE	−0.289***	−0.199***	1	−0.115***	−0.124***	0.040***	0.211***
OWNERSHIP	0.062***	0.017*	−0.113***	1	0.066***	−0.122***	0.059***
BIG10	0.073***	0.179***	−0.124***	0.068***	1	−0.029***	−0.044***
MAO	−0.089***	−0.015*	0.040***	−0.118***	−0.029***	1	−0.063***
MINDEX	−0.042***	0.066***	0.187***	0.045***	−0.033***	−0.069***	1

icantly positive at the 1% level. The third column uses the ratio of R&D investment to sales revenue (*RD/SALE*) as the dependent variable. The coefficient of the independent variable *TAXCREDIT* is 0.006, which is significantly positive at the 1% level. The fourth column takes firms with R&D investment >0 as the sample and *RD/SALE* as the dependent variable. The coefficient of the independent variable *TAXCREDIT* remains significantly positive at the 1% level.

Among the control variables, the coefficient of *LEV* is significantly negative, which implies that the higher the ratio is, the more serious the level of financial constraints faced by companies is. Financial constraints limit firms' abilities to invest in R&D, which is consistent with the results of older studies (Himmelberg and Petersen, 1994; Zhang et al., 2017). The coefficients of *PRIVATE* are significantly positive at the 1% level, indicating that non-state-owned enterprises have higher innovation capabilities. The coefficient of *OWNERSHIP* is significantly negative, indicating that the concentration of equity is not conducive to corporate innovation and that the agency conflict between large shareholders and small shareholders affects corporate R&D investment. The coefficient of *BIG10* is significantly positive, indicating that top 10 audit firms effectively supervise firms' economic behaviors and enable firms to make innovative decisions that are good for long-term development.

4.2. Robustness and endogeneity tests

To verify the robustness of the results in Section 4.1, we change the measurement method of the dependent variable and re-examine the research question. Previous studies measure the degree of firms' innovation invest-

Table 4
Main results.

Variables	(1) *RD/TA* Full Sample	(2) *RD/TA* RD > 0 Sample	(3) *RD/SALE* Full Sample	(4) *RD/SALE* RD > 0 Sample
TAXCREDIT	0.003***	0.002***	0.006***	0.004***
	(8.274)	(5.344)	(7.261)	(4.196)
LNTA	−0.001	−0.001***	0.002**	0.001
	(−1.578)	(−3.791)	(2.277)	(0.870)
LEV	−0.007***	−0.004**	−0.030***	−0.028***
	(−4.280)	(−2.196)	(−6.881)	(−5.510)
QUICK	0.0002	0.0002	0.003***	0.003***
	(0.918)	(0.964)	(4.197)	(4.758)
CASH	0.004*	0.007***	0.003	0.006
	(1.868)	(2.618)	(0.476)	(0.960)
COCF	0.011***	0.013***	0.008	0.004
	(3.894)	(3.610)	(1.266)	(0.536)
ROA	0.033***	0.037***	−0.046***	−0.067***
	(6.096)	(5.944)	(−3.564)	(−4.467)
BM	−0.006***	−0.006***	−0.018***	−0.020***
	(−6.142)	(−5.164)	(−7.457)	(−7.142)
BH	−0.001	−0.0002	−0.004**	−0.001
	(−1.560)	(−0.156)	(−2.339)	(−0.589)
PRIVATE	0.002***	0.0001	0.008***	0.006***
	(3.147)	(0.083)	(6.705)	(4.132)
OWNERSHIP	−0.005***	−0.006***	−0.013***	−0.018***
	(−2.838)	(−3.249)	(−3.723)	(−4.497)
BIG10	0.001**	0.001*	0.002**	0.002*
	(2.250)	(1.838)	(2.029)	(1.850)
MAO	−0.001	0.001	−0.002	0.006
	(−1.160)	(0.464)	(−0.438)	(1.213)
MINDEX	0.001***	0.001***	0.001***	0.001***
	(6.710)	(5.517)	(4.583)	(3.027)
CONS	0.015**	0.034***	−0.021	−0.001
	(2.017)	(4.060)	(−1.309)	(−0.030)
Year	YES	YES	YES	YES
Industry	YES	YES	YES	YES
Observations	12,578	10,484	12,578	10,484
Adj. R^2	0.213	0.186	0.213	0.203

ment in two dimensions. From the perspective of innovation input, they use the R&D expenditure items in the financial statements. From the perspective of innovation output, they use patent application as a proxy. In the robustness test, we choose the number of patent applications in the current year to represent corporate innovation. Specifically, we calculate the number of patent applications in the current year plus 1 and take its natural logarithm as the dependent variable. Li and Zheng (2016) show that invention patents can better represent the substantial innovation of firms with investment value. Therefore, we further distinguish the types of patents and examine the impacts of firms' tax credit ratings on the number of invention patents and other patent applications. The results are shown in Table 5, Panel A. The first column uses the total number of patent applications as the dependent variable. The coefficient of the independent variable *TAXCREDIT* is 0.229, which is significantly positive at the 1% level. The second column uses the total number of invention patent applications as the dependent variable. The coefficient of the independent variable *TAXCREDIT* is again significantly positive at the 1% level. The third column uses the total number of other patent applications as the dependent variable. The coefficient of the independent variable here aligns with our expectations, indicating that from the perspective of innovation output, corporate tax credit rating has a significant positive impact on patent applications.

The main results of this study may have endogeneity problems. Sample self-selection indicates that companies with an A-level tax credit rating may invest more in R&D. Missing variables and other factors that have

Table 5
Endogeneity test results.

Panel A: Change the Measurement of Dependent Variables

Variables	(1)	(2)	(3)
	LNPATENT	*LNINVENT*	*LNOTHER*
TAXCREDIT	0.229***	0.166***	0.160***
	(6.994)	(5.989)	(5.606)
Controls	YES	YES	YES
Year	YES	YES	YES
Industry	YES	YES	YES
Observations	12,578	12,578	12,578
Adj. R^2	0.428	0.371	0.406

Panel B: Change Model

Variables	(1)	(2)
	RD/TA	*RD/SALE*
DUM_P	0.001***	0.005***
	(5.669)	(7.171)
DUM_N	0.0002	−0.001*
	(0.907)	(−1.839)
Controls	YES	YES
Year	YES	YES
Industry	YES	YES
Observations	11,465	11,675
Adj. R^2	0.023	0.030

Panel C: Between-Group T-test

Variables	(1)	(2)	(3)
	TAXCREDIT = 0	*TAXCREDIT* = 1	*DIFF*
RD/TA	0.014	0.017	0.003***
TAXCREDIT	0	1	1.000***
LNTA	22.314	22.298	−0.012
LEV	0.4296	0.4299	0.0003
QUICK	1.751	1.768	0.017
CASH	0.165	0.167	0.002
COCF	0.044	0.043	−0.001
ROA	0.051	0.050	−0.001
BM	0.434	0.428	−0.006
BH	0.054	0.053	−0.001
PRIVATE	0.647	0.649	−0.002
OWNERSHIP	0.366	0.365	−0.001
BIG10	0.456	0.455	−0.001
MAO	0.024	0.028	−0.004
MINDEX	8.261	8.263	−0.002
Observations	4552	4552	0

Panel D: Results of PSM Method

Variables	(1)	(2)	(3)
	RD/TA	*RD/SALE*	*LNPATENT*
TAXCREDIT	0.003***	0.006***	0.217***
	(7.883)	(6.919)	(6.181)
Controls	YES	YES	YES
Year	YES	YES	YES
Industry	YES	YES	YES
Observations	9104	9104	9104
Adj. R^2	0.210	0.217	0.459

not been considered, such as market environment and policy orientation, can affect the relationship between corporate tax credit rating and innovation investment. To address these possible endogeneity problems, we use the following methods:

1. Change model. In the main regression, we use the amount of R&D investment in year $T + 1$ as the dependent variable to solve the alternative explanation of reverse causality. To further characterize the causal relationship between the independent and dependent variables, we use the change model to perform the regression. Specifically, we take the change values of all of the continuous variables in the model for the years T and $T–1$. The independent variable DUM_P indicates that the taxpayer has not been graded A in year $T–1$ but has been graded A in year T. DUM_N indicates that the company has been graded A in year $T–1$ but not in year T. The results are shown in Table 5, Panel B. The first column uses RD/TA as the dependent variable; the coefficient of the independent variable DUM_P is significantly positive. The second column uses $RD/SALE$ as the dependent variable; the coefficient of the independent variable DUM_P is 0.005 and significantly positive at the 1% level. The coefficient of DUM_N is –0.001 and significantly negative at the 10% level, indicating that firms increase their R&D investment after being designated as an A-level taxpayer. On the contrary, when the tax rating is downgraded, alongside the cancellation of preferential policies and changes in the information environment, the listed company reduces its R&D investment.
2. PSM method. To circumvent the issues of missing variables and sample self-selection, we follow Sun et al. (2019), use PSM to perform one-to-one matching and regress model (1) on the matched sample. Specifically, we first construct a PSM sample, in which the treatment group is a sample with an A-level tax credit rating in year T and the control group contains the sample with the remaining tax credit ratings for that year. Second, we calculate the propensity matching score and use a logit model to calculate the probability of obtaining an A-level tax credit rating, with the dependent variable being a binary variable that indicates whether the tax rating for year T is A and the explanatory variables being the same as in model (1). Third, we match the sample using a one-to-one nearest neighbor matching method; the matched sample contains 9104 (4552 pairs) firm-year observations. Table 5, Panel C shows the differences between the treatment and control samples. Fourth, we use the matched sample to perform the multiple regression. As shown in Table 5, Panel D, regardless of whether R&D investment or R&D output is used as the dependent variable, the coefficient of the independent variable $TAXCREDIT$ is significantly positive at the 1% level, indicating that the results of our study remain valid after considering the problem of missing variables and that designation as an A-level taxpayer prompts firms to increase their R&D innovation.
3. DID based on the PSM method (PSM-DID). To further verify the causal relationship between tax credit rating and corporate innovation, we follow Li et al. (2018) and use PSM samples to test for a significant increase in corporate innovation before and after designation as an A-level taxpayer for the first time. $TREAT$ equals 0 if the company has never been rated as an A-level taxpayer and $POST$ is a dummy variable that equals 1 after the company is designated as an A-level taxpayer for the first time, and 0 otherwise. To avoid the effects of other policy and economic factors, we select a 3-year event window around the first year of being designated as an A-level taxpayer. The results are shown in Table 6, Panel A. The significantly positive coefficient of the interaction term indicates that after being designated as an A-level taxpayer for the first time, corporate innovation increases significantly and that a higher tax credit rating can provide firms with the resources and conditions required for innovation. To verify the impact of the tax credit rating policy on corporate innovation, we conduct the PSM-DID test with the tax credit rating policy issued in 2014 and the following joint punishment policy implemented in 2015 as the time of policy impact. We find that the incentive effect of tax credit ratings on corporate innovation must be established on the premise that the corresponding reward and punishment measures are gradually improved. After the gradual establishment of various auxiliary policies, firms innovate more.

Furthermore, we explore the cumulative effect between tax credit ratings and innovation. Specifically, we distinguish how many times a listed company has been rated as an A-level taxpayer. $FIRST$ equals 1 when a company is rated as an A-level taxpayer for the first time. $SECOND$ equals 1 when a company is rated as an A-level taxpayer twice. $THIRD$ equals 1 when a company is rated as an A-level taxpayer more than

Table 6
PSM-DID and cumulative effects results.

Panel A: PSM-DID		
Variables	(1)	(2)
	RD/TA	*RD/SALE*
*TREAT * POST*	0.002***	0.006***
	(3.198)	(3.908)
TREAT	0.003***	0.007***
	(4.110)	(4.106)
POST	−0.0002	−0.002
	(−0.352)	(−1.318)
Controls	YES	YES
Year	YES	YES
Industry	YES	YES
Observations	5777	5777
Adj. R^2	0.161	0.181
Panel B:Cumulative Effect		
Variables	(1)	(2)
	RD/TA	*RD/SALE*
FIRST	0.004***	0.008***
	(10.174)	(9.709)
SECOND	0.003***	0.006***
	(6.809)	(5.549)
THIRD	0.002***	0.002*
	(3.502)	(1.806)
Controls	YES	YES
Year	YES	YES
Industry	YES	YES
Observations	12,578	12,578
Adj. R^2	0.214	0.215

twice. The results are shown in Table 6, Panel B. The coefficients of these three variables follow a decreasing trend from top to bottom, indicating that the greatest promotion effect on corporate innovation occurs when a listed company has been rated as A-level taxpayer for the first time, with the magnitude of this effect decreasing gradually. This also verifies that the tax incentive method brings in the resources needed for firms' R&D to a certain extent. Accompanied by the accumulation of resources, our results reveal a phenomenon of diminishing marginal utility.

4.3. Channel inspection

The above analyses show that better tax credit ratings stimulate innovation investment by firms. We next examine how tax credit ratings affect corporate innovation decisions (i.e., we focus on their influence channels). First, innovation investment usually has greater uncertainty, necessitating more substantial and accurate information for managers' decision-making processes. A higher tax credit rating implies that a company's internal reporting system is relatively complete, that the collection and transmission of internal information is more efficient and that the information obtained by managers is more conducive to the accurate identification of innovative projects and the making of correct innovation investment decisions. To test whether a higher tax credit rating indicates higher internal information validity, which is more helpful to a company's innovation investment, we adopt path analysis and use the number of managerial earnings forecasts (*Voluntary*) to measure the usefulness of information for managers' decision-making processes. We use this parameter because managers' voluntary disclosure contains forward-looking information related to the development of the company, and the higher the accuracy of earnings forecasts is, the better the market response is. Low-quality managerial earnings forecasts negatively affect managers' reputations and future job opportunities. Therefore, the higher the number of voluntary earnings forecasts is, the better the quality of useful informa-

tion for management decisions is (Libby et al., 2006; Li and Xiao, 2015). The results are shown in columns (1) and (2) of Table 7. β (*RD*/*TA*, *TAXCREDIT*) is significantly positive, indicating that companies with an A-level tax credit rating increase their R&D innovation; β (*Voluntary*, *TAXCREDIT*) equals 0.176 and is significantly positive at the 1% level, indicating that a higher tax credit rating increases the effectiveness of a company's internal information. The indirect effect of internal information effectiveness accounts for 7.89% of the total effect, indicating that the effectiveness of internal information is one of the channels through which tax credit ratings affect firms' innovation investment decisions and that it has a partial mediating effect.

Second, innovation investment is characterized by large investment amounts, high investment risk and long payback periods for funds, increasing the financing requirements. The information asymmetry between external investors and corporate insiders makes the financing of innovation more difficult. Therefore, the implementation of R&D projects is always faced with greater financing constraints. A better tax credit rating directly grants enterprises the convenience of financial funds support and bank loans. Furthermore, it improves the quality of information disclosure and sends positive signals to investors that are validated by tax regulators. As a result, receiving a higher tax credit rating helps companies alleviate financial constraints. Following Almeida et al. (2004), we calculate the KZ index; the larger the KZ index is, the stronger the financial constraints faced by a company are. The results are shown in columns (3) and (4) of Table 7. The indirect effect of financing constraints accounts for 4.68% of the total effect, indicating that the problem of financial constraints is one of the channels through which the tax credit rating affects corporate innovation investment decisions and that it has a partial mediating effect.

Finally, innovation investment has a high spillover effect. Therefore, to protect their own proprietary technologies and core competitiveness, companies may reduce the disclosure of relevant information. This makes their accounting information less transparent, thereby providing more opportunities for managers to manipulate earnings. The establishment of the tax credit evaluation system helps stakeholders obtain true information about the company, strengthens the role of external supervision, restricts the opportunistic behaviors of managers and enhances the accuracy of R&D expenditure accounting, thus ensuring the motivating effect of the executives' compensation mechanism and alleviating the principal-agent problem. Following Li (2007), we use the turnover rate of total asset (*TURNOVER*) to measure agency costs. The results are shown in columns (5) and (6) of Table 7. The indirect effect of agency cost accounts for 4.64% of the total effect, indicating that agency cost is one of the channels through which tax credit rating affects firms' innovative investment decisions and that it has a partial mediating effect.

Furthermore, we examine the impact of tax credit ratings on the internal control system, financial information quality, financing costs and government subsidies in as much detail as possible. Following previous studies, we use the Dibo Internal Control Index (*IC*) to measure the quality of internal control, with a larger IC index indicating more standardized internal processes and higher quality of internal control. We use the infor-

Table 7
Channel inspection.

Variables	Internal Information Validity *Voluntary*		Financial Constraints *KZ*		Agency Cost *TURNOVER*	
	(1) Coefficient	(2) t	(3) Coefficient	(4) t	(5) Coefficient	(6) t
Direct Effect						
β (*RD*/*TA*, *TAXCREDIT*)	0.003***	(8.274)	0.003***	(9.942)	0.003***	(9.979)
Percentage	92.11%		95.32%		95.36%	
Indirect Effect						
β (*RD*/*TA*, *MEDIATOR*)	0.001***	(7.486)	0.004***	(8.324)	0.004***	(11.487)
β (*MEDIATOR*, *TAXCREDIT*)	0.176***	(6.453)	0.035***	(6.577)	0.035***	(4.741)
Total Indirect Effect	0.0002***	(6.479)	0.00014***	(5.161)	0.00014***	(4.383)
Percentage	7.89%		4.68%		4.64%	
CONTROLS		YES		YES		YES
Year		YES		YES		YES
Industry		YES		YES		YES
Observations		12,578		12,578		12,578

mation disclosure assessment rating issued by the Shenzhen Stock Exchange (*Opacity*) to measure the quality of financial information, with larger values of *Opacity* indicating lower quality of financial information. We use a residual income valuation model (generalized least squares model) to calculate the cost of equity capital (*COE*) of an enterprise and directly measure the cost of obtaining equity financing from outside investors. We use the ratio of financial expenses paid in the current period and the average balance of bank borrowings to measure the cost of debt (*COD*). The total amount of government subsidies (*Subsidy*) from other income and non-operating income is used to measure the financial funds obtained by an enterprise. The debt financing scale (*FINANC_Debt*) is measured by the cash received from issuing bonds and obtaining loans in the cash flow statement. The regression results are shown in Table 8. Higher tax credit ratings significantly improve the standardization of internal processes, financial information quality, government subsidy funds and debt financing scale. They also reduce corporate equity and debt financing costs, provide necessary resources for corporate innovation and effectively guarantee the implementation of innovative projects.

4.4. Cross-sectional tests

The above analyses show that a good tax credit rating can increase corporate innovation investment. We next examine whether the above effects differ under various circumstances. Specifically, we examine the possible impact of the number of analysts that follow a company from the perspective of the information environment, the internal governance structure from the perspective of corporate governance and the implementation of the Gold Tax Project III from the perspective of policy formulation.

From the perspective of the information environment, tax credit ratings require the collection and evaluation of corporate tax historical, internal and external information. It not only regulates corporate taxation behavior, but improves the quality of corporate internal reporting and external information disclosure. As information intermediaries, financial analysts use their professional skills to more extensively collect, process and release private information about the company and effectively reduce the information asymmetry between internal and external stakeholders (Schipper, 1991; Fang, 2007). Therefore, we expect tax credit ratings to exert a stronger effect when the number of analysts that follow a company is smaller (i.e., when the information environment is more opaque). The results are shown in columns (1) and (2) of Table 9. Tax credit ratings have a significantly higher promotion effect on corporate innovation for samples with low information transparency than for those with higher information transparency, indicating that good tax credit ratings can improve the quality of information, alleviate information asymmetry, boost corporate innovation and complement the information mining role of analysts.

From the perspective of corporate governance, the separation of corporate ownership and control causes a principal-agent problem between shareholders and management. Executives have the motivation to satisfy their own needs through opportunistic manipulation and harm shareholders' rights and interests. Executive shareholding unifies the goals of corporate managers and owners to a certain extent, reduces conflicts of interest and eases the principal-agent problem (Bizjak et al., 1993; Han et al., 2006). Tax credit ratings improve the collection and reporting of internal information and expand the information sources of external information users; this is more conducive to supervision by external stakeholders, making executives more likely to consider the long-term development of an enterprise during decision-making. Therefore, we expect tax credit rat-

Table 8
Results of Supplementary Tests.

Variables	(1) *IC*	(2) *Opacity*	(3) *COE*	(4) *COD*	(5) *Subsidy*	(6) *FINANC_Debt*
TAXCREDIT	0.114***	−0.090***	−0.002**	−0.018**	0.326***	0.007**
	(4.465)	(−5.909)	(−2.044)	(−2.068)	(4.535)	(2.137)
Controls	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES
Industry	YES	YES	YES	YES	YES	YES
Observations	12,571	7660	9201	11,189	11,264	12,578
Adj. R^2	0.281	0.284	0.143	0.091	0.122	0.298

Table 9
Cross-Sectional Tests.

Variables	*RD/TA*					
	Information Environment		Executive Shareholding		The implementation of Gold Tax Project III	
	High	Low	High	Low	Before	After
	(1)	(2)	(3)	(4)	(5)	(6)
TAXCREDIT	0.002***	0.004***	0.002***	0.004***	0.0033***	0.0026***
	(4.979)	(7.454)	(3.877)	(7.052)	(7.095)	(5.497)
DIFF		**0.002*** **		**0.002** **		**−0.0007**
CONTROLS	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES
Industry	YES	YES	YES	YES	YES	YES
Observations	7868	4709	6083	6081	7093	5485
Adj. R^2	0.238	0.120	0.202	0.169	0.110	0.303

ings to exert a stronger effect when the managerial ownership is lower (i.e., when the principal-agent problem is more serious). The results are shown in columns (3) and (4) of Table 9. The tax credit rating is significantly more effective in promoting corporate innovation for the sample with low executive shareholding than for that with higher managerial ownership, indicating that the tax credit rating mobilizes the enthusiasm of the managers' scientific decisions, reduces the agency costs and benefits the long-term development of an enterprise.

From the perspective of policy formulation, taxation is an important source of national public finances. As a result, the improvement of compliance with tax laws and promotion of taxpayers' integrity and self-discipline are issues that need to be resolved when developing a taxation system. The Gold Tax Project III is a compulsory tax collection method and tax management information service project established by the State Administration of Taxation. It uses big data and cloud computing to realize information exchange in administrative supervision, with the aim of strengthening tax management and reducing administrative costs. Since 2013, the Gold Tax Project III has successively launched the national and local tax monorails in Chongqing, Guangdong, Hebei, Hunan and other provinces, and it has been implemented nationwide since 2016. The implementation of the Gold Tax Project III has greatly improved firms' internal tax management foundations and may have an alternative or complementary effect to that of tax credit ratings. To test the impact of compulsory tax supervision policies on the effect of tax credit ratings, we divide samples into those before and after the implementation of the Gold Tax Project III. The results are shown in columns (5) and (6) of Table 9. Before the implementation of the Gold Tax Project III, tax credit ratings have a higher promotion effect on corporate innovation, but the difference between these two groups is not significant, indicating that from the perspective of policy effectiveness, tax credit ratings and the Gold Tax Project III have complementary effects. After the implementation of the Gold Tax Project III, tax credit ratings still improve the corporate tax reporting system, incrementally improve the quality of information disclosed to outside investors and enhance the innovation vitality of a company.

5. Conclusion

We examine the economic consequences of tax credit ratings, an innovative means of tax collection and management, and specifically the impact of tax credit ratings on corporate innovation investment decisions. We find that higher tax credit ratings encourage companies to increase innovation investment. This positive impact manifests through three channels. First, tax credit ratings help managers more accurately identify R&D projects; a higher tax credit rating implies that a firm has better internal information collection and transmission. After managers obtain more comprehensive and higher-quality information, they can accurately assess the prospects and future benefits of R&D projects. Second, tax credit ratings can alleviate corporate financial constraints; a higher tax credit rating not only grants the direct convenience of financial funds and bank loans but also indicates better internal information systems in the company. The improvement in information quality reduces information asymmetry. The endorsement of tax supervision also encourages investors to increase their willingness to invest. Third, tax credit ratings alleviate the principal-agent problem;

overall, the establishment of a tax credit evaluation system restricts managers' opportunistic behaviors by strengthening punishments and introducing external supervision. By enhancing the accuracy of R&D expenditure accounting, the tax credit evaluation system facilitates the motivating role of the executive compensation mechanism. After using the change model, PSM method and PSM-DID method to alleviate the endogeneity problem, we reveal a causal relationship between tax credit ratings and corporate innovation investment. Our results also pass robustness tests. Further, we examine whether the above effects differ under various circumstances; we specifically consider the possible impact of the number of analysts that follow the company from the perspective of the information environment, the internal governance structure from the perspective of corporate governance and the difference between the implementation of the Gold Tax Project III and tax credit ratings from the perspective of policy formulation. We find that the relationship between tax credit ratings and corporate R&D investment is more significant for samples with poor information environment and a low proportion of managerial ownership. The implementation of the Gold Tax Project III does not significantly affect the role of tax credit ratings, confirming the effects of tax credit ratings in alleviating information asymmetry and reducing agency costs, which are complementary to the compulsory tax policies and their incremental contributions. Tax credit ratings improve tax compliance by enterprises and stimulate enthusiasm for innovation by firms.

The findings of this study enrich our knowledge of the economic consequences of tax credit ratings. Unlike previous negative constraints imposed by tax violations and subsequent penalties, tax credit ratings use *ex ante* positive incentives to increase corporate tax compliance and stimulate corporate innovation, resulting in double dividends. The results of this study effectively compensate for the lack of research in the field of incentive tax supervision, comprehensively evaluate the impact of the implementation of tax credit ratings on various stakeholders and show that tax compliance can bring real benefits to enterprises instead of simply increasing costs.

Our findings also have practical significance and policy guidance implications. First, incentive-based tax supervision increases companies' tax compliance by improving corporate information systems and is applicable to all taxpayers. Compared with the original penalty-based supervision system, the incentive-based system has a more profound impact on enterprises because of wider coverage. Second, tax credit ratings not only enhance the willingness of enterprises to comply with tax laws and regulations but also promote corporate R&D investment, thereby helping the long-term development of enterprises, generating double dividends for both the government and enterprises and reflecting the significance of policy innovation. Third, the tax credit rating system implemented by the State Administration of Taxation integrates corporate history and current internal tax information with external information from credit and land perspectives, which accurately and comprehensively measures the true credit status of an enterprise and contributes to the construction of a social credit system. Finally, we propose a possible method by which to stimulate innovation by enterprises. The 2020 government work report emphasizes the need to seek breakthroughs in key and important areas, and policy formulation and reforms should play a leading role in this field. The tax credit rating is a reasonable means of encouraging enterprises to participate in innovation and gathering support for national construction and development.

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.

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The impact of anti-corruption measures and risk effects on equity incentives and financial misreporting in China

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ABSTRACT

This study examines the effects of anti-corruption and equity incentive risk on financial misreporting in the context of China's unique corporate ownership structure and governance regime. Using a sample comprising 2,708 cases of financial restatement over the 2007–2017 period. Our key findings suggest that managers' shareholdings are significantly and positively associated with their firms' financial misreporting, and certain equity risk factors dramatically alter Chinese corporate governance. Furthermore, managers' motivation to misreport is significantly more pronounced in non–state owned enterprises (non-SOEs), suggesting that equity incentive risk effects mitigate the "absence of ownership" problem believed to affect SOEs. Managers in highly competitive industries and firms with low institutional ownership are found to be highly motivated to misreport performance.

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1. Introduction

A wide range of research has explored the relationship between equity incentives and financial misreporting in both developed economies and China; however, the evidence generated by such research is mixed. Some researchers attribute these mixed results to differences in sample size, research design and measures of equity incentives. The unique nature of Chinese businesses in terms of ownership structure and corporate governance suggests that agency problems are more pronounced in state-owned enterprises (SOEs) than in non-SOEs. In this context, SOE managers are believed to have stronger incentives to fraudulently correct stock prices to increase their personal wealth, and to face lower expected costs from doing so (Yu, 2007; Zhang and Ma, 2011; Hass et al., 2016; Zhang et al., 2018). New political and regulatory developments that have taken place in China since 2012 have not been considered in related research. Most studies have used datasets covering periods up to 2010, thereby failing to gauge the effect of new reforms, such as the anti-corruption campaign,[1] on Chinese corporate governance.

[1] The 18th National Congress of the Communist Party of China (CPC) was held in Beijing on 8 November 2012. Since then, a series of regulations on fighting corruption, such as the *Eight Provisions*, have been successively issued, setting off an unprecedented anti-corruption crackdown. As of October 2017, the CPC Central Committee had investigated 440 party members and other officials at or above the provincial level, including 43 members and alternate members of the CPC Central Committee and nine members of the CPC Central Commission for Discipline Inspection. More than 8,900 bureau-level and 63,000 county-level officials have been disciplined. The anti-corruption campaign has changed China's political ecosystem dramatically (Han and Sun, 2017).

The anti-corruption campaign is thought to have directly reduced self-interested, in-service consumption and the willingness to seek rents by SOE executives (Wang and Kong, 2016; Zhong et al., 2016) while imposing stricter performance evaluation standards for the assessment, appointment, removal, reward and punishment of government officials and executives of SOEs.

Thus, it is reasonable to deduce that the anti-corruption campaign may have made executives more risk-averse; this may especially be true for SOE management. In this context, Armstrong et al. (2013) suggest that the incentives facing risk-averse executives comprise two countervailing effects, a positive "reward effect" and a negative "risk effect." They find that equity holdings incentivize managers to misreport not because the managers' wealth is linked to the value of the equity but because their wealth is linked to the equity's risk. However, few studies have explored this risk effect in the context of the relationship between equity incentives and financial misreporting in China.

The anti-corruption campaign was intended to suppress firms' speculative behavior, such as earnings management and abusive accounting policies, and led to improvements in their earnings quality (Lei and Wang, 2019). However, the number of instances of financial misreporting by listed firms has continued to increase. For example, in 2018, the China Securities Regulatory Commission (CSRC) meted out 310 administrative penalties, representing an increase of 38.39% from the previous year[2].

Therefore, there is need for a comprehensive investigation of financial misreporting that considers the characteristics of the structure of the Chinese business environment. This study aims to explore the risk effects of managers' motivation to misreport in the context of the unique forms of prevailing ownership structure and corporate governance in China. To accomplish this, we use a large sample spanning ten years (2007–2017). The starting point of our sample is the year when the CSRC began to encourage public firms to introduce equity incentive schemes. Before 2007, few firms adopted equity incentive schemes; even in firms where such schemes were adopted, the impact of managers' shareholdings was mitigated by "lock-up period restrictions[3],-" which reduced managers' motivation to increase their wealth by influencing the stock price. On 1 January 2007, Accounting Standards for Business Enterprises No. 28—Changes of Accounting Policies and Accounting Estimates and Error Correction was implemented. This was the first time that a Chinese accounting standard officially introduced the concept of a "retrospective restatement," marking the establishment of a formal system for governing financial restatement.

Current research on the effects of US equity incentive measures is typically based on the sensitivity of managers' portfolios to stock prices (portfolio delta) or to stock price volatility (portfolio vega). In China, however, due to low investor protection, stock prices tend to only weakly reflect firms' levels of performance and risk, and the data needed to compile these portfolio sensitivities are not always available.

Following the studies of Firth et al. (2006a,b, 2007), Conyon and He (2011, 2014), Conyon et al. (2013) and Hass et al. (2016), we use managers' equity shareholding ratios as a proxy for managers' equity incentives. Following the studies of John et al. (2008) and Boubakri et al. (2013), we use the volatility of firm earnings as a measure of the effects of business risk (*Risk*) and expect business risk to act as a mediator of managers' motivation to misreport, which, according to Baron and Kenny (1986), can be captured by the Sobel intermediate factor test.

As this study falls within the area of Generally Accepted Accounting Principles (GAAP), we use both restatements and earnings management as proxies for financial misreporting. For the empirical investigation, we first use logit regressions for our baseline tests to examine the relationship between equity incentives and two measures of financial misreporting, namely, financial restatement and earnings management. To control for observed differences between firms with different levels of equity incentive, we use propensity score matching (PSM) and then rerun the tests using the matched sample of firms having equity incentive plans. To alleviate concerns of self-selection bias, we further use Heckman tests to address the potential endogeneity issue.

[2] From the annual report on the work of CSRC, http://www.csrc.gov.cn/pub/zjhpublic/G00306201/ndbg/201903/t20190329_353507.htm.

[3] According to CSRC regulations for listed firms' equity incentives, before 2007, relevant stocks could not be sold within a year of the date of vesting. Before the lock-up period expiry, the sale of shares not exceeding 5% of the firm's share capital over 12 months were permissible.

We find that managers' shareholdings are significantly and positively correlated with financial misreporting, suggesting that equity incentives strongly motivate managers to manipulate firms' performance. The levels of industrial competitiveness and institutional ownership are also found to exert a strong influence on managers' motivation to manage earnings, especially in more competitive industries and in firms with low institutional ownership. It is also established that risk aversion–related mechanisms may mitigate managers' motivation to manipulate firms' performance in SOEs, less competitive industries and firms with high institutional ownership. The evidence obtained is of great significance, as it provides insights into the impact of the anti-corruption campaign on managers' risk behaviors.

This study makes three major contributions to the field. First, we extend the literature by examining equity incentives' risk effect in the context of China's unique forms of ownership structure and corporate governance. Second, we apply alternative empirical techniques to a granular dataset that spans a long period, generating robust evidence on the relationship between equity incentives and financial misreporting. Third, this study offers pertinent and timely recommendations to policymakers on how to improve the efficiency of China's stock markets, strengthen its ability to support the real economy and modify its regulations on equity incentives, if required. Appropriate modifications should help constrain self-interested behavior in managers, especially managers of non-SOEs and of firms in highly competitive industries and with low institutional ownership, as these conditions are found to exacerbate the manipulation of reported corporate performance.

The remainder of the paper is organized as follows: Section 2 reviews the relevant literature, while Section 3 develops our hypotheses on equity incentives and financial misreporting. Section 4 presents the data, the variables used in the study and the empirical methodology adopted. Section 5 discusses the results, and Section 6 concludes the study.

2. Literature review

2.1. Equity incentives and financial misreporting

Equity incentive programs can provide an effective mechanism for solving the agency problem (Jensen and Meckling, 1976). However, while they are designed to align the interests of managers and shareholders, these performance-based incentives may also motivate managers to misreport performance and induce rising stock prices for their own benefit. Bar et al. (2003) demonstrate that managers can be incentivized to misreport performance under a broad range of conditions. Positive associations between equity incentives and financial restatements are also identified by Bergstresser and Philippon (2006), Burns and Kedia (2006), Goldman and Slezak (2006), Harris and Bromiley (2007), Peng and Roell (2008), Johnson et al. (2009) and Armstrong et al. (2013).

While there is a large body of empirical research on the impact of equity incentives on misreporting, the results are mixed or inconclusive. For example, Erickson et al. (2006) find no evidence of an association between equity incentives and accounting fraud. Similarly, Armstrong et al. (2010) find that accounting manipulation is less likely in firms whose CEOs enjoy high levels of equity incentives. Armstrong et al. (2013) identify a possible explanation for the mixed results found in the literature, namely that differences in the sample size or research design (e.g. regression usually derives positive correlations, whereas the use of a matched-pair design may yield no correlation). There is, however, another explanation for these mixed results, namely that misreporting increases risk. The portfolio delta (sensitivity of a manager's wealth to changes in the stock price) has two countervailing effects on a risk-averse manager's incentive to misreport, resulting in a net effect with an ambiguous sign (Armstrong et al., 2013).

Financial restatements are most often made by firms that have suffered substantial losses in market value (Palmrose et al., 2004; Karpoff et al., 2008), increases in the cost of capital (Hribar and Jenkins, 2004) or high executive turnover (Srinivasan, 2005; Hennes et al., 2008). Restatements call into question the credibility of a firm's future financial reports, as they indicate the poor quality of its previously released financial information.

Firm managers can use their accounting discretion to affect reported earnings; through this mechanism, they can also affect stock prices, provided that capital markets have difficulty detecting earnings management. Cheng and Farber (2008) find that firms' managers may be motivated to inflate and/or smooth earnings to beat analysts' forecasts. Chen et al. (2005) find that in China, stock-based compensation and ownership pat-

terns may provide an incentive for earnings management. Several researchers have also discovered that board composition and ownership structure affect the incidence of fraud (Chen et al., 2006; Jia et al., 2009; Hou and Moore, 2010; Firth et al., 2011). Conyon and He (2014) study the consequences of corporate fraud on executive compensation in China, showing a tendency for the fixed element of executive compensation (e.g. base salary, bonus and stipends) to decrease after the announcement of a CSRC enforcement action. The authors also show that corporate fraud is more pronounced in less developed regions of China.

Hass et al. (2016) demonstrate that equity incentives for management tend to encourage corporate fraud, and they also find a negative, albeit insignificant, relationship between supervisory board members' equity incentives and corporate fraud. These authors also argue that the effect of equity incentives on corporate fraud is more pronounced in SOEs than in non-SOEs. They attribute this to the observation that SOE management teams are less able to affect their compensation and simultaneously face weaker monitoring, which offers them more opportunities to commit fraud. Thus, the expected costs of such fraud are low and the incentives to commit it strong, potentially motivating SOE management teams to increase their wealth via their stockholdings. Zhang et al. (2018) find that "tournament incentives," in the form of large pay disparities between the CEO and other executives, may reduce the occurrence of financial restatement in China. This negative association is found to be more pronounced for SOEs than non-SOEs.

2.2. Risk effects of equity incentives

Previous studies suggest that the portfolio delta (the change in a manager's wealth resulting from a unit percentage change in the company's stock price) has two countervailing effects on a risk-averse manager's decision to misreport. First, a higher delta implies an increase in the value of the manager's wealth from any given increase in the stock price, i.e. the reward effect. However, a higher delta may discourage misreporting, as it amplifies the impact of the company's equity risk on the overall riskiness of a manager's equity portfolio, discouraging risk-averse managers from taking on risky projects, i.e. the "risk effect" (Carpenter, 2000; Ross, 2004; Lewellen, 2006; Armstrong and Vashishtha, 2012).

Research suggests two reasons for the association between financial misreporting and managers' assessments of equity risk. First, misreporting increases the likelihood of extreme negative returns. While successful misreporting temporarily inflates a stock's price, once detected, the price typically undergoes a significant decline (e.g. Feroz et al., 1991; Dechow et al., 1996; Palmrose et al., 2004; Karpoff et al., 2008; Bardos et al., 2011). Second, misreporting, by its very nature, decreases the quality of a firm's financial reports and obfuscates its true value. As a result, the level of uncertainty in the market concerning the firm's share value may increase (e.g. Kravet and Shevlin, 2010; Bhattacharya et al., 2012).

Some studies have investigated the impact of the anti-corruption campaign on corporate governance in China. Starting in 2012, the anti-corruption campaign has dramatically changed China's political ecosystem (Han and Sun, 2017). It is beyond doubt that this change in corruption governance has affected both SOEs and non-SOEs. While executives at both types of firms share similar economic interests, those at SOEs also have an interest in political promotion, which could imply differences in their motivation to engage in earnings management. The campaign has directly reduced the willingness of SOE executives to engage in self-interested, in-service consumption and rent-seeking behavior (Wang and Kong, 2016; Zhong et al., 2016). This strict external environment creates two incentives for SOE executives. First, to obtain opportunities for political promotion, senior executives at SOEs tend to abandon accrual earnings management activities that are not well concealed and could result in their suffering a relatively large penalty. Second, the anti-corruption blitz seems likely to have activated Communist Party organizations' governance and supervision within SOEs more than in non-SOEs, thus improving the effectiveness of internal controls and helping to curb the earnings management behaviors that are likely to result in the largest penalties (Lei and Wang, 2019).

2.3. Equity incentives and ownership structure

A unique feature of Chinese firms is the strong influence of their ownership structures on the effectiveness of their corporate governance. Chinese SOEs and non-SOEs exhibit significant differences in terms of their own-

ership, monitoring and control mechanisms (Peng et al., 2010). As described in the literature, the state and parent SOEs hold sufficient shares to maintain voting control and exert significant political influence (Fan et al., 2007). Reflecting this finding, the literature has identified a tendency for lower-quality corporate governance and more serious agency problems at SOEs. Related studies have documented that in SOEs, performance evaluations, salary increases and career advancement often depend on political connections and the geographical location of the SOE (Du et al., 2012; Hass et al., 2014; Zhang et al., 2018). Furthermore, an SOE's management typically has very little power to maximize firm value or affect the firm's ownership structure. Various elements of state ownership may increase the incentive and create more opportunities to commit corporate fraud. For example, in China's political system, bureaucrats are selected through political processes; they typically have very weak incentives and limited capability to monitor firms and maximize shareholder value (Conyon and He, 2011, 2014).

In China, several other factors affecting management decision-making processes in the face of performance challenges have been discovered, including differences in the legal environment, corporate governance, competitiveness and institutions. These factors all stem from variations in the level of marketization across the Chinese mainland (Fan et al., 2007; Su and Alexiou, 2019).

3. Development of hypotheses

3.1. Equity incentives and financial misreporting

China's financial markets, institutions and legal environment have lagged behind the rapid development of the nation's real economy (Chen et al., 2005). Therefore, the chances of identification of and punishment for earnings manipulation may be relatively low, leaving managers with strong motivation to maximize their own wealth via such manipulation, even after allowing for the risk and costs of punishment. Becker (1968) suggests that agents commit fraud only if the benefits exceed the costs of getting caught and punished. That is, the lower the expected costs relative to the expected increase in wealth, the stronger the individual's incentive to engage in fraudulent activities. Despite major improvements in China's legal framework, accounting fraud in the country is widespread, potentially hindering economic development. Chinese-listed firms are well known for behaviors such as profit inflation, fictitious transactions and false disclosures (Chen et al., 2006).

Managers' wealth is sensitive to short-term variations in stock prices, which can motivate managers with significant equity incentives to attempt to increase stock prices in the short term. Given that the capital market uses current earnings as a basis for predicting future earnings when pricing firms' equity, these managers can manage earnings using accounting discretion, potentially boosting the stock price in the short term (Stein, 1989). The CSRC's 2018 Annual Accounting Supervision Report of Listed Companies, published in 2019, identifies several accounting supervision problems, including manipulation of earnings, selective disclosure in financial statements and profit manipulation through the fabrication of transactions. For example, Kangde Xin Composite Material Group Co., Ltd., inflated reported profits by $1.6 billion from 2015 to 2018 using a variety of means, including inflating business income and understating operating costs; the company had in fact suffered a loss of $900 million over that period, far exceeding the profits it had earned since its listing. In another example, Longli Bio Holdings falsely increased its profits from 2015 to 2017 through fraudulent activities involving the modification of its financial statements. The recent Luckin Coffee accounting scandal,[4] which caused losses exceeding $1.1 billion by foreign investors, shocked both the US Securities Exchange Commission (SEC) and the CSRC.

Overall, however, Chinese investor protection and corporate governance have greatly improved. Since 2005, the Ministry of Finance has expressed its commitment to bringing the Chinese Accounting Standards

[4] According to The Wall Street Journal, on 2 April 2020, Luckin Coffee, Inc., a Chinese firm listed on the Nasdaq in May 2019, revealed that it had fabricated transactions representing nearly $700 million in revenues between the second and fourth quarters of 2019, causing its stock price to plummet. Several US law firms accused Luckin Coffee of making false and misleading statements and violating US securities laws. On 3 April 2020, the CSRC strongly condemned financial fraud, declaring that offending firms would be punished to the full extent of the law. The SEC is conducting a thorough investigation of the fraud, which is expected to have a substantial effect on Chinese firms listed in US markets.

for Business Enterprises (which contain loopholes permitting the abuse of accounting policies) in line with the International Financial Reporting Standards, thus aiming to enforce the adoption of high standards of financial reporting by domestic firms. However, the practice of firm performance misreporting remains prevalent. Thus, we hypothesize that managers may wish to influence investors' perceptions of their firms and thereby manipulate stock prices.

We use volatility of firm earnings as a mediating factor that captures a manager's motivation for financial misreporting although, unlike vega, it does not directly reflect the risk of stock options (Armstrong et al., 2013). However, as riskier corporate operations exhibit more volatile returns to capital and earnings (John et al., 2008, Boubakri et al., 2013), volatility of firm earnings is thought to be closely related to earnings management, which usually has no cash flow-in. Following the Sobel intermediate factor test method of Baron and Kenny (1986), we expect business risk to act as a mediator of managers' motivation to misreport; thus, our main hypothesis is as follows:

H1. Managers' equity incentives have a positive association with corporate financial misreporting; the risk effect of business involves impact mechanisms.

3.2. Ownership structure and anti-corruption

Since the anti-corruption campaign began, government departments, other institutions and independent third-party auditors have been assigned increased supervision responsibilities, and a crackdown on enterprises' illegal and speculative activities has been instigated. In the process, relatively strict external audit requirements have made the exposure of earnings management via accruals more likely, increasing the risk that managers will incur severe punishment. Therefore, in the external governance environment created by the anti-corruption blitz, managers are likely to have become risk-averse and to have reduced their attempts to use accruals to manage earnings. The anti-corruption campaign is likely to have impacted both SOEs and non-SOEs; however, a more direct impact on executives at SOEs is expected.

Although the economic goals of executives at SOEs and non-SOEs are ultimately similar (namely, to do well in their performance evaluations and maximize personal rewards), SOE executives have the additional, more attractive goal of political promotion. The effect of an SOE's performance on its executives' promotion prospects therefore determines the degree of attention paid by SOE executives to their firms' performance. The effect of firm performance on managers' performance evaluations may mean that firm performance also affects managers' choices regarding accounting policies and procedures, as well as their production, operation, investment and financing decisions (Zeng and Ye, 2005). To achieve political promotion, SOE executives have largely abandoned the use of earnings management to embellish their enterprises' business performance (Lei and Wang, 2019).

Political promotion aside, economic interests continue to affect the behavior of SOE executives. First, even successful misreporting inflates a company's stock price only temporarily; once it is detected, there is typically a significant decline in the price (e.g. Feroz et al., 1991; Dechow et al., 1996; Palmrose et al., 2004; Karpoff et al., 2008; Bardos et al., 2011). Second, misreporting may increase the market's uncertainty concerning a firm's share price (e.g. Kravet and Shevlin, 2010; Bhattacharya et al., 2012).

Overall, we argue that the anti-corruption campaign has created a stricter external governance environment, which in turn has made SOE executives more risk-averse and thus more cautious about equity risk. This risk effect should exert a constraining effect on SOE executives' self-interested behavior and weaken their motivation to engage in the manipulation of corporate performance. Therefore, we presume that managers of SOEs are more risk-averse than their non-SOE counterparts. In view of the above, we expect business risk to act as a mediator of managers' motivation to misreport, and thus we propose the following hypotheses.

H2a. The positive association between managers' equity incentives and financial misreporting is stronger in non-SOEs than in SOEs.

H2b. The positive association between managers' equity incentives and financial misreporting in SOEs was suppressed after the 2012 anti-corruption campaign.

4. Empirical investigation

4.1. Data

Following the studies of Firth et al. (2007, 2010, 2011), Hou and Moore (2010), Conyon and He (2011, 2014) and Conyon et al. (2013), we obtain data on managers' equity incentives from China Stock Market & Accounting Research (CSMAR), a leading Chinese business data and information services company. We collect accounting restatement samples from the website of Dibo Enterprise Risk Management Technology Co., Ltd (DIB),[5] an internal control services provider in China. These samples include all accounting restatements by firms listed on the Chinese stock market and contain admissions of earnings manipulation, fabrication of assets, postponements of disclosure, false statements and failure to disclose information subject to enforcement actions taken by the CSRC or the Shanghai and Shenzhen stock exchanges. The reasons for restatement are also listed and include price manipulation, fraudulent listings, provision of illegal guarantees, illegal related-party transactions and involvement in litigation. We also collect most of the required firm characteristics from the CSMAR data, excluding observations from firms in the financial services sector. We remove certain extreme values, thus eliminating executives with a shareholding ratio higher than one or with a negative value. All of the variables are winsorised at the 1st and 99th percentiles. Our final sample consists of an unbalanced panel, with 2,708 firms and 21,216 firm-year observations for the 2007–2017 period.

Following Rosenbaum and Rubin (1983), we apply PSM instead of matched-pair sampling, as the matched-pair design may not reveal correlations, and we adopt a matching score based on firm size, leverage, return on assets and free cash flow. We conduct a regression analysis robustness test on the matched samples. From the restatement sample, we select 245 firms engaged in the false presentation of earnings and 155 firms engaged in the inflation of profits. We then use earnings manipulation and profit inflation as alternative variables for restatement in robustness tests.

4.2. Variables

In the literature, financial misreporting is usually measured by the following three proxies: financial restatement, earnings management and corporate fraud. Although these activities share certain traits, they are not the same. According to Erickson et al. (2006), financial restatements and earnings management do not necessarily reflect an intent to deceive, whereas corporate fraud does by definition. We want our investigation to fall within GAAP. Thus, we use restatements and earnings management as proxies for financial misreporting, as both are closely related to managers' misreporting motivation.

We examine the relationship between equity incentives and two measures of financial misreporting, namely, financial restatement and earnings management. We adopt financial restatement as a measure of managers' attempts to intentionally misreport financial information and earnings management as a measure of managers' attempts to manipulate their firms' reported performance. By using two distinct measures of financial misreporting, we aim to ensure that our inferences are applicable to misreporting in general rather than specific to any one measure.

4.2.1. Measures of incentives

As our primary goal is to examine how managers' equity incentives affect corporate financial misreporting, we focus on management teams' equity incentives[6] (e.g. Erickson et al., 2006; Jiang et al., 2010; Feng et al. 2011;). In our initial tests, we define the management's incentives as their total equity shareholding (*Sharehold-*

[5] DIB is China's first specialist internal control and risk management-focused company and its first professional risk management technology company. Since 2008, DIB has released an annual internal control index report on China's listed companies, available at http://www.dibdata.cn.

[6] Firm decisions are usually made by teams (Aggarwal and Samwick, 2003). Due to the anti-corruption campaign in China, the State-owned Assets Supervision and Administration Commission (SASAC) has required SOEs' important policy decisions to be made by management teams instead of a single person. We therefore examine the equity incentives of the entire top management team.

ing, i.e. the shares held by the management, including the president, CEO, vice president, deputy managers, assistant managers, company secretary and other directors, as a percentage of the firm's total equity).

4.2.2. Control variables

In addition to the main independent variables of interest, we also control for certain firm characteristics. Specifically, to control for characteristics of firms' internal governance mechanisms, we use the following variables: number of board members (*Board*); number in the top management team (*Num*) (Chen et al., 2006); whether the firm was audited by a Big 4 auditor (*Big4*) (Zhang et al., 2018); market-adjusted annual return, on a monthly basis, as a measure of past stock performance (*Returns*) (Armstrong et al., 2013); the book-to-market ratio (*Btm*) to control for firms' growth potential; and leverage (*Lev*), the ratio of a firm's total long-term debt to total assets, as a measure of firms' financial risk (Erickson et al., 2006). To control for corporate performance and proxy for the risk of financial distress, following Dechow et al. (1996) and Erickson et al. (2006), we use the return on assets (*Roa*), the natural logarithm of the ratio of cash to total assets (*Cash*), Altman's (1968) Z-score measure (*Z*) and the firm's age (*Age*). Furthermore, in line with Hass et al. (2016), we include firm size, measured by the natural logarithm of total assets (*Size*) and the change in sales scaled by prior-period sales (*Growth*). Intangible assets (*Intangible*), inventory (*Inventory*) and accounts receivable (*Receivable*) are all important determinants of discretionary accruals; thus, we take them into account as control variables. We set the variable *SOE* equal to 1 if a firm is state owned, and 0 otherwise.

4.3. Methodology

Following Bergstresser and Philippon (2006), Burns and Kedia (2006) and Armstrong et al. (2013), we examine the relationship between management shareholdings and specific proxies of financial misreporting. In particular, we use a logit and ordinary least squares (OLS) regression analysis, with financial restatement and earnings management serving as dependent variables. We use the value of discretionary accruals based on the modified Jones model (Dechow and Sloan, 1995). Subsequently, we use the Sobel intermediate factor test method of Baron and Kenny (1986) to explore the role of business risk as a mediator of managers' motivation to engage in misreporting. We also examine whether this relationship changes when the following are taken into account: firms' ownership structure, the degree of competition at their headquarters, the proportion of ownership held by institutional investors and whether the observation is from before 2012 or from 2012 onward.

We estimate a series of regressions of the following form:

$$Restatement_{i,t} = \alpha + \beta Shareholdings_{i,t} + \gamma Controls_{i,t} + Industry + Year + \varepsilon_{i,t} \quad (1)$$

$$DA_{i,t} = \alpha + \beta Shareholdings_{i,t} + \gamma Controls_{i,t} + Industry + Year + \varepsilon_{i,t} \quad (2)$$

We then estimate a series of regressions in mechanism test form as follows:

$$Restatement_{i,t} \ or \ DA_{i,t} = \alpha + \beta Shareholdings_{i,t} + \gamma Controls_{i,t} + Industry + Year + \varepsilon_{i,t} \quad (3)$$

$$Risk_{i,t} = \alpha + \beta Shareholdings_{i,t} + \gamma Controls_{i,t} + Industry + Year + \varepsilon_{i,t} \quad (4)$$

$$Restatement_{i,t} \ or \ DA_{i,t} = \alpha + \beta Shareholdings_{i,t} + \delta Risk_{i,t} + \gamma Controls_{i,t} + Industry + Year + \varepsilon_{i,t} \quad (5)$$

where

$$Risk_i = \sqrt{\frac{1}{T-1}\sum_{t=1}^{T}\left(E_{it} - \frac{1}{T}\sum_{t=1}^{T}E_{it}\right)^2} \ | T = 5$$

$$E_{it} = \frac{EBITDA_{it}}{ASSET_{it}} - \frac{1}{X_t}\sum_{k=1}^{X}\frac{EBITDA_{kt}}{ASSET_{kt}}$$

where *Restatement* is the measure of financial restatement,*DA* is the measure of the value of earnings management (discretionary accruals), *Risk* is the measure of the effects of business risk and *Controls* is a vector of

Table 1
Descriptive statistics.

Variable Name	Obs	Mean	SD	Min	Median	Max
Restatement	21,216	0.12	0.33	0.00	0.00	1.00
DA	21,216	0.00	0.09	−0.59	0.01	0.48
Shareholding	21,216	0.05	0.11	0.00	0.00	0.58
Board	21,216	8.83	1.77	5.00	9.00	15.00
Z	21,216	6.64	9.22	−0.44	3.66	63.42
Num	21,216	14.97	4.17	7.00	14.00	28.00
Big4	21,216	0.06	0.23	0.00	0.00	1.00
Btm	21,216	0.51	0.25	0.07	0.48	1.09
Return	21,216	0.07	0.52	−1.05	−0.03	2.55
Inventory	21,216	0.16	0.15	0.00	0.12	0.75
Receivable	21,216	0.11	0.10	0.00	0.08	0.45
Size	21,216	22.00	1.29	19.19	21.84	25.82
Lev	21,216	0.46	0.22	0.05	0.46	1.03
Roa	21,216	0.04	0.06	−0.21	0.04	0.23
Cash	21,216	0.18	0.13	0.01	0.14	0.69
Growth	21,216	0.13	0.34	−0.97	0.11	1.67
Age	21,216	10.95	6.23	2.00	11.00	28.00
Intangible	21,216	0.05	0.07	0.00	0.03	0.90

Note. This table presents descriptive statistics for the firms in our sample from the 2007–2017 period with 21,216 observations. All of the variables are defined in Appendix A.

control variables (all of the variables are defined in Appendix A).[7,8] We also control for industry (*Industry*) and year (*Year*) fixed effects in our model. We compute the statistical significance levels of heteroscedasticity tests based on adjusted standard errors. We also check for multicollinearity using variance inflation factors (VIFs). The VIFs are below 3, which is much lower than the threshold of 10 suggested by Kennedy (2008).

4.4. Descriptive statistics and correlations

Table 1 presents the descriptive statistics for our sample. It shows that 12% of our sample is related to financial restatement and that the mean and median of discretionary accruals (DA) are 0.00 and 0.01, respectively. The mean and median of *Shareholding* are 6% and 0.00%, respectively. For several firm characteristics, the average book-to-market ratio (*Btm*) is 0.5, and the average debt-to-asset ratio (*Lev*) is 0.45. The average firm is approximately 10.38 years old and has an annual sales growth of 13%.

Table 2 reports the Pearson's correlation coefficients of the variables involved in our study from columns 1 to 17 in the lower box, and the Spearman's correlation coefficients from columns 2 to 18 in the upper box. This correlation analysis provides the first preliminary evidence on the positive relationship between management shareholdings and earnings management.

5. Results

5.1. Logit and OLS regression analysis

5.1.1. Equity incentives and financial misreporting

We use a logit regression model to examine the relationship between restatement and equity incentives, an OLS regression model to explore the relationship between *DA* and equity incentives and an OLS regression model to review the mechanism between *Risk* and financial misreporting.

[7] Here, *i* and *t* represent firm and year, respectively. *T* represents an observation period of five years. *Risk* represents the rolling standard deviation of volatility of firm earning within five years (John et al., 2008).

[8] *X* represents the total number of firms in a certain industry, and *k* represents the *k*th firm in the industry. *E* represents industry adjusted earnings (EBIT/ASSET).

Table 2
Pearson/Spearman correlation coefficient matrix.

	1	2	3	4	5	6	7	8	9	10
1. *Restatement*		0.01**	0.01**	−0.02**	−0.02***	0.00	−0.03***	−0.00	−0.02***	0.00
2. *DA*	0.01**		0.10***	−0.01	0.14***	0.03***	−0.04***	−0.04***	−0.00	0.08***
3. *Shareholdings*	0.02***	0.07***		−0.14***	0.30***	0.13***	−0.10***	−0.19***	−0.03***	−0.02***
4. *Board*	−0.01*	−0.01	−0.15***		−0.18***	0.26***	0.10***	0.19***	0.00	−0.02***
5. *Z*	−0.01	0.06***	0.22***	−0.16***		−0.09***	−0.13***	−0.54***	0.11***	−0.14***
6. *Num*	0.00	0.03***	0.02**	0.31***	−0.09***		0.09***	0.11***	−0.02***	0.01
7. *Big4*	−0.03***	−0.03***	−0.08***	0.12***	−0.08***	0.11***		0.16***	−0.01*	−0.04***
8. *Btm*	−0.01	−0.02**	−0.20***	0.20***	−0.51***	0.12***	0.18***		−0.25***	0.11***
9. *Return*	−0.01**	−0.00	−0.01**	−0.01	0.12***	−0.02***	−0.02***	−0.27***		0.02***
10. *Inventory*	−0.01	0.13***	−0.08***	−0.03***	−0.19***	−0.01	−0.03***	0.16***	0.02**	
11. *Receivable*	0.01	0.13***	0.21***	−0.11***	0.02***	0.05***	−0.07***	−0.18***	−0.01	−0.10***
12. *Size*	−0.01**	0.06***	−0.19***	0.26***	−0.36***	0.26***	0.36***	0.61***	−0.07***	0.10***
13. *lev*	0.03***	−0.13***	−0.26***	0.16***	−0.51***	0.08***	0.09***	0.40***	0.04***	0.30***
14. *Roa*	−0.06***	0.33***	0.12***	0.01	0.29***	0.02***	0.04***	−0.22***	0.11***	−0.08***
15. *Cash*	−0.03***	−0.02***	0.17***	−0.06***	0.38***	−0.05***	−0.06***	−0.22***	0.01**	−0.17***
16. *Growth*	0.01	0.04***	0.07***	−0.00	0.01	0.03***	−0.01	−0.05***	0.11***	0.02***
17. *Age*	0.02**	−0.07***	−0.41***	0.07***	−0.22***	−0.04***	0.05***	0.21***	−0.01	0.13***
18. *Intangible*	0.01*	−0.11***	−0.04***	0.03***	−0.03***	0.03***	0.06***	−0.02***	0.01	−0.20***

	11	12	13	14	15	16	17	18
1. *Restatement*	0.01	−0.01	0.03***	−0.07***	−0.02***	0.00	0.02**	0.03***
2. *DA*	0.11***	0.05***	−0.14***	0.29***	0.01	0.05***	−0.09***	−0.11***
3. *Shareholdings*	0.29***	−0.11***	−0.28***	0.21***	0.17***	0.12***	−0.43***	0.02***
4. *Board*	−0.11***	0.23***	0.15***	0.01	−0.05***	−0.00	0.08***	0.01**
5. *Z*	0.21***	−0.50***	−0.84***	0.49***	0.39***	0.09***	−0.34***	0.05***
6. *Num*	0.05***	0.23***	0.07***	0.01	−0.02**	0.04***	−0.06***	0.08***
7. *Big4*	−0.08***	0.29***	0.10***	0.04***	−0.07***	−0.00	0.05***	0.02***
8. *Btm*	−0.19***	0.58***	0.42***	−0.30***	−0.20***	−0.08***	0.22***	−0.07***
9. *Return*	−0.01	−0.06***	0.03***	0.13***	0.02***	0.11***	0.01*	−0.00
10. *Inventory*	0.06***	0.04***	0.25***	−0.10***	−0.08***	0.02**	0.04***	−0.15***
11. *Receivable*		−0.19***	−0.12***	0.06***	0.10***	0.09***	−0.31***	0.03***
12. *Size*	−0.16***		0.41***	0.01	−0.16***	0.08***	0.30***	−0.09***
13. *lev*	−0.05***	0.38***		−0.40***	−0.33***	−0.00	0.35***	−0.09***
14. *Roa*	0.04***	0.05***	−0.38***		0.28***	0.35***	−0.22***	−0.03***
15. *Cash*	0.00	−0.18***	−0.37***	0.26***		0.06***	−0.20***	−0.08***
16. *Growth*	0.07***	0.08***	0.01	0.31***	0.03***		−0.15***	−0.03***
17. *Age*	−0.25***	0.26***	0.33***	−0.16***	−0.20***	−0.08***		−0.06***
18. *Intangible*	−0.11***	−0.03***	−0.00	−0.05***	−0.13***	−0.02**	0.02***	

Note. Lower box reports Pearson's correlation coefficients; upper box reports Spearman's correlation coefficients.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 3 presents the results from the logit/OLS regressions with financial misreporting serving as the dependent variable (proxied by restatement and *DA*) and the results of the mechanism tests on financial restatement and earnings management based on the full sample.

In columns 1 and 2, a positive relationship between restatement/earnings management and shareholding is established, and the results in both columns are significant at the 1% level. These results suggest that equity incentives encourage managers to misreport their performance by using discretionary accounting. The effects of manager shareholding on financial restatement and discretional accruals are not only statistically significant but also economically large. A one-standard deviation increase in manager shareholdings is associated with an increase of 2.267% in the standard deviation of financial restatement and 2.567% in the standard deviation of discretional accruals.

In column 3, the coefficient of managerial shareholdings is significant and positively associated with *Risk*, suggesting that a higher level of managerial shareholdings leads to a higher level of business risk. Column 4

Table 3
Mechanism tests for financial restatement and earnings management on equity incentives.

Variable	(1) Restatement	(2) DA	(3) Risk	(4) Restatement	(5) DA
Shareholding	**0.647*****	**0.021*****	**3.368*****	**0.640****	**0.021*****
	(2.91)	**(3.94)**	**(2.65)**	**(2.37)**	**(3.28)**
Risk				**0.003***	**0.005****
				(1.89)	**(2.26)**
Board	0.010	−0.000	0.034	0.010	−0.000
	(0.70)	(-0.33)	(0.42)	(0.70)	(-0.27)
Z	0.000	0.000*	−0.012**	0.000	0.000*
	(0.44)	(1.77)	(-2.24)	(0.39)	(1.75)
Num	−0.002	0.000**	0.031	−0.002	0.000**
	(-0.32)	(2.27)	(0.94)	(-0.31)	(2.26)
Big4	−0.289**	−0.022***	0.514	−0.288**	−0.022***
	(-2.51)	(-9.59)	(1.24)	(-2.50)	(-9.59)
Btm	−0.194	0.002	2.013***	−0.189	0.004
	(-1.31)	(0.62)	(2.84)	(-1.28)	(0.99)
Returns	−0.038	−0.001	−0.450	−0.039	−0.002
	(-0.83)	(-1.00)	(-1.37)	(-0.85)	(-1.32)
Inventory	−0.219	0.068***	2.451**	−0.214	0.068***
	(-1.18)	(10.32)	(2.43)	(-1.15)	(10.35)
Receivable	−0.665***	0.085***	−1.400	−0.669***	0.085***
	(-2.68)	(12.53)	(-1.08)	(-2.70)	(12.55)
Size	−0.048	0.004***	−0.509***	−0.049*	0.004***
	(-1.60)	(4.81)	(-3.13)	(-1.65)	(4.60)
Lev	0.586***	−0.040***	0.210	0.588***	−0.041***
	(4.21)	(-8.80)	(0.28)	(4.23)	(-8.94)
Roa	−2.450***	−0.010	6.037**	−2.438***	−0.010
	(-5.58)	(-0.69)	(2.43)	(-5.55)	(-0.70)
Cash	−0.278	−0.099***	2.013	−0.274	−0.100***
	(-1.41)	(-17.79)	(1.60)	(-1.39)	(-17.83)
Growth	0.214***	−0.001	−1.120***	0.211***	−0.002
	(3.07)	(-0.50)	(-3.15)	(3.03)	(-0.55)
Age	0.007*	−0.000*	0.085***	0.007*	−0.000*
	(1.73)	(-1.81)	(4.37)	(1.77)	(-1.81)
Intangible	0.330	−0.073***	−0.696	0.329	−0.073***
	(0.99)	(-9.53)	(-0.53)	(0.98)	(-9.55)
Constant	−0.516	−0.069***	13.950***	−0.473	−0.069***
	(-0.87)	(-4.20)	(4.35)	(-0.79)	(-4.19)
Year	YES	YES	YES	YES	YES
Industry	YES	YES	YES	YES	YES
N	21,216	21,216	21,216	21,216	21,216
Adj/Pseudo R^2	0.079	0.103	0.199	0.089	0.114
Sobel Z-value				1.706*	1.960**

Note. This table presents results from logit regressions of financial restatement and OLS regressions of earnings management on equity incentives and control variables (columns 1 and 2) and the results of mechanism tests for financial restatement and earnings management. Column 3 examines the relationship between *Risk* and managerial shareholding in the subsample with restatement. Columns 4 and 5 examine the relationship between *Risk*, financial restatement and earnings management, estimated using logit and OLS regression. All variables are defined in Appendix A. t (z)-statistics appear in curved brackets and are based on standard errors clustered by firm and year. ***, ** and * indicate 1%, 5% and 10% significance levels, respectively.

shows that *Risk* is positively associated with financial restatement, i.e. significant at the 10% level, whereas in column 5, the *Risk* is also significant at the 5% level and positively associated with earnings management.

In the full sample, the Sobel Z values for restatement and earnings management are 1.706 and 1.960, respectively, which are significant at the 10% and 5% levels, respectively. This indicates that *Risk* acts as a mediator between managers' motivation to manipulate earnings and restatement, implying that the business risk associated with shareholding exerts an influence on financial misreporting. This provides evidence of a risk effect.

Table 4
Equity incentives, anti-corruption and financial restatement.

Variable	(1) Restatement SOE = 0	(2) Restatement SOE = 1	(3) Restatement SOE = 0 Year < 2012	(4) Restatement SOE = 0 Year ≥ 2012	(5) Restatement SOE = 1 Year < 2012	(6) Restatement SOE = 1 Year ≥ 2012	(7) Restatement SOE = 1 Year < 2012
Shareholding	**0.640*****	1.677	**0.986****	**0.484***	**4.377***	−6.880	0.575
	(2.73)	(0.72)	**(2.23)**	**(1.74)**	**(1.66)**	(-0.92)	(0.15)
Risk							**0.007***
							(1.83)
Board	0.006	0.030	−0.007	0.016	0.032	0.017	0.016
	(0.31)	(1.53)	(-0.19)	(0.66)	(1.31)	(0.50)	(0.57)
Z	−0.000	0.004	0.001	−0.001	0.007**	−0.003	−0.003
	(-0.42)	(1.55)	(0.49)	(-0.70)	(2.13)	(-0.34)	(-0.40)
Num	−0.007	−0.001	−0.027*	0.000	−0.003	−0.002	0.006
	(-0.95)	(-0.15)	(-1.79)	(0.01)	(-0.30)	(-0.13)	(0.46)
Big4	0.014	−0.459***	0.300	−0.108	−0.777***	0.067	−0.251
	(0.08)	(-2.96)	(1.02)	(-0.52)	(-3.72)	(0.27)	(-1.11)
Btm	−0.380*	0.012	−0.406	−0.490*	0.311	−0.364	−0.072
	(-1.80)	(0.06)	(-1.16)	(-1.82)	(1.09)	(-0.95)	(-0.22)
Returns	−0.044	−0.066	0.067	−0.113	−0.069	−0.034	−0.096
	(-0.76)	(-0.88)	(0.72)	(-1.50)	(-0.60)	(-0.36)	(-1.04)
Inventory	0.291	−0.899***	−0.098	0.586*	−1.091***	−0.508	−0.634
	(1.18)	(-3.10)	(-0.24)	(1.92)	(-2.92)	(-0.97)	(-1.42)
Receivable	−0.878***	−0.171	−1.890***	−0.580	−0.196	−0.096	−0.004
	(-2.71)	(-0.44)	(-2.75)	(-1.56)	(-0.43)	(-0.12)	(-0.01)
Size	0.038	−0.102**	−0.003	0.058	−0.139**	−0.063	−0.123**
	(0.90)	(-2.36)	(-0.04)	(1.12)	(-2.51)	(-0.89)	(-1.96)
Lev	0.308*	0.878***	0.083	0.372	1.001***	0.654	0.902***
	(1.65)	(3.99)	(0.27)	(1.58)	(3.76)	(1.63)	(2.64)
Roa	−2.908***	−1.819***	−1.314	−3.788***	−1.883**	−1.507	−1.005
	(-5.08)	(-2.62)	(-1.34)	(-5.58)	(-2.06)	(-1.34)	(-1.00)
Cash	−0.262	−0.477	−0.707	−0.174	−0.570	−0.086	−0.379
	(-1.06)	(-1.41)	(-1.63)	(-0.57)	(-1.36)	(-0.15)	(-0.75)
Growth	0.205**	0.182	−0.109	0.352***	0.282**	−0.044	−0.024
	(2.31)	(1.63)	(-0.64)	(3.45)	(2.14)	(-0.23)	(-0.14)
Age	0.009*	0.007	0.005	0.008	0.016*	−0.017	−0.019
	(1.65)	(1.09)	(0.42)	(1.22)	(1.92)	(-1.11)	(-1.55)
Intangible	0.677	−0.032	−0.121	1.250**	0.039	0.126	0.175
	(1.41)	(-0.06)	(-0.15)	(2.07)	(0.06)	(0.15)	(0.25)
Constant	−2.217***	0.509	−1.537	−2.835***	1.365	−0.131	0.682
	(-2.59)	(0.59)	(-0.98)	(-2.76)	(1.28)	(-0.09)	(0.54)
Year	YES	YES	YES	YES	YES	YES	YES
Industry	YES	YES	YES	YES	YES	YES	YES
N	11,596	9,620	4,260	7,336	4,540	5,080	4,540
Pseudo R^2	0.076	0.095	0.103	0.068	0.082	0.093	0.090
Empirical P-value		0.657		0.247		0.041**	
Sobel Z-value							1.660*

Note. This table presents a comparison of the results and mechanism tests for SOEs' and non-SOEs' financial restatement as a function of equity incentives and control variables. Column 1 examines the relationship between restatement and managerial shareholding in the subsample of non-SOEs. Column 2 examines the relationship between restatement and managerial shareholding in the subsample of SOEs. Columns 3 and 4 examine the subsample of non-SOEs before 2012 and in the years after and including 2012, respectively. Columns 5 and 6 examine the subsample of SOEs before 2012 and in the years after and including 2012, respectively. Column 7 shows the results of the mechanism tests for column 5, estimated using logit and OLS regression. All of the variables are defined in Appendix A. z-statistics appear in curved brackets and are based on standard errors clustered by firm and year. ***, ** and * indicate 1%, 5% and 10% significance levels, respectively.

Regarding the control variables, our results show significant negative relationships between *Big 4* and restatement, suggesting that the probability of financial restatement is lower for firms audited by Big 4 audit firms, consistent with the results of Zhang et al. (2018). Financial leverage (*Lev*) is positively related to restate-

Table 5
Equity incentives, anti-corruption and earnings management.

Variable	(1) DA SOE = 0	(2) DA SOE = 1	(3) DA SOE = 0 Year < 2012	(4) DA SOE = 0 Year ≥ 2012	(5) DA SOE = 1 Year < 2012	(6) DA SOE = 1 Year ≥ 2012	(7) DA SOE = 1 Year < 2012
Shareholding	**0.018*****	0.052	**0.030*****	**0.009****	**0.120***	0.086	0.112
	(3.20)	(0.92)	**(2.89)**	**(2.18)**	**(1.73)**	(0.96)	(1.41)
Risk							**0.002***
							(1.81)
Board	−0.000	0.000	−0.000	−0.000	0.000	0.000	0.000
	(-0.33)	(0.28)	(-0.39)	(-0.39)	(0.06)	(0.56)	(0.02)
Z	0.000	0.000	0.000	0.000*	0.000	0.000	0.000
	(1.55)	(0.97)	(1.00)	(1.88)	(0.15)	(0.17)	(0.18)
Num	0.000	0.000**	−0.000	0.000	0.000	0.000	0.000
	(0.73)	(2.14)	(-0.44)	(0.94)	(1.60)	(1.43)	(1.35)
Big4	−0.026***	−0.019***	−0.024***	−0.028***	−0.023***	−0.015***	−0.023***
	(-5.60)	(-7.20)	(-2.74)	(-5.09)	(-6.51)	(-4.26)	(-5.14)
Btm	0.002	−0.002	−0.002	−0.002	0.000	0.003	0.000
	(0.39)	(-0.43)	(-0.24)	(-0.21)	(0.01)	(0.35)	(0.03)
Returns	0.000	−0.004*	0.003	−0.002	−0.005**	−0.005	−0.005**
	(0.09)	(-1.77)	(0.97)	(-0.93)	(-2.15)	(-1.53)	(-2.07)
Inventory	0.080***	0.054***	0.128***	0.036***	0.090***	0.025*	0.090***
	(8.71)	(5.57)	(8.98)	(3.17)	(7.74)	(1.74)	(6.82)
Receivable	0.105***	0.056***	0.099***	0.103***	0.118***	0.029**	0.117***
	(11.11)	(5.53)	(5.57)	(9.37)	(8.70)	(2.12)	(7.36)
Size	0.007***	0.002**	0.008***	0.005***	0.005***	−0.000	0.005***
	(4.77)	(2.34)	(3.55)	(2.80)	(3.94)	(-0.09)	(3.26)
Lev	−0.050***	−0.028***	−0.081***	−0.024***	−0.047***	−0.013	−0.047***
	(-7.23)	(-4.71)	(-6.76)	(-2.99)	(-6.29)	(-1.35)	(-5.19)
Roa	−0.038*	0.023	−0.061*	−0.018	0.561***	0.046	0.561***
	(-1.83)	(1.09)	(-1.77)	(-0.73)	(21.92)	(1.33)	(18.44)
Cash	−0.089***	−0.119***	−0.120***	−0.085***	−0.116***	−0.095***	−0.116***
	(-11.89)	(-13.34)	(-9.25)	(-9.00)	(-10.21)	(-7.09)	(-8.32)
Growth	0.006*	−0.012***	0.004	0.007	−0.043***	−0.021***	−0.043***
	(1.67)	(-2.59)	(0.58)	(1.53)	(-7.26)	(-2.80)	(-6.63)
Age	−0.000	−0.000*	−0.001***	0.000	−0.001**	0.000	−0.001*
	(-0.66)	(-1.74)	(-4.07)	(1.62)	(-2.30)	(0.72)	(-1.85)
Intangible	−0.085***	−0.065***	−0.064**	−0.099***	−0.060***	−0.065***	−0.059***
	(-5.55)	(-8.01)	(-2.49)	(-5.18)	(-5.55)	(-5.55)	(-4.29)
Constant	−0.113***	−0.040*	−0.128***	−0.087***	−0.106***	−0.003	−0.106***
	(-4.23)	(-1.87)	(-2.91)	(-2.68)	(-4.00)	(-0.09)	(-3.23)
Year	YES	YES	YES	YES	YES	YES	YES
Industry	YES	YES	YES	YES	YES	YES	YES
N	11,596	9,620	4,260	7,336	4,540	5,080	4,540
Adj R^2	0.064	0.050	0.105	0.053	0.205	0.043	0.205
Empirical P-value		0.551		0.186		0.070*	
Sobel Z-value							1.652*

Note. This table presents a comparison of results and mechanism tests for SOEs' and non-SOEs' earnings management as a function of equity incentives and control variables. Column 1 examines the relationship between earnings management and managerial shareholding in the subsample of non-SOEs. Column 2 examines the relationship between earnings management and managerial shareholding in the subsample of SOEs. Columns 3 and 4 examine the subsample of non-SOEs before 2012 and in the years after and including 2012, respectively. Columns 5 and 6 examine the subsample of SOEs before 2012 and in the years after and including 2012, respectively. Column 7 shows the results of mechanism tests for column 5, estimated using logit and OLS regression. All of the variables are defined in Appendix A. t-statistics appear in curved brackets and are based on standard errors clustered by firm and year. ***, ** and * indicate 1%, 5% and 10% significance levels, respectively.

ment, suggesting that firms with high financial risk are more likely to issue financial restatements. The age of the firm is positively related to restatement, possibly because firms with long track records have an incentive to engage in earnings manipulation to protect those track records. These findings are consistent with Erickson

et al. (2006) and Feng et al. (2011). Returns (*Roa*) are strongly negatively related to restatement, suggesting that poor performance may be an important driver of firms' misreporting of performance; this is consistent with the results of Armstrong et al. (2013). Growth in sales is strongly positively related to restatement, which is not consistent with Armstrong et al. (2013), who found a significantly negative relationship between growth of sales and restatement. Accounts receivable (*Receivable*) are negatively related to restatement, suggesting that firms may use accounts receivable to manipulate performance. Other control variables are mostly consistent with the literature (e.g. Dechow et al., 1996; Chen et al., 2006; Hass et al., 2016).

Overall, the results indicate significant positive associations between shareholding and restatement and between shareholding and discretionary accruals, suggesting that managers' equity incentives are positively associated with corporate financial misreporting. Further evidence suggests that *Risk* acts as a mediator between managers' motivation to manipulate earnings and restatement. The fact that the business risk associated with shareholding exerts an influence on financial misreporting implies that the risk effect of business is one of the mechanisms that influences corporate misreporting. H1 is therefore confirmed.

5.1.2. Equity incentives, ownership structure and anti-corruption

Table 4 reports the results of the regression and mechanism test of the relationship between shareholding and financial restatement based on subsamples of SOEs and non-SOEs before and after 2012, which were conducted to gauge the impact of the anti-corruption campaign. As shown in column 1, in the non-SOE sample, the coefficient of managerial shareholdings is positive and significant at the 1% level. Columns 3 and 4 suggest that, in the non-SOE sample, the coefficients of managerial shareholdings are positive and significant at the 5% and 10% levels, respectively, both before and after 2012. Column 2 shows that in the SOE sample, shareholding does not have a significant effect on restatement. However, in column 5 for the pre-2012 SOE sample, the coefficient of managerial shareholdings is positive and significant at the 10% level, suggesting that before the anti-corruption campaign, SOEs managers had a strong motivation to falsify their financial reports.

As shown in column 6, in the post-2012 SOE sample, the coefficient of managerial shareholdings is insignificant, indicating that SOE managers have had less motivation to misinform their financial reports since the anti-corruption campaign began. Column 7 shows the results of the mechanism test on column 5. *Risk* is positively associated with financial restatement and significant at the 10% level. The Sobel Z value for restatement is 1.660 and weakly significant at the 10% level, indicating that before the anti-corruption campaign, SOE managers were also less risk-averse, implying that they have been more risk-averse and cautious about equity risk than their non-SOE counterparts since the anti-corruption campaign began.

Table 5 reports the results of the regression and mechanism test between shareholding and earnings management based on the same subsamples as in Table 4. As shown in column 1, in the non-SOE sample, the coefficient of managerial shareholdings is positive and significant at the 1% level. Columns 3 and 4 in the non-SOE sample indicate that the coefficients of managerial shareholdings are positive and significant at the 1% and 5% levels, respectively. Column 2 shows that in the SOE sample, shareholding does not affect earnings management. However, as presented in column 5, in the pre-2012 SOE sample, the coefficient of managerial shareholdings is positive and significant at the 10% level, suggesting that before the anti-corruption campaign, SOE managers had strong motivation to manipulate corporate performance. In column 6, in the post-2012 sample, the coefficient of managerial shareholdings is insignificant, indicating that SOEs' managers have not had the motivation to manage their earnings since the anti-corruption campaign began.

Column 7 shows the results of the mechanism test on column 5. *Risk* is positively associated with earnings management and significant at the 10% level. The Sobel Z value for restatement is 1.652 and significant at the 10% level, indicating that before the anti-corruption campaign, SOE managers were less risk-averse. Consistent with Table 4, this implies that SOE managers have been more risk-averse and more cautious about equity risk than their non-SOE counterparts since the anti-corruption campaign began.

From the results in Tables 4 and 5, we can establish that managers in non-SOEs are more likely to manipulate financial performance than those in SOEs, which is consistent with H2a, suggesting that the positive association between managers' equity incentives and financial misreporting is stronger in non-SOEs than in SOEs. The anti-corruption campaign had a significant influence on SOEs' corporate governance by making their managers more risk-averse, which is consistent with H2b and supports the view that the positive asso-

Table 6
Mechanism tests for financial restatement and earnings management: Competition.

Variable	(1) Restatement High-HHI	(2) Restatement Low-HHI	(3) Restatement Low-HHI	(4) DA High-HHI	(5) DA Low-HHI	(6) DA Low-HHI
Shareholding	0.565	**0.726*****	**0.507****	**0.021*****	**0.017*****	**0.016****
	(1.59)	**(2.71)**	**(1.72)**	**(2.70)**	**(2.64)**	**(2.21)**
Risk			**0.120***			**0.006***
			(1.67)			**(1.77)**
Board	0.020	−0.002	−0.002	0.000	−0.001	0.000
	(1.06)	(-0.11)	(-0.10)	(0.04)	(-1.04)	(0.06)
Z	−0.000	0.003	0.003	−0.000	0.000**	−0.000
	(-0.02)	(1.31)	(1.22)	(-0.38)	(2.17)	(-0.47)
Num	0.001	−0.005	−0.005	0.001**	−0.000	0.001**
	(0.16)	(-0.63)	(-0.67)	(2.43)	(-0.06)	(2.39)
Big4	−0.246	−0.329**	−0.331**	−0.023***	−0.027***	−0.023***
	(-1.53)	(-2.03)	(-2.04)	(-4.79)	(-5.97)	(-4.78)
Btm	−0.079	−0.199	−0.180	0.007	0.012	0.008
	(-0.35)	(-0.99)	(-0.89)	(1.05)	(1.53)	(1.18)
Returns	−0.095	0.011	−0.012	−0.001	−0.003	−0.002
	(-1.44)	(0.18)	(-0.20)	(-0.66)	(-1.27)	(-1.18)
Inventory	−0.292	−0.049	−0.041	0.070***	0.100***	0.071***
	(-1.20)	(-0.15)	(-0.13)	(5.47)	(9.84)	(5.50)
Receivable	−0.444	−0.668**	−0.671**	0.127***	0.166***	0.127***
	(-1.11)	(-2.07)	(-2.08)	(10.79)	(10.06)	(10.81)
Size	−0.130***	0.022	0.019	0.006***	0.007***	0.006***
	(-3.00)	(0.53)	(0.47)	(4.04)	(4.19)	(3.95)
Lev	0.635***	0.576***	0.561***	−0.043***	−0.065***	−0.044***
	(3.06)	(3.08)	(2.99)	(-5.80)	(-6.97)	(-5.88)
Roa	−2.099***	−2.739***	−2.747***	0.538***	0.524***	0.538***
	(-3.20)	(-4.89)	(-4.91)	(23.11)	(18.03)	(23.14)
Cash	−0.710**	0.071	0.059	−0.070***	−0.113***	−0.071***
	(-2.44)	(0.27)	(0.22)	(-8.37)	(-10.33)	(-8.39)
Growth	0.281***	0.148	0.142	−0.026***	−0.023***	−0.026***
	(3.13)	(1.54)	(1.47)	(-5.13)	(-5.60)	(-5.18)
Age	0.001	0.010*	0.010*	−0.000*	−0.000	−0.000*
	(0.13)	(1.78)	(1.80)	(-1.88)	(-0.54)	(-1.86)
Intangible	0.162	0.868	0.826	−0.088***	−0.062***	−0.089***
	(0.39)	(1.46)	(1.38)	(-4.11)	(-5.26)	(-4.17)
Constant	1.164	−2.271***	−2.294***	−0.138***	−0.129***	−0.139***
	(1.36)	(-2.89)	(-2.92)	(-4.79)	(-4.10)	(-4.83)
Year	YES	YES	YES	YES	YES	YES
Industry	YES	YES	YES	YES	YES	YES
N	9,689	11,527	11,527	9,689	11,527	11,527
Adj/Pseudo R^2	0.090	0.077	0.075	0.207	0.176	0.208
Empirical P-value		0.073*			0.227	
Sobel Z-value			1.638*			1.645*

Note. This table presents a comparison of mechanism tests for financial restatement and earnings management for firms in high- and low-competition environments as a function of equity incentives and control variables. All of the variables are defined in Appendix A. t (z)-statistics appear in curved brackets and are based on standard errors clustered by firm and year. ***, ** and * indicate 1%, 5% and 10% significance levels, respectively.

ciation between managers' equity incentives and financial misreporting in SOEs has become less pronounced since 2012.

It should be emphasized that any inconsistency between our findings and those of previous studies (e.g. Hass et al., 2016) may be due to the following reasons. First, the sample data in Hass et al. (2016) spans from 2000 to 2010, thereby excluding significant reforms that have since taken place in China and have altered the Chinese corporate governance regime, such as the anti-corruption campaign. Second, Hass et al. (2016) use different proxy measures and a different data source. They use corporate fraud as a proxy for misreporting,

and their data on fraudulent firms are from the CSRC Enforcement Actions Research Database. In contrast, we use restatement and earnings management as proxies for misreporting, which are more closely related to GAAP, and our data sources are DIB (for accounting restatement samples) and CSMAR (for earnings management). As Erickson et al. (2006) suggest, although corporate fraud and restatement and earnings management may share certain traits, they differ in that financial restatement and earnings management do not necessarily reflect an intent to deceive, whereas corporate fraud does, by definition.

Table 7
Mechanism tests for financial restatement and earnings management: Institutional ownership.

Variable	(1) Restatement High-Inst	(2) Restatement Low-Inst	(3) Restatement Low-Inst	(4) DA High-Inst	(5) DA Low-Inst	(6) DA Low-Inst
Shareholding	0.004	**0.847*****	**0.532****	**0.013***	**0.045*****	**0.044*****
	(0.01)	**(3.35)**	**(2.21)**	**(1.71)**	**(3.63)**	**(2.97)**
Risk			**0.133***			**0.007***
			(1.89)			**(1.76)**
Board	0.046**	−0.024	−0.026	−0.000	−0.001	−0.001
	(2.44)	(-1.21)	(-1.22)	(-0.09)	(-1.19)	(-0.88)
Z	0.004	−0.000	−0.000	0.000*	0.000*	0.000
	(1.51)	(-0.03)	(-0.13)	(1.81)	(1.65)	(0.99)
Num	−0.017**	0.011	0.011	−0.000	0.001***	0.001**
	(-2.11)	(1.33)	(1.31)	(-0.32)	(2.77)	(2.24)
Big4	−0.199	−0.433*	−0.491*	−0.029***	−0.023***	−0.023***
	(-1.50)	(-1.87)	(-1.92)	(-5.04)	(-7.62)	(-6.25)
Btm	−0.131	−0.195	−0.171	0.003	0.006	0.007
	(-0.61)	(-0.89)	(-0.71)	(0.47)	(1.07)	(1.02)
Returns	0.011	−0.076	−0.078	−0.001	−0.004**	−0.005***
	(0.16)	(-1.25)	(-1.27)	(-0.31)	(-2.56)	(-2.64)
Inventory	−0.165	−0.279	−0.341	0.100***	0.077***	0.077***
	(-0.60)	(-1.05)	(-1.21)	(13.12)	(10.89)	(7.38)
Receivable	−0.452	−0.802**	−0.849**	0.151***	0.138***	0.138***
	(-1.27)	(-2.32)	(-2.23)	(15.11)	(15.21)	(11.55)
Size	−0.073*	−0.008	−0.020	0.010***	0.006***	0.006***
	(-1.78)	(-0.19)	(-0.40)	(7.87)	(5.61)	(3.90)
Lev	0.684***	0.602***	0.654***	−0.057***	−0.045***	−0.046***
	(3.15)	(3.38)	(3.40)	(-10.88)	(-8.03)	(-5.95)
Roa	−1.816***	−2.607***	−2.837***	0.566***	0.491***	0.491***
	(-2.68)	(-4.72)	(-4.81)	(34.30)	(27.60)	(19.56)
Cash	−0.404	−0.172	−0.199	−0.083***	−0.097***	−0.097***
	(-1.37)	(-0.65)	(-0.70)	(-11.18)	(-13.46)	(-10.05)
Growth	0.224**	0.203**	0.193**	−0.025***	−0.025***	−0.025***
	(2.21)	(2.34)	(2.05)	(-9.73)	(-9.34)	(-5.19)
Age	−0.002	0.015**	0.006	−0.000**	−0.000	−0.000
	(-0.26)	(2.48)	(0.89)	(-1.97)	(-0.23)	(-0.18)
Intangible	0.668	0.122	0.002	−0.072***	−0.066***	−0.066***
	(1.49)	(0.24)	(0.00)	(-4.86)	(-5.76)	(-5.36)
Constant	0.058	−1.522*	−1.345	−0.202***	−0.120***	−0.120***
	(0.07)	(-1.69)	(-1.38)	(-7.88)	(-5.67)	(-4.35)
Year	YES	YES	YES	YES	YES	YES
Industry	YES	YES	YES	YES	YES	YES
N	10,714	10,502	10,502	10,714	10,502	10,502
Adj/Pseudo R^2	0.084	0.081	0.081	0.211	0.172	0.172
Empirical P-value	0.038**		0.029**			
Sobel Z-value			1.704*			1.660*

Note. This table presents a comparison of mechanism tests for financial restatement and earnings management for firms with high and low institutional ownership ratios as a function of equity incentives and control variables. All of the variables are defined in Appendix A. t (z)-statistics appear in curved brackets and are based on standard errors clustered by firm and year. ***, ** and * indicate 1%, 5% and 10% significance levels, respectively.

5.2. Additional analysis

5.2.1. Moderating role of competition

Competition in firms' product markets can act as an external corporate governance enforcement mechanism (Giroud and Mueller, 2010, 2011). The more competitive the market, the more difficult it is to achieve performance targets. Thus, in more competitive markets, managers may be willing to take more risks to manipulate financial performance. Similarly, the lower the level of competition, the lower the pressure on performance, reducing managers' incentives to take the risks involved in managing performance. Following Hass et al. (2016), we use the Herfindahl–Hirschman index (HHI) of industrial market concentration as a proxy for market competitiveness. A low HHI value implies below-median industrial concentration and a market closer to perfect competition, whereas a high HHI value indicates above-median industrial concentration and market conditions closer to monopoly. We expect managers whose firms are in highly competitive markets to face greater challenges meeting performance targets, encouraging these managers to engage in earnings manipulation.

Table 6 reports the regression results and mechanism test results for financial restatement and earnings management based on competition. Column 2 shows that in the high-competition sample, management shareholdings are positively associated with financial restatement and significant at the 1% level. This association is not significant when there is low competition. Columns 4 and 5 show that in both the low- and high-competition industry samples, shareholdings are positively associated with earnings management, and both results are significant at the 1% level. Columns 3 and 6 show that *Risk* is positively associated with financial restatement and earnings management, and both results are significant at the 10% level.

The Sobel Z value for restatement, reported at the foot of Table 6, is 1.638 and significant at the 10% level, while the Sobel Z value for earnings management is 1.645 and also significant at the 10% level. This finding implies that managers in low-competition industries are more risk-averse than those in high-competition industries, suggesting that the latter are more likely to manipulate financial performance than the former when facing performance challenges. This finding is inconsistent with Hass et al. (2016), according to whom equity incentives have a significantly positive effect on corporate fraud in both competitive and non-competitive industries. As mentioned above, this divergence may be due to differences in sample size, measurement proxies and/or data sources.

5.2.2. Moderating role of institutions

Institutional investors play a central role in accounting choices (Cumming and Walz, 2010; Bird and Karolyi, 2016). In the context of earnings management, studies show that institutional ownership is negatively related to earnings management (e.g. Bushee, 1998; Chung et al., 2002). We expect that managers whose firms are owned to a greater extent by institutional investors may face greater monitoring intensity, which may discourage them from engaging in earnings manipulation.

Table 7 reports the regression and mechanism test results for financial restatement and earnings management based on institutional ownership. Column 1 indicates that in the low institutional ownership sample, management shareholdings are positively associated with financial restatement, which is significant at the 1% level; however, this association is insignificant when there is high institutional ownership. Columns 4 and 5 show that in both the low and high institutional ownership samples, shareholdings are positively associated with earnings management and significant at the 1% and 10% levels, respectively. Columns 3 and 6 show that *Risk* is weakly significant (i.e. at the 10% level) and positively associated with financial restatement and earnings management. The Sobel Z value for restatement, reported at the foot of the table, is 1.704 and significant at the 10% level, while the Sobel Z value for earnings management is 1.660 and also significant at the 10% level. This finding implies that managers in high institutional ownership firms are more risk-averse than those in low institutional ownership firms, suggesting that the latter are more likely to manipulate financial performance than the former when facing performance challenges.

Table 8
Robustness tests for financial restatement involving earnings manipulation and profit inflation.

Variable	(1) *Restate_p*	(2) *Restate_p*	(3) *Restate_up*	(4) *Restate_up*
Shareholding	**0.995****	**1.176***	**1.661*****	**2.210*****
	(2.08)	**(1.96)**	**(2.89)**	**(3.06)**
Board		0.017		0.033
		(0.37)		(0.53)
Z		0.009***		−0.003
		(2.94)		(-0.48)
Num		0.045**		0.053**
		(2.39)		(2.25)
Big4		−1.509*		−1.281
		(-1.88)		(-1.16)
Btm		−0.088		0.748
		(-0.14)		(0.92)
Returns		−0.253		−0.081
		(-1.58)		(-0.34)
Inventory		−0.552		−0.319
		(-0.70)		(-0.29)
Receivable		−0.474		1.184
		(-0.52)		(1.02)
Size		0.222*		0.081
		(1.86)		(0.50)
Lev		−0.454		−1.400**
		(-0.85)		(-2.01)
Roa		−6.381***		−5.931***
		(-4.40)		(-3.16)
Cash		−0.129		0.068
		(-0.18)		(0.07)
Growth		0.047		−0.177
		(0.21)		(-0.69)
Age		−0.014		−0.014
		(-0.96)		(-0.70)
Intangible		0.181		1.812
		(0.16)		(1.26)
Constant	−2.031***	−8.107***	−4.743***	−6.767**
	(-5.40)	(-3.45)	(-4.22)	(-2.05)
Year	YES	YES	YES	YES
Industry	YES	YES	YES	YES
N	2,546	2,546	2,546	2,546
Pseudo R^2	0.080	0.132	0.149	0.138

Note. This table presents the results of robustness tests using logit model regressions separately estimated on samples featuring earnings manipulation and profit inflation as a function of equity incentives and control variables. All of the variables are defined in Appendix A. z-statistics appear in curved brackets and are based on standard errors clustered by firm and year. ***, ** and * indicate 1%, 5% and 10% significance levels, respectively.

5.3. Robustness tests

5.3.1. Alternative measures

To test the robustness of our results, we use alternative proxies to replace restatement, earnings management and the measure of shareholding. First, we limit the sample of financial restatements to review the impact of equity incentives on profit restatements. The total sample observation thus becomes 2,546 (21,216 × 0.12). For this test, we replace the original financial restatement with a dummy variable to indicate whether a profit restatement occurred and a dummy variable to indicate whether there was an increase in profit. We use *Restate_p* (a dummy variable set to 1 for restatements involving earnings manipulation only) and *Restate_up* (which is identical to *Restate_p* but set to 1 only if profits are overstated) as alternatives to *Restatement*.

Table 9
Alternative measures of shareholding and discretionary accruals.

Variable	(1) *Restatement*	(2) *DA*	(3) *DA_DD*	(4) *DA_Perf*
Shareholding_log	**0.694*****	**0.025*****		
	(2.60)	**(3.76)**		
Shareholding			**0.011*****	**0.027*****
			(2.74)	**(3.82)**
Board	0.010	−0.000	−0.000	−0.000
	(0.68)	(-0.34)	(-0.91)	(-0.80)
Z	0.000	0.000*	0.000	0.000**
	(0.44)	(1.77)	(0.80)	(2.18)
Num	−0.002	0.000**	0.000**	0.000
	(-0.32)	(2.26)	(2.16)	(1.57)
Big4	−0.289**	−0.022***	−0.013***	−0.025***
	(-2.51)	(-9.58)	(-6.15)	(-7.72)
Btm	−0.195	0.002	0.014***	0.010**
	(-1.32)	(0.62)	(4.16)	(1.99)
Returns	−0.038	−0.001	0.002**	−0.002
	(-0.84)	(-1.00)	(2.01)	(-1.35)
Inventory	−0.220	0.068***	0.021***	0.088***
	(-1.18)	(10.32)	(3.87)	(11.16)
Receivable	−0.663***	0.085***	0.034***	0.144***
	(-2.67)	(12.53)	(6.02)	(15.16)
Size	−0.048	0.004***	0.003***	0.007***
	(-1.61)	(4.80)	(3.33)	(5.95)
Lev	0.585***	−0.040***	−0.036***	−0.052***
	(4.21)	(-8.80)	(-7.55)	(-9.15)
Roa	−2.447***	−0.010	0.702***	0.531***
	(-5.58)	(-0.69)	(42.50)	(29.04)
Cash	−0.275	−0.099***	−0.043***	−0.091***
	(-1.40)	(-17.79)	(-10.53)	(-13.34)
Growth	0.215***	−0.001	−0.027***	−0.024***
	(3.08)	(-0.50)	(-12.44)	(-7.70)
Age	0.007*	−0.000*	−0.000**	−0.000
	(1.65)	(-1.81)	(-2.11)	(-1.50)
Intangible	0.330	−0.073***	−0.039***	−0.069***
	(0.99)	(-9.53)	(-5.24)	(-6.51)
Constant	−0.504	−0.069***	−0.052***	−0.135***
	(-0.85)	(-4.19)	(-3.26)	(-6.11)
Year	YES	YES	YES	YES
Industry	YES	YES	YES	YES
N	21,216	21,216	21,216	21,216
Adj/Pseudo R^2	0.029	0.053	0.466	0.189

Note. This table presents the results of robustness tests using different measures of shareholding and discretionary accruals (modified Jones model, Dechow and Dichev, 2002; Kothari et al., 2005). All of the variables are defined in Appendix A. t-statistics appear in curved brackets and are based on standard errors clustered by firm and year. ***, ** and * indicate 1%, 5% and 10% significance levels, respectively.

Table 8 presents the results of the robustness tests focusing on financial restatement. Columns 2 and 4 show that managers' shareholdings are significantly positively associated with restatement.

Second, we use an alternative definition to measure managers' shareholdings and earnings management. First, to mitigate the concern of skewness of shareholding, we use a log-transformed measure to address this issue. We define *Shareholding_log* as the logarithm of 1 plus *Shareholding*. The second alternative measure is based on discretional accruals (*DA_DD* and *DA_Perf*) as described by Dechow and Dichev (2002) and Kothari et al. (2005). Table 9 presents this analysis and demonstrates that our main results continue to hold.

Table 10
Robustness tests for financial restatement using PSM methods.

Panel A

Variable	Matched-sample mean		%bias	*t*-test
	Treated	Control		
Big4	0.067	0.064	1.3	0.73
Size	22.016	21.989	2.1	1.25
Lev	0.502	0.486	7.2	4.53
Roa	0.032	0.034	−3.6	−1.65
Cash	0.166	0.169	−2.3	−1.47
Growth	0.117	0.120	−1.0	−0.64

Panel B

	(1) Restatement PSM	(2) DA PSM
Shareholding	**0.633****	**0.029*****
	(2.02)	**(3.64)**
Board	0.005	−0.000
	(0.27)	(-0.10)
Z	0.003	0.000
	(1.45)	(0.44)
Num	0.003	0.000**
	(0.45)	(2.36)
Big4	−0.325**	−0.024***
	(-2.11)	(-8.90)
Btm	−0.177	−0.002
	(-0.89)	(-0.34)
Returns	−0.064	−0.001
	(-1.16)	(-0.72)
Inventory	−0.100	0.067***
	(-0.40)	(8.69)
Receivable	−0.584*	0.070***
	(-1.70)	(8.19)
Size	−0.049	0.005***
	(-1.17)	(4.58)
Lev	0.504**	−0.041***
	(2.51)	(-6.63)
Roa	−2.167***	0.013
	(-3.86)	(0.71)
Cash	−0.670**	−0.111***
	(-2.47)	(-14.76)
Growth	0.076	−0.004
	(0.89)	(-1.24)
Age	0.004	−0.000**
	(0.76)	(-2.52)
Intangible	0.456	−0.071***
	(1.13)	(-8.26)
Constant	−0.480	−0.080***
	(-0.57)	(-3.99)
Year	YES	YES
Industry	YES	YES
N	14,748	14,748
Adj/Pseudo R^2	0.084	0.188

Note. This table presents results of the PSM analysis related to financial restatement (5,276 observations). For the PSM method, matching with non-restating firms was based on firm size, leverage, ROA and cash flow. All of the variables are defined in Appendix A. t (z)-statistics appear in curved brackets and are based on standard errors clustered by firm and year. ***, ** and * indicate 1%, 5% and 10% significance levels, respectively.

Table 11
Robustness tests: Heckman test.

	(1)		(2)	(3)
	First-stage		Second-stage	
Variable	*Shareholding*		*Restatement*	*DA*
Big4	−0.409***	*Shareholding*	**0.509*** **	**0.021*** **
	(-4.17)		**(4.03)**	**(3.25)**
Size	0.147***	*Board*	−0.005	−0.000
	(7.81)		(-0.56)	(-0.27)
Lev	−0.873***	*Z*	0.000	0.000**
	(-8.03)		(0.65)	(1.99)
Roa	0.897***	*Num*	0.002	0.000*
	(3.10)		(0.71)	(1.88)
Cash	0.071	*Big4*	−0.192***	−0.022***
	(0.48)		(-2.79)	(-7.28)
Growth	0.048*	*Btm*	−0.102	0.002
	(1.72)		(-1.42)	(0.50)
Shareholding_avg	8.941***	*Returns*	−0.047**	−0.001
	(9.56)		(-1.97)	(-0.97)
		Inventory	−0.183	0.068***
			(-1.55)	(9.03)
		Receivable	−0.152	0.085***
			(-1.02)	(9.85)
		Size	−0.004	0.004
			(-0.07)	(1.13)
		Lev	0.236	−0.040
			(0.36)	(-0.97)
		Roa	−1.549**	−0.011
			(-2.52)	(-0.28)
		Cash	−0.242	−0.100***
			(-1.22)	(-8.43)
		Growth	0.102	−0.001
			(1.60)	(-0.35)
		Age	0.007***	−0.000
			(2.84)	(-1.45)
		Intangible	0.182	−0.073***
			(0.94)	(-7.43)
		IMR	−0.134	−0.001
			(-0.12)	(-0.02)
Constant	−2.965***	*Constant*	−0.849	−0.068
	(-7.19)		(-0.50)	(-0.65)
Year	YES	Year	YES	YES
Industry	YES	Industry	YES	YES
N	21,216	N	21,216	21,216
Pseudo R^2	0.099	Adj/Pseudo R^2	0.062	0.113

Note. This table presents the results of the Heckman test derived from the estimation of financial restatement as a function of equity incentives and control variables. Column 3 presents the results of a probit model regression. All of the variables are defined in Appendix A. t (z)-statistics appear in curved brackets and are based on standard errors clustered by firm and year. ***, ** and * indicate 1%, 5% and 10% significance levels, respectively.

5.3.2. Tests using PSM analysis

In this subsection, we use PSM analysis to control for observed differences between firms with different levels of equity incentive. Specifically, to obtain propensity scores, we set an indicator variable, *Shareholding_dum*, which equals 1 if the firm implements an equity incentive plan, and 0 otherwise. We run a logit regression to calculate the likelihood of a firm's having an equity incentive plan (*Shareholding_dum* = 1), which estimates the function on firm-level financial characteristics. Following Rosenbaum and Rubin (1983), Efendi et al.

Table 12
Robustness tests using lagged values of control variables.

Variable	(1) *Restatement*	(2) *Risk*	(3) *Restatement*	(4) *DA*	(5) *DA*
Shareholding	**0.732*****	**2.072****	**0.619*****	**0.027*****	**0.021*****
	(3.24)	**(2.14)**	**(2.83)**	**(4.58)**	**(4.10)**
Risk			**0.003****		**0.006****
			(2.12)		**(2.31)**
Board	0.016	0.046	0.016	−0.000	−0.000
	(1.09)	(0.63)	(1.09)	(-0.87)	(-0.84)
Z	0.000	−0.005	0.000	0.000	0.000
	(0.15)	(-0.85)	(0.14)	(1.57)	(1.50)
Num	−0.005	0.024	−0.005	0.000*	0.000*
	(-0.85)	(0.81)	(-0.85)	(1.72)	(1.69)
Big4	−0.433***	0.305	−0.432***	−0.026***	−0.026***
	(-3.37)	(0.85)	(-3.37)	(-10.39)	(-10.46)
Btm	−0.221	1.621***	−0.219	0.008*	0.010**
	(-1.37)	(2.96)	(-1.36)	(1.80)	(2.09)
Returns	−0.070	−0.138	−0.071	−0.001	−0.002
	(-1.25)	(-0.50)	(-1.26)	(-0.47)	(-1.13)
Inventory	−0.296	1.496*	−0.294	0.072***	0.073***
	(-1.47)	(1.74)	(-1.47)	(10.14)	(10.16)
Receivable	−0.622**	0.013	−0.622**	0.143***	0.143***
	(-2.40)	(0.01)	(-2.40)	(18.81)	(18.82)
Size	−0.034	−0.358***	−0.035	0.007***	0.006***
	(-1.06)	(-2.58)	(-1.08)	(7.05)	(6.87)
Lev	0.554***	−0.412	0.554***	−0.046***	−0.046***
	(3.71)	(-0.61)	(3.70)	(-8.96)	(-9.10)
Roa	−2.828***	3.096	−2.825***	0.516***	0.517***
	(-5.95)	(1.38)	(-5.95)	(29.34)	(29.36)
Cash	−0.275	1.926*	−0.272	−0.089***	−0.089***
	(-1.34)	(1.80)	(-1.32)	(-15.01)	(-15.04)
Growth	0.317***	−0.667**	0.316***	−0.022***	−0.022***
	(4.34)	(-2.09)	(4.32)	(-6.84)	(-6.90)
Age	0.010**	0.053***	0.010**	−0.000	−0.000
	(2.32)	(3.32)	(2.34)	(-1.61)	(-1.57)
Intangible	0.465	−0.827	0.464	−0.075***	−0.075***
	(1.31)	(-0.73)	(1.30)	(-8.75)	(-8.74)
Constant	−1.623**	11.341***	−1.596**	−0.141***	−0.140***
	(-2.54)	(4.10)	(-2.50)	(-7.57)	(-7.52)
Year	YES	YES	YES	YES	YES
Industry	YES	YES	YES	YES	YES
N	18,671	18,671	18,671	18,671	18,671
Adj/Pseudo R^2	0.083	0.122	0.086	0.179	0.185
Sobel Z-value			1.866*		1.993**

Note. This table presents the results of the robustness test using the lagged values of control variables. All of the variables are defined in Appendix A. t (z)-statistics appear in curved brackets and are based on standard errors clustered by firm and year. ***, ** and * indicate 1%, 5% and 10% significance levels, respectively.

(2005) and Erickson et al. (2006), the variables used in the PSM approach include *Big4*, *Size*, *Lev*, *Roa*, *Cash* and *Growth*. Thereafter, we construct a one-to-one match with no replacement, using a caliber distance of 0.03 from those firms without equity incentive plans (*Shareholding_dum* = 0) to form the control group. In Panel A of Table 10, the results show that after using PSM, the difference in all of the control variables between the two groups becomes smaller and not significant.

Panel B of Table 10 presents results from the PSM tests, focusing on financial restatement and discretionary accruals (14,748 observations). Columns 1 and 2 show that managers' shareholdings are significantly posi-

tively associated with restatement and discretionary accruals, consistent with the regression results reported in our main findings.

5.3.3. Heckman tests

Although we document a significant and positive association between manager shareholdings and financial misreporting, our results may suffer from selection bias. For example, managers of firms with lower profits have greater incentive to misreport. To improve firm performance, shareholders are more likely to implement equity incentives for managers, which can cause self-selection bias. Accordingly, in this subsection, we use the Heckman two-stage test to mitigate this endogeneity concern.

In the first stage, we construct a probit model to estimate the probability of firms' having equity incentive plans. We consider the following firms' factors in the estimation: *Big4*, *Size*, *Lev*, *Roa*, *Cash* and *Growth*. As the Heckman model requires an exogeneous variable, we use the industry average value of *Shareholding*, excluding the firm concerned (*Shareholding_avg*), to satisfy this requirement. Firms with similar industry conditions may share a common incentive to implement an equity incentive plan; thus, *Shareholding_avg* is likely to be positively associated with *Shareholding*. However, a firm's own incentive may not be correlated with other firms' decisions on equity incentives.

The results of the first stage regression are reported in Panel A of Table 11. We find that the coefficient of *Shareholding_avg* is positively significant at the 1% level, suggesting that the exogenous variables are valid. The first stage regression generates the inverse Mills ratio (*IMR*), and we include this in the second stage regression to control for self-selection bias. The other control variables in the second stage model are the same as those in Eq. (1) and Eq. (2). We report the results of the second stage regression in Panel B of Table 11. The results show that the coefficients on *Shareholding* remain positive and statistically significant, consistent with our main findings.

5.3.4. Lagged values analysis

Our findings suggest that increased managers' shareholdings are associated with increased levels of earnings management. However, there is a possibility of reverse causation in our regression models. To mitigate this, we estimate our models using lagged values of the dependent variable and all of the control variables. Table 12 presents the results of these tests, which verify the primary findings.

In summary, the regression, PSM, Heckman test analyses and endogeneity test all yield consistent results, supporting the conclusion that shareholdings motivate managers to misreport firm performance. These results are consistent with H1, which states that managers' equity incentives encourage financial misreporting and that the risk effect of business is one of the main mechanisms that motivate managers to manipulate corporate performance.

These findings indicate that aversion to business risk alters managers' motivations in a way that is dependent on differences in firms' structure, competition and institutional ownership. SOE managers are more risk-averse than non-SOE managers due to the higher costs associated with equity risk. Risk imposes an additional burden on SOE managers, who must contend with not only market pressures but also pressures coming from the external governance environment, including local governments, State Asset Supervision and Administration Commission (SASAC), third-party supervision and the firms' certified public accountants and employees. Their motivation to manipulate performance is therefore blunted.

Furthermore, the more competitive the market, the more difficult it is to achieve performance targets. Thus, managers in more competitive markets may be willing to assume greater risk to manipulate financial performance, while those in less competitive markets, facing reduced performance pressures, have weaker incentives to take the risk of managing reported performance. The managers whose firms are more heavily owned by institutional investors face greater monitoring intensity than those in low institutional ownership firms, which makes them more risk-averse. When facing performance challenges, the risk effect of equity incentives may discourage these managers from engaging in earnings manipulation.

Our findings explain why performance misreporting by firms remains prevalent in the context of the anti-corruption campaign and a stricter corporate governance environment. Namely, the managers of non-SOEs, of firms in highly competitive industries and of firms with low institutional ownership may be less risk-averse in relation to equity incentives than their respective peers. This finding also suggests that the risk effects associated with equity incentives can help to mitigate SOEs' "absence of ownership" problem.

6. Concluding remarks

This study explores the relationship between equity incentives and financial misreporting in 2,708 cases of financial restatement for the 2007–2017 period. Our results show a significant positive association between managers' shareholdings and the manipulation of their firms' reported performance. Based on the unique ownership structures and corporate governance regime prevailing in China and taking the risk effect associated with equity incentives into consideration, our findings suggest that the motivation of managers to manipulate firms' reported performance is more significant in non-SOEs (vs. SOEs), highly competitive (vs. less competitive) industries and low (vs. high) institutional ownership firms. These findings are attributed to the potential for risk aversion-related mechanisms to mitigate managers' motivation to manipulate firms' performance in SOEs, less competitive industries and high institutional ownership firms. Our results present empirical evidence suggesting that the anti-corruption campaign in China has increased managers' risk-aversion. However, much of the evidence is in line with findings in the literature and consistent with the observation that the number of cases of financial misreporting in China has been increasing. The robustness tests in our study yield estimates consistent with our hypotheses.

Important policy implications for enhancing the efficiency of the Chinese stock market can be derived from these results. For example, the CSRC should adjust provisions regarding equity incentives to restrict managers' ability to engage in self-interested behavior through earnings manipulation. This restriction should be imposed on managers of non-SOEs, of firms in highly competitive industries and of firms with low institutional ownership, possibly by exploiting their aversion to business risk. Tougher regulation of equity incentives could better align the interests of managers and their shareholders.

This study presents empirical evidence on the relationship between equity incentives and financial misreporting in China, especially the influence of shareholding and differences in levels of competition and institutional ownership. However, to overcome the limitations of this study, future research should further clarify differences in the influences on managers' motivation regarding fraudulent activity, restatement and earnings manipulation. The study uses *Risk* as a proxy for business risk, capturing mediation effects in the analysis between equity incentives and misreporting, which means that the results should be interpreted with caution, as other stakeholders, such as the CEO or CFO, may also exert influence on a firm's business risk. The risk effect associated with equity incentives should be examined in greater detail and in consideration of the characteristics of the Chinese stock market.

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.

Appendix A. Definitions of variables

Dependent variable	Definition	Source
Restatement	Dummy variable. Equals 1 for any year in which a firm issues a financial restatement, and 0 otherwise.	http://www.dibdata.cn/#/product/2/risk; http://www.csrc.gov.cn/pub/zjhpublic/index.htm?/channel/3300/3313.

Restate_p	Dummy variable. Equals 1 for any year in which a firm issues a financial restatement that affects earnings, and 0 otherwise.	http://www.dibdata.cn/#/product/2/risk; http://www.csrc.gov.cn/pub/zjhpublic/index.htm?/channel/3300/3313.
Restate_up	Dummy variable. Equals 1 for any year in which a firm issues a financial restatement correcting an overstatement of profit, and 0 otherwise.	http://www.dibdata.cn/#/product/2/risk; http://www.csrc.gov.cn/pub/zjhpublic/index.htm?/channel/3300/3313.
DA	The value of discretionary accruals, based on the modified Jones model (Dechow and Sloan, 1995).	http://www.dibdata.cn/#/product/2/risk; CSMAR; firm annual reports
Independent variable	Definition	Source
Shareholding	Percentage of equity shares held by the top management members, multiplied by 100.	CSMAR
Control variable	Definition	Source
Board	Number of board members.	CSMAR
Z	Z score (Altman, 1968)	CSMAR
Num	Number of top management team members.	CSMAR
Big4	Dummy variable. Equal to 1 if the firm is audited by a Big 4 auditor, and 0 otherwise.	CSMAR
Btm	Ratio of book value of equity to market value of equity.	CSMAR
Returns	Market-adjusted annual returns on a monthly basis.	CSMAR
Inventory	Ratio of inventory to total assets.	CSMAR; firm annual reports
Receivable	Ratio of accounts receivable to total assets.	CSMAR; firm annual reports
Size	Natural logarithm of assets.	CSMAR
Lev	Ratio of total liabilities to total assets.	CSMAR
Roa	Return on assets.	CSMAR
Cash	Natural logarithm of ratio of cash to total assets.	CSMAR
Risk	The rolling standard deviation of volatility of firm earnings within 5 years.	
Age	Number of years the firm has been listed on the stock market.	CSMAR
Intangible	Ratio of research and development and advertising expenditure to sales.	CSMAR; firm annual reports
Growth	Change in sales scaled by previous-period sales.	CSMAR
Other variables	Definition	Source
SOE	Dummy variable. Equals 1 if enterprise is owned by the state, and 0 otherwise.	CSMAR
HHI	Below-median HHI industrial concentration indicates high competition, and above-median indicates low competition.	CSMAR
Inst	Ratio of ownership held by institutional investors in a firm.	CSMAR

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Stock market restrictions and corporate social responsibility: Evidence from IPO suspension in China

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ABSTRACT

Improving corporate social responsibility (CSR) requires not only the efforts of firms themselves but also the support of the appropriate institutional environment. This paper assesses whether access to the stock market can promote firms' CSR. Using China's suspension of IPOs in 2012–2014, we find that firms affected by the suspension show lower CSR in their listing year. The later listing after the suspension ends, the greater reduction in CSR. Moreover, the effect of the IPO suspension is more serious for firms with financial constraints than for non-financially constrained firms. Furthermore, we show that the IPO suspension has an adverse impact on firms' liquidity and profitability. When this suspension ends, firms' CSR activities recover within 1–2 years. Overall, our conclusion enriches the literature on the factors influencing CSR and provides firm-level evidence of the adverse impact of an IPO suspension.

1. Introduction

While the development of enterprises has brought with it outstanding economic achievements, social problems such as deceiving investors, squeezing employees, and polluting the environment have also attracted attention. Investigating how to promote corporate social responsibility (CSR) has significant theoretical and practical value. Most of the literature focuses on how firm-level or stakeholder-level characteristics influence CSR (e.g., Agle et al., 1999; Porter and Kramer, 2006; Dyck et al., 2019; Chen et al., 2020). Several researchers focus on how external environmental factors such as the local community affect CSR (e.g.,

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Marquis et al., 2007).[1] Given the growing scholarly attention paid to CSR, there is more space to study the impact of external financial factors on CSR.

In this paper, we seek to understand whether and how the stock market can influence firms' CSR activities. The relationship between the stock market and CSR can be positive or negative. On the one hand, by allocating resources, the stock market reduces information asymmetry in corporate financing, lowers financing costs, and provides the necessary funds for CSR. On the other hand, conflicts between the stock market and firm managers may hurt CSR. The stock market has limited access to the non-financial information that reflects the intrinsic value of a firm. Due to stock market pressure, managers concerned about their stock price are more likely to adopt short-sighted behaviors (e.g., Stein, 1989; Fang et al., 2014), thereby reducing CSR investment. Scholtens (2006) concludes that the stock market has a minimal effect on CSR. Thus, whether the stock market is beneficial to CSR remains controversial.

Reverse causality may be a problem when researching the direct influence of the stock market on CSR. Specifically, suppose that our empirical results show a positive relationship between entering the stock market and CSR. In that case, a possible alternative explanation is that companies with higher CSR are more likely to enter the stock market. Theoretically, CSR may attract investor attention and help firms obtain financing. Conversely, if stock market awareness is insufficient, firms may delay entering the market (Lucas and McDonald, 1990). In practice, firms with lower CSR do not meet the requirement of sustainable development and find it more challenging to pass regulatory authorities' reviews. Therefore, a simple empirical design is insufficient to test our research problem effectively, so this study must be conducted through unique scenarios.

We take the suspension of initial public offerings (hereafter "IPO suspension") imposed by the CSRC in 2012 as a quasi-natural experiment to test the impact of exogenous stock market restrictions on the post-listing CSR behavior of firms. There are two reasons why we choose this event as a quasi-natural experiment. First, an IPO is a critical way for firms to tap the stock market for financing. The impact of an IPO suspension can, to a certain extent, reflect the influence the stock market has on firms. Furthermore, the suspension is determined by the Chinese government rather than the firms. The CSRC is unlikely to be influenced by CSR activities to decide on the suspension. We define firms listed before the suspension as the control group, and firms that should be listed close to the control group but whose listing date is delayed due to the IPO suspension as the treatment group.

We first explore whether firms affected by the IPO suspension decrease their CSR activities. We test whether the treatment group has lower CSR performance, controlling for several firm-level variables and industry and listing year fixed effects. We find that the IPO suspension is associated with lower CSR scores, including less responsible behavior toward shareholders, suppliers, customers and consumers, the environment, and society at large. Additionally, we find that the number of days between the IPO suspension and the listing date has no impact on CSR in the control group but is negatively related to CSR in the treatment group, which means that firms seriously affected by the IPO suspension engage in less CSR activities.

We next conduct several robustness tests to verify our results. First, we use several placebo tests to exclude the impact of the order in which firms are listed and find no relationship between the IPO suspension and CSR in the fake events. Second, we consider the alternative explanation that our result is caused by stock market performance instead of the IPO suspension. We test the relationship between the return on a firm's stock during the listing year and CSR and exclude this explanation. Third, we consider omitted variables, including liquidity, raising funds in the IPO, and state ownership. We also change the measurement of CSR and the definition used for the control group. Our results are unaffected.

We then ask how the IPO suspension can influence CSR. We propose three possible channels, namely financial constraints, the exit of Venture Capital/Private Equity (VC/PE) and institutional investors, and accounting information quality. Our results show that firms with more financial constraints show lower CSR when affected by the IPO suspension. Instead, the exit of external investors and the quality of accounting information are less likely to explain the relationship between the IPO suspension and CSR.

[1] For more drivers of CSR, see the literature reviews in Carroll and Shabana (2010), Aguinis and Glavas (2012), and Frynas and Yamahaki (2016).

Finally, we conduct two additional analyses. We find that the IPO suspension can affect a firm's profitability and liquidity. We also find that this suspension can reduce CSR only in the short term after it ends. In the second and third years after recovery from the IPO suspension, any significant negative effect disappears.

Overall, our empirical results support the view that the stock market can promote CSR. We provide consistent evidence that firms affected by restrictions on stock market access have poor CSR performance. The findings suggest that financial constraints caused by these restrictions are the reason that firms reduce their CSR activities.

Our paper contributes to explanations for CSR. CSR is a traditional concept in management, but financial scholars have paid more attention to CSR in recent years (e.g., Fatemi et al., 2015; Ferrell et al., 2016; Lins et al., 2017; Dyck et al., 2019). In this context, this paper explores the impact of stock market access on CSR and finds that restricted market access plays a significant role. In contrast to papers that focus on firms' financial constraints to explain CSR investments (e.g., Erhemjamts et al., 2013), our research is closer to the real stock market, and our identification strategy has fewer endogeneity concerns.

Our paper also contributes to the literature that explores the negative impact of an IPO suspension. Studies show that an IPO suspension can decrease affected firms' performance, R&D, and innovation output (Song and Xin, 2017; Cui and Yang, 2018; Cong and Howell, 2021). Our paper offers evidence that an IPO suspension harms CSR. Additionally, we propose three channels to explain the results of an IPO suspension. In contrast to Cong and Howell (2021), who show that innovation by VC/PE-backed firms is more likely to be affected by an IPO suspension, we find that the financial constraint channel better explains how this suspension influences CSR.

The paper proceeds as follows. Section 2 briefly describes the related literature. Section 3 shows the institutional background and develops our hypothesis. Section 4 introduces the data and empirical strategies. Section 5 presents the results of our analysis. Section 6 discusses the underlying channels and other related results. Section 7 concludes the paper.

2. Literature review

In this section, we briefly sort through prior research to show that CSR is a long-term investment and discuss the impact of going public on firms.

2.1. CSR is a long-term investment

CSR is not only a requirement of corporate strategy or business ethics but also brings benefits to the firm. Several studies note the positive impact of CSR on many aspects of firms. There is much research that investigates whether CSR can benefit a firm's economic returns. For instance, Russo and Fouts (1997) find a positive relationship between environmental performance and economic performance, and this relationship strengthens with industry growth. Dimson et al. (2015) report that firms with CSR activities can gain an abnormal return of 7.1% on stock price. The market reaction is stronger when firms' activities concern climate change or corporate governance. Meanwhile, CSR can have many positive impacts on enterprises. In terms of financing, Goss and Roberts (2011) find that companies with lower CSR have higher borrowing costs. El Ghoul et al. (2011) also find a negative relationship between CSR and firms' equity cost. As for investing, Deng et al. (2013) examine the role of CSR in mergers and acquisitions. They find that acquirers with greater CSR can get more out of a merger in both the short and long run. Additionally, firms in China can use CSR to build political connections (Lin et al., 2015).[2]

Fatemi et al. (2015) suggest that CSR can affect firms' growth, cost of capital, and survival. They develop a valuation model to balance the profits and expenses of CSR and indicate that the cost of CSR can create value for shareholders over an extended period. In summary, from a financial perspective, CSR is essentially a long-term investment project.

[2] For more information on CSR and corporate finance, see Fatemi et al. (2015).

2.2. The impact of the IPO on firms

One of the essential functions of the stock market is to reduce information asymmetry and provide financing channels for corporate investment. Meanwhile, an IPO is one of the most important ways for firms to join the stock market. Research suggests that the direct impact of an IPO on firms is reflected in the following three aspects. First, compared with private equity, an IPO can provide funds with lower cost and less risk. Chemmanur and Fulghieri (1999) suggest that the risk premium demanded by venture capitalists is more significant because such investors are not fully diversified and require higher returns from their holdings. Pástor et al. (2008) argue that going public can reduce risk because a portfolio of stocks is less risky than an investment concentrated in a private firm. Second, an IPO can reduce the information asymmetry between firms and stakeholders due to information disclosure requirements. Pagano et al. (1998) find that going public can reduce credit costs because public information disclosure can decrease information asymmetry and risk. Another reason is that an IPO gives firms a better chance of obtaining external funds, which reduces banks' bargaining power. Maksimovic and Pichler (2001) conclude that an IPO can boost trust among stakeholders, including potential investors, customers, suppliers, and creditors, increasing the firm's value. Finally, the separation of ownership and control caused by an IPO may exacerbate the agency problem of enterprises, which can change managers' motivations and behaviors (Bertrand and Schoar, 2003).

However, researchers do not produce consistent results on the relationship between an IPO and corporate investment. On the one hand, much research shows a negative impact on corporate investment after going public. Asker et al. (2015) compare the investment behavior of similar public and private firms and find that public firms, influenced by short-term pressure, invest less and are less responsive to changes in investment opportunities than private firms. Graham et al. (2005) argue that managers may reject a project that will affect earnings in the current quarter, even though the project's net present value (NPV) is positive in the long run. They contend that stock market investors cannot assess the value of long-term projects. Kong et al. (2015) propose three reasons why a firm's productivity declines after an IPO: managers prefer to invest in traditional projects due to the agency problem; if firms have to disclose related information when competing for patents, their strength decreases; and the residual claim for innovation is lower after going public. In contrast, others such as Gilje and Taillard (2016) examine individual projects in the U.S. natural gas industry and conclude that private firms are less responsive than public firms to changes in investment opportunities. That is, a public listing can mitigate the underinvestment problem.

Overall, the impact of an IPO on corporate investment remains controversial, which may be caused by different perceptions of the IPO. Some researchers consider that an IPO reduces the information asymmetry between investors and firms, whereas others emphasize that an IPO is a process of separating ownership and control, which creates agency problems. An IPO is a complex process, including changes in factors such as obtaining funds, information disclosure, equity diversification, and beginning public market transactions. It is difficult for researchers to separate different influences when comparing public and private firms. However, China's IPO suspension offers a new perspective in IPO studies. The suspension extends only the duration of the IPO process; however, when going public, firms also need to disclose relevant information and experience agency problems. Therefore, the IPO suspension allows us to design an empirical test that can eliminate much of the interference from external factors and draw accurate conclusions about firms' approach to CSR.

3. Institutional background and hypothesis development

This section introduces the background to the IPO suspension and explains why this suspension can affect CSR.

3.1. Institutional background

Although China's stock market registration system is undergoing reform, the listing process is still the approval system for most firms. It requires firms going public to meet the conditions stipulated by the CSRC in terms of net assets, income, profits, and many related aspects. The approval-based IPO process has a long

waiting time and great uncertainty. In addition to the complicated and strict listing rules, another reason is the IPO suspension policy implemented by the CSRC from time to time.

An IPO suspension refers to an administrative intervention ordered by the CSRC to stabilize the stock market based on conditions at the time (Song and Xin, 2017). From 1994 to 2018, there were nine IPO suspensions in the Chinese stock market. Most of these suspensions occurred in bearish market conditions (Lee et al., 2019) with the longest suspension lasting from November 2, 2012 to January 17, 2014, for 441 days.[3] This suspension occurred as the European and American stock markets performed extremely well while the Chinese stock market continued to fall. The CSRC suspended all IPO reviews and launched a full-scale special inspection of the financial reports of firms going public.

Typically, the Public Offering Review Committee of the CSRC holds weekly working meetings to review items such as IPOs, issuance of convertible bonds, and announces the results on the CSRC website every week. The CSRC no longer reviews IPO firms when the suspension begins and will not make any of the usual announcements. There is no warning before the suspension begins or ends, so firms cannot predict whether or when the suspension will happen. Therefore, an IPO suspension is exogenous and can be regarded as a quasi-natural experiment.

3.2. Hypothesis development

In the IPO application stage, firms set out the investment projects they are raising funds for in a prospectus. However, if firms are affected by an IPO suspension, they will not obtain these funds in the expected time. We argue that an IPO suspension will not only affect the investment projects shown in the prospectus but also other investment activities of the firm.

According to the Modigliani–Miller Theorem (Modigliani and Miller, 1958), in a perfect market, an investment project is unaffected by how that firm is financed. Thus, even if firms experience an exogenous IPO suspension, they can immediately raise funds through bank loans or other methods to complete the planned investment projects. However, in reality, firms may have financial constraints due to information asymmetry and financial friction, leading to changes in their investment decisions, for four reasons. First, going public is a relatively low-cost financing method (Chemmanur and Fulghieri, 1999; Pástor et al., 2008) and cannot increase pressure on the capital structure. After an IPO suspension, using other financing channels to raise funds may increase financing costs, reduce the NPV of investment projects, and change firms' investment strategies. Second, in practice, a large amount of financing requires time, first for a firm to make its application, then for the financier to approve it, and finally for the financial intermediary's due diligence. Firms affected by an IPO suspension may fail to speedily obtain funds that should have been raised in the IPO through other channels and have to postpone or cancel their investment plans. Third, to succeed in the IPO approval process, firms are more likely to reduce debt as much as possible before the IPO, maintaining the status that the CSRC considers ''healthy.'' However, this approach means that firms do not have excess free cash flow for internal financing after an IPO suspension, increasing their financial constraints. Finally, policy uncertainty related to an IPO suspension may make financiers reluctant to supply funds as they also do not know when the suspension will end. In other words, an IPO suspension may negatively affect firms' other financing activities.

We concede that the purpose of IPO fundraising is generally not for CSR, but an IPO suspension will still have an adverse impact on CSR, for two reasons. First, an IPO suspension poses a challenge to cash flow and reduces liquidity. Even if IPOs resume, the funds obtained must be used for the projects described in the prospectus, but firms are still in the recovery stage of a liquidity crisis. Given the liquidity considerations, firms are more likely to choose investment projects with shorter payback periods and higher cash returns in the short term. However, CSR can only be effective in the long run (e.g., Aupperle et al., 1985). Related research finds that capital markets, especially in China, pay insufficient attention to CSR (Shen et al., 2012; Deng et al., 2013). Thus, investing in CSR is not the optimal choice for firms that experience an IPO suspension. Second,

[3] The last firm to list before this IPO suspension was Zhejiang Shibao Co., Ltd, which went public on November 2, 2012. The first firm to list after this IPO suspension was Neway Valve (Suzhou) Co., Ltd, which went public on January 1, 2014. No IPO took place between these two firms.

the profitability of firms may be significantly affected by an IPO suspension by making them postpone their investment plans and miss investment opportunities. Research suggests that firms with resource advantages, such as higher profitability, are more likely to carry out CSR activities (Waddock and Graves, 1997; Ferrell et al., 2016). Thus, when the firm's profitability fails to recover after a suspension, its level of CSR may still be low. Additionally, some CSR indicators do not improve output performance immediately because they require continuous, long-term input to be effective (McWilliams and Siegel, 2000).

Although CSR may benefit firms, it is unlikely that the required funds can be found in debt financing, for four reasons. First, the benefits of CSR are related to a firm's strategy and reputation, which cannot be fully measured by cash flow (Fatemi et al., 2015), while debt financiers pay more attention to whether the firm has the cash flow to repay a loan. Second, CSR has a long payback period and high uncertainty, factors that do not meet debt financing requirements. Third, similar to R&D, CSR activities usually cannot offer collateral, so banks are unlikely to provide loans for them. Finally, CSR may also be the form taken by agency costs incurred by managers seeking to enhance their reputation or cover up unethical behavior (Hemingway and Maclagan, 2004; Quan et al., 2015). These costs show a strong information asymmetry and are difficult for financiers to distinguish.

Above all, an IPO suspension has an adverse impact on corporate investment. Due to the impact on liquidity and profitability, affected firms' CSR investment declines. Based on the above analysis, we formulate our research hypothesis:

Hypothesis. Firms affected by an IPO suspension are likely to show lower CSR.

4. Sample and empirical strategy

In this section, we describe the sample construction, the key variables used in our empirical strategy, and our research design.

4.1. Sample and data source

We choose as our research event China's IPO suspension between November 2, 2012 and January 17, 2014, lasting 441 days, for three reasons. First, this suspension was the longest in the history of the Chinese stock market, which highlights its impact on affected firms. Second, our CSR data are only available after 2010. There are only two suspensions after that, and the other, which occurred between July and November 2015, only lasted approximately 4 months. Third, this suspension was caused by exogenous factors and is suitable for empirical investigation. We select firms planning to list around this IPO suspension as our research sample. Firms going public by reverse mergers are excluded as IPO suspensions do not influence reverse mergers.[4]

We obtain IPO firms and their related financial data from the China Stock Market and Accounting Research (CSMAR) database. The approval dates for firms going public are hand-collected from the CSRC website. VC/PE data are from the PEdata database. CSR performance data come from http://stockdata.stock.hexun.com/zrbg/. Section 4.2 gives more details about our sample.

4.2. Variables

We take CSR as our dependent variable. There are two common databases measuring listed Chinese firms' CSR performance: Rankins CSR Ratings (RKS) and http://stockdata.stock.hexun.com/zrbg/. RKS only contains firms that disclose CSR reports proactively, whereas http://stockdata.stock.hexun.com/zrbg/ evaluates all listed firms for their CSR performance every year. Most firms in our sample do not disclose CSR reports proactively. Therefore, we choose the index from http://stockdata.stock.hexun.com/zrbg/ as the measurement of CSR in this study. Hexun.com is a famous Chinese financial website that has released a rating score on

[4] In China, firms can go public through an IPO or reverse merger. IPO firms undergo review by the CSRC's Public Offering Review Committee, whereas reverse merger firms are reviewed by the CSRC's Restructuring and Merger Committee, which has different rules and is not influenced by an IPO suspension. See Lee et al. (2019).

listed firms' CSR performance since 2010. This index relies on a professional and authoritative evaluation system (Hu et al., 2018) related to shareholders, employees, suppliers, customers and consumers, the environment, and wider society, including 13 two-level and 37 three-level indicators. Firms in different industries are weighted differently so that they can be compared with each other.

The independent variable is whether a firm is influenced by the IPO suspension during the IPO process. Following Cong and Howell (2021), we define firms with an approval date before November 2, 2012 and with a listing date after January 17, 2014 as the treatment group influenced by the IPO suspension. Firms listing a year or less before the suspension, that is, between November 2, 2011 and November 2, 2012, are defined as the control group. We assume that firms with adjacent approval dates are similar because the order in which IPOs take place is random. To reduce potential differences between these two groups, firms that did not pass the CSRC's review are excluded. There are 66 firms in the treatment group and 188 firms in the control group in our study.

For firm-level control variables, we use firm size (*Size*; log of total assets), leverage (*Lev*; total debt divided by total assets), profitability (return on assets, *ROA*; earnings divided by total assets), and tangibility (property, plant, and equipment ratio, *PPER*; net value of fixed assets divided by total assets). We also include two variables (VC/PE-backed, *VC*, and PE ratio, *PERatio*) related to the IPO process, and two variables (CEO independence, *CEODep*, and independent director ratio, *IndepR*) related to corporate governance. Detailed definitions of the variables are provided in Table 1.

4.3. Regression model

Using the cross-sectional data of IPO firms, we estimate the following regression model to test the effect of the IPO suspension on CSR:

$$\mathrm{CSR}_{it} = \alpha + \beta Sus_i + \gamma X_{it-1} + Industry_i + year_t + \varepsilon \quad (1)$$

In this equation, CSR_{it} is the dependent variable and represents the CSR performance of firm i in its listing year t. The independent variable, Sus_i, equals 1 if firm i is influenced by the IPO suspension (treatment group) and 0 otherwise (control group). According to Section 3.2, we expect β to be significantly negative, indicating a negative relationship between the IPO suspension and CSR.

X_{it-1} represents a set of firm characteristics before its IPO as controls, including *Size*, *Lev*, *ROA*, *PPER*, *VC*, *PERatio*, *CEODep*, and *IndepR*, which are from the financial statements for the most recent period prior to listing. $Industry_i$ and $year_t$ indicate industry[5] and listing year fixed effects, respectively, addressing the concern that the results are driven by industry or listing year. The model's regression constant and error term are given by α and ε, respectively. All variables are winsorized at the 1st and 99th percentiles to reduce the influence of extreme values. The t-statistics are based on robust standard errors clustered at the industry level.

5. Empirical results

In this section, we present the summary statistics of the key variables and t-tests for differences between the treatment group and the control group before their IPO. After that, we assess the effect of the IPO suspension on CSR and develop several robustness checks.

5.1. Descriptive statistics and differences

Table 2 provides the summary statistics of the main variables shown in Table 1. The mean (median) CSR score, the sum of the five responsibilities, is 27.386 (25.395), with a total score of 100. Of all the firms in our sample, 26.0% are influenced by the IPO suspension. As for IPO characteristics, 61.0% of the firms are VC/PE-backed while planning their IPO and their average PE ratio is 30.15. The firms in our sample have to wait 262 days before being approved for listing.

[5] Industries are classified according to the 2012 industry classification standard of the CSRC.

Table 1
Variable definitions.

Variable		Definition
Dependent Variables	*CSR*	CSR rating score from hexun.com, measured as the sum of *SHR*, *EMR*, *SCCR*, *ENR*, and *SR* by weighting.
	SHR	Shareholder responsibility rating score, related to a firm's profitability, debt repayment, return, creditworthiness, and innovation.
	EMR	Employee responsibility rating score, related to a firm's efficiency, safety, and care of employees.
	SCCR	Supplier, customer, and consumer responsibility rating score, related to a firm's product quality, after-sales service, and level of integrity.
	ENR	Environmental responsibility rating score, related to a firm's awareness, management certification system, and the effect of input amounts on the environment.
	SR	Social responsibility rating score, related to a firm's tax payments and donations.
Independent Variables	*Sus*	Dummy variable that equals 1 when a firm's IPO process is influenced by the IPO suspension (treatment group) and 0 otherwise (control group).
	Daydif	The number of days between the firm's listing date and the IPO suspension. For the treatment group, *Daydif* equals the number of days between the listing date and January 17, 2014, and is always equal to or greater than 0. For the control group, *Daydif* equals the difference from the listing date to November 2, 2012, and is always equal to or less than 0.
Control Variables	*Size*	The natural logarithm of total assets.
	Lev	Total debt/total assets.
	ROA	Earnings/total assets.
	PPER	Net value of fixed assets/total assets.
	VC	Dummy variable that equals 1 if a firm has VC/PE investor(s) at the time of its IPO and 0 otherwise.
	PERatio	IPO stock price/earnings per share.
	CEODep	Dummy variable that equals 1 if a firm's CEO is the firm's manager and 0 otherwise.
	IndepR	The number of independent directors/the total number of directors.
Instrumental Variable	*Waitday*	The number of days between the firm's approval date and its listing date.

Table 2
Summary statistics.

Variable	Number of observations	Mean	Median	Standard deviation	Minimum	Maximum
CSR	254	27.386	25.395	11.622	12.030	76.040
SHR	254	18.866	18.975	3.466	5.540	27.930
EMR	254	2.169	1.420	2.643	0.000	15.000
SCCR	254	1.000	0.000	3.587	0.000	20.000
ENR	254	1.065	0.000	3.985	0.000	23.000
SR	254	4.281	3.110	3.134	−10.000	23.380
Sus	254	0.260	0.000	0.439	0.000	1.000
Size	254	20.426	20.228	1.078	18.651	25.112
Lev	254	0.419	0.431	0.178	0.044	0.775
PPER	254	0.198	0.180	0.137	0.005	0.666
ROA	254	0.096	0.080	0.072	0.001	0.366
VC	254	0.610	1.000	0.489	0.000	1.000
PERatio	254	30.153	28.975	10.398	6.230	63.400
CEODep	254	1.563	2.000	0.497	1.000	2.000
IndepR	254	0.373	0.333	0.051	0.250	0.571
Waitday	254	262.138	124.500	266.629	25.000	1,301.000

Note: This table shows the summary statistics of our dependent variables, independent variables, control variables, and instrumental variable. Our sample consists of 254 cross-sectional observations. All variables are winsorized at the 1st and 99th percentiles. The definitions of all variables are provided in Table 1.

To test the difference between the treatment and control groups, we use t-tests to determine how many days of delay are caused by the IPO suspension and whether any characteristics are different before the IPO, and the results are presented in Table 3. The firms in the treatment group, which are affected by the IPO suspension, have to wait 683.4 days on average from their approval date to their listing date, whereas the firms in the control group only have to wait 114.8 days. However, there is no significant difference in the firm-level variables between the two groups before their IPO. We also test for differences in firms' liquidity, state ownership, and IPO fundraising, and the results are similar.

5.2. Main results

We first test the relationship between the IPO suspension and overall CSR to validate our hypothesis, and the result are shown in Panel A of Table 4. To ensure the robustness of our results, we use different regression

Table 3
Differences between the treatment group and the control group.

Variable	Control group (Sus = 0)		Treatment group (Sus = 1)		Mean difference	p-value
	Number of observations	Mean	Number of observations	Mean		
Waitday	188	114.796	66	683.439	−568.644***	0.000
Asset	188	1,577.499	66	2,472.351	−894.852	0.392
Lev	188	0.416	66	0.417	−0.002	0.946
ROA	188	0.095	66	0.101	−0.006	0.551
PPER	188	0.196	66	0.209	−0.013	0.519
CEODep	188	1.586	66	1.500	0.086	0.228
IndepR	188	0.373	66	0.376	−0.003	0.704
Curratio	188	2.661	66	2.568	0.093	0.825
SOE	188	0.118	66	0.076	0.043	0.339
Fundraised	188	700.796	66	651.810	48.986	0.610

Note: This table summarizes the *t*-test results for the mean difference between the treatment group and the control group. *Asset* is a firm's total assets. *Curratio* is the ratio of current assets to total assets. *SOE* is a dummy variable that equals 1 if a firm is state-owned. *Fundraised* represents the amount raised by the IPO. The definitions of the other variables are provided in Table 1. The p-values presented in the last column are two-tailed, and ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table 4
IPO suspension and CSR.

Panel A: IPO suspension and overall CSR

Model	(1) OLS	(2) OLS	(3) OLS	(4) 2SLS	(5) GMM
Sus	−3.141***	−6.700***	−8.669***	−9.174***	−9.138**
	(−3.280)	(−4.033)	(−3.888)	(−2.597)	(−2.022)
Size			4.215***	4.220***	4.213***
			(4.190)	(4.606)	(3.685)
Lev			−21.479***	−21.470***	−21.457***
			(−4.921)	(−5.379)	(−4.029)
ROA			8.770**	8.704**	8.698
			(2.310)	(2.325)	(0.873)
PPER			−7.670	−7.616	−7.593
			(−1.375)	(−1.438)	(−1.399)
VC			−2.777**	−2.781***	−2.791**
			(−2.388)	(−2.640)	(−2.001)
PERatio			−0.016	−0.017	−0.017
			(−0.252)	(−0.293)	(−0.226)
CEODep			−0.701	−0.710	−0.723
			(−0.951)	(−1.039)	(−0.507)
IndepR			−7.748	−7.585	−7.557
			(−0.834)	(−0.978)	(−0.548)
_cons	28.202***	22.748***	−44.498*	−44.459**	−44.543*
	(25.865)	(20.824)	(−2.071)	(−2.246)	(−1.862)
Industry FE	No	Yes	Yes	Yes	Yes
Year FE	No	Yes	Yes	Yes	Yes
Observations	254	254	254	254	254
R-squared	0.014	0.140	0.248	0.248	0.248
Adj. R-squared	0.010	0.085	0.173	0.173	0.173

Panel B: IPO suspension and classified CSR

Dependent Variable	(1) SHR	(2) EMR	(3) SCCR	(4) ENR	(5) SR
Sus	−1.861*	−0.751	−1.801**	−2.060***	−2.336**
	(−2.070)	(−1.587)	(−2.995)	(−4.153)	(−2.233)
Controls	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	254	254	254	254	254
R-squared	0.343	0.268	0.144	0.200	0.457
Adj. R-squared	0.277	0.195	0.058	0.120	0.403

Note: This table provides the results of the effect of the IPO suspension on CSR. Panel A reports the estimates of different regression models. The dependent variable is *CSR*. Columns (1), (2), and (3) use the OLS model, column (4) uses the 2SLS model, and column (5) uses the GMM model. Columns (4) and (5) use *Waitday* as the instrumental variable. Panel B shows whether the IPO suspension affects activities classified as CSR. "Controls" indicates whether this regression contains the control variables, including *Size*, *Lev*, *ROA*, *PPER*, *VC*, *PERatio*, *CEODep*, and *IndepR*. "Industry FE" and "Year FE" indicate whether this regression includes industry and listing year fixed effects, respectively. The t-statistics are based on standard errors clustered at the industry level and reported in brackets. The definitions of all variables are provided in Table 1. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

models. Column (1) presents the regression results between the IPO suspension and CSR without fixed effects and control variables. Industry and listing year fixed effects are included in column (2). Column (3) shows the results with fixed effects and control variables (Eq. (1)). Following Song and Xin (2017), we use the waiting days between the approval date and the listing date (*Waitday*) as an instrumental variable to run the two-stage least squares (2SLS) model and the generalized method of moments (GMM) model in column (4) and column (5), respectively. All of these regressions suggest that the IPO suspension has a negative impact

on CSR, which is consistent with our hypothesis. As for the control variables, the regression results show that firm size (*Size*) and profitability (*ROA*) have a positive effect on CSR, whereas leverage (*Lev*) and VC/PE-backed (*VC*) have a negative influence on CSR.

We report estimates of the effect of the IPO suspension on a firm's responsibility to shareholders (*SHR*), employees (*EMR*), suppliers, customers and consumers (*SCCR*), the environment (*ENR*), and society in general (*SR*) in Panel B of Table 4. The results show that the IPO suspension has a negative impact on all types of CSR performance. Notably, the impact on employee responsibility, shown in column (2), is negative but not significant. The reason may be that awareness rather than funding is needed to increase a firm's responsibility to its employees. Specifically, safety and care, two critical indicators of employee responsibility, require managers to pay more attention instead of paying more money and may not be influenced by financial constraints.

Finally, we test whether the time from the IPO suspension to the firm's listing date could affect CSR performance. Intuitively, firms listing before the suspension (control group) and after it (treatment group) should be different. Before the IPO suspension occurred, listing firms did not know of the event and would not change their CSR strategies. So, the number of days from the IPO suspension has no impact on CSR in the control group. In contrast, firms affected by the suspension have to wait in line after the recovery and remain financially constrained. Therefore, the shorter the time from suspension to listing, the smaller the effect of the delay on firms that are financially constrained and the greater the subsequent recovery in CSR investments. Fig. 1 illustrates the CSR trends for firms listing around the IPO suspension and confirms the above discussion. Fig. 1 also proves that firms do not know that the suspension will happen before it takes place, as mentioned in Section 3.1.

5.3. Robustness tests

We conduct several tests on the robustness of our results. First, we use several placebo tests to exclude the impact of the order in which listing takes place. If firms listed earlier always engage in more CSR activities, our main results are due to the order of approval or listing instead of the IPO suspension because firms in the control group always go public earlier than those in the treatment group. To eliminate the above possibility, we construct mock dates for the start or end of the IPO suspension, always place the control group before the treatment group, and rerun the regression in Eq. (1).

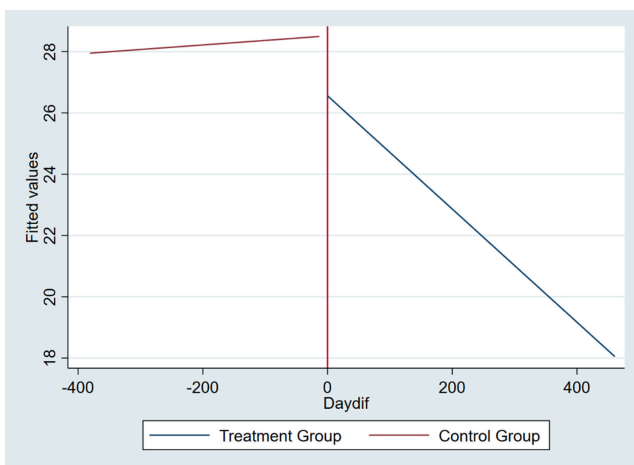

Fig. 1. The number of days from the IPO suspension and CSR fitted values. Note: This figure presents the trends of firms' CSR performance listing around the IPO suspension. The x-axis is *Daydif* defined in Table 1. The y-axis is the fitted values of the regression on *Daydif* and *CSR*. We run the regression on the treatment group and the control group, separately. The treatment group is defined as firms influenced by the IPO suspension after their approval date ($Sus = 1$), while the control group represents firms listing before the IPO suspension ($Sus = 0$).

Table 5
Placebo tests.

Dependent variable	(1) CSR	(2) CSR	(3) CSR	(4) CSR
Sus	−0.610	−0.389	−0.559	0.361
	(−0.130)	(−0.341)	(−0.390)	(0.616)
Controls	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	474	418	271	337
R-squared	0.195	0.198	0.351	0.281
Adj. R-squared	0.148	0.149	0.293	0.233

Note: This table shows the placebo tests that define the treatment and control groups using a mock start or end date of the IPO suspension. "Controls" indicates whether this regression contains the control variables, including *Size*, *Lev*, *ROA*, *PPER*, *VC*, *PERatio*, *CEODep*, and *IndepR*. "Industry FE" and "Year FE" indicate whether this regression includes industry and listing year fixed effects, respectively. The t-statistics are based on standard errors clustered at the industry level and reported in brackets. The definitions of all variables are provided in Table 1. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

The results are shown in Table 5. Column (1) uses firms with an approval date between November 2, 2011 and November 2, 2012 as the treatment group and firms with an approval date between November 2, 2010 and November 2, 2011 as the control group. Column (2) uses firms with a listing date between November 2, 2011 and November 2, 2012 as the treatment group and firms with a listing date between November 2, 2010 and November 2, 2011 as the control group. Column (3) uses firms with an approval date between January 17, 2015 and January 17, 2016 as the treatment group and firms with an approval date between January 17, 2014 and January 17, 2015 as the control group. Column (4) uses firms with a listing date between January 17, 2015 and January 17, 2016 as the treatment group and firms with a listing date between January 17, 2014 and January 17, 2015 as the control group. The results show no effect on the treatment group, which means that the decrease in CSR is caused by the IPO suspension instead of the order of listing.

Next, we consider an alternative explanation for our results. There may be concern that our results are caused by trends in the Chinese stock market. IPO suspensions always occur when the stock market falls and end with an upward trend, so the stock performance of the treatment group is likely to be better than that of the control group. Moreover, research suggests that firms with worse performance are more motivated to engage in CSR activities to divert attention from bad news (Hemingway and Maclagan, 2004; Quan et al., 2015). To examine this explanation, we test the relationship between the firm's stock return in the listing year (*YReturn*) and CSR. If this alternative explanation holds, the regression coefficient will be significantly negative. The result in Table 6, column (1) is not significant, so we exclude this alternative explanation.

We then consider some omitted variables. Some firms may have more opportunities to go public before the suspension, which can lead to potential differences between the treatment group and the control group. For example, firms with greater liquidity risk or raising more funds may be motivated to list as quickly as possible and go public just before the IPO suspension. In addition, state-owned firms may know about a planned IPO suspension because of their political connections, which may bias the empirical results. We add raising funds from the IPO (*FundRasied*), liquidity (*Curratio*), and state ownership (*SOE*) to Eq. (1) as new control variables. Table 6, column (2) presents the results. The change in the dependent variables does not alter our main results.

We also change the measurement of CSR. Considering that firms' donation level can directly reflect their readiness to take part in CSR activities, we use *Donation*, measured by the natural logarithm of the amount donated in the listing year, as a new dependent variable. Table 6, column (3) shows that our results are robust when using this new variable.

Finally, we compare the treatment group with different control groups. The selection of the original control group may be accidental because of the small amount of data. We select firms whose listing date is 12 months or less before the IPO suspension as the control group in the original setting. In this section, we test two new control groups containing firms listed within 6 and 24 months of the suspension. The results are shown in

Table 6
Other robustness tests.

Dependent variable	(1) CSR	(2) CSR	(3) Donation	(4) CSR	(5) CSR
YReturn	−0.580				
	(−0.699)				
Sus		−8.048***	−2.221**	−9.645***	−7.955***
		(−3.342)	(−2.562)	(−3.381)	(−3.065)
Fundraised		−0.002			
		(−0.829)			
Curratio		−0.471**			
		(−2.544)			
SOE		3.925			
		(1.570)			
Controls	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	254	252	254	156	493
R-squared	0.249	0.233	0.266	0.288	0.194
Adj. R-squared	0.170	0.144	0.192	0.177	0.151

Note: This table presents several robustness tests, including alternative explanations for stock market trends, the addition of omitted variables, and new control groups. The independent variable in column (1), *YReturn*, is a firm's stock return in the listing year. Three new control variables are added in column (2), which are the log of the amount raised in the IPO (*FundRaised*), current assets/current liabilities (*Curratio*), and state ownership (*SOE*). The independent variable in column (3), *Donation*, is the natural logarithm of the amount donated in the listing year. Columns (4) and (5) define firms whose listing date is within 6 and 24 months of the IPO suspension as the control group, respectively. "Controls" indicates whether this regression contains the control variables, including *Size*, *Lev*, *ROA*, *PPER*, *VC*, *PERatio*, *CEODep*, and *IndepR*. "Industry FE" and "Year FE" indicate whether this regression includes industry and listing year fixed effects, respectively. The t-statistics are based on standard errors clustered at the industry level and reported in brackets. The definitions of the other variables are provided in Table 1. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table 6, columns (4) and (5), respectively, and show that the relationship between the IPO suspension and CSR remains unchanged.

6. Additional analyses

In this section, we carry out several additional analyses based on the above results. First, we examine the possible channels for the decline in CSR after the IPO suspension. Then, we show evidence of firms' other financial changes after the suspension. Finally, we discuss whether the IPO suspension affects CSR for a long time.

6.1. Possible channels

We propose that the relationship between the IPO suspension and CSR is influenced by financial constraints, the exit of VC/PE/institutional investors, or the quality of accounting information. It is essential to figure out the real channel because different policy recommendations are based on different channels. If the decrease in CSR is caused by restricted access to the stock market, it is necessary to consider minimizing the adverse effects on firms of the intervention. However, if the decrease is related to the individual characteristics of some firms, strengthening supervision of these firms is imperative.

6.1.1. Financial constraint channel

As shown in Section 3.2, an IPO suspension creates obstacles to financing, which forces firms to decrease their investment sensitivity to reduce their operating expenses and possible risks (Fazzari et al., 1988; Almeida et al., 2004). Firms under financial constraints prefer to invest in projects with a shorter payback period than those with higher returns but which require more time. Research suggests a negative relationship between

financial constraints and corporate innovation (e.g., Howell, 2017; Yu et al., 2019). Therefore, firms influenced by an IPO suspension are less likely to be able to access funds that would have been obtained from the stock market at a similar cost and thus have to decrease their CSR investment.

The SA index is widely used to measure financial constraints (Hadlock and Pierce, 2010), but it is not suitable for measuring the financial constraints of IPO firms because it considers the age of listed firms. We use two methods to determine whether the financial constraint channel depresses CSR. First, we examine firms' return on equity because profitable firms have a greater ability to repay loans and attract investors, have greater access to finance, and are therefore less likely to be affected by an IPO suspension. We also anticipate that an IPO suspension may affect high technology firms less because these firms have government certification, enjoy more R&D subsidies, pay less tax, and send a positive signal to the credit market, reducing their

Table 7
Channel tests.

Dependent variable	(1) CSR	(2) CSR	(3) CSR	(4) CSR	(5) CSR	(6) CSR
Sus*ROE	26.727**					
	(2.964)					
Sus*Hightech		8.222**				
		(2.294)				
Sus*Exit			3.041			
			(0.735)			
Sus*IO				−0.057		
				(−0.608)		
Sus*DA					−0.111	
					(−0.108)	
Sus*AO						−0.448
						(−0.491)
Sus	−12.196***	−13.048***	−9.830***	−8.227***	−7.574**	−7.985***
	(−3.814)	(−4.314)	(−6.110)	(−(−5.806)	(−2.869)	(−4.892)
ROE	−10.001					
	(−0.291)					
Hightech		−0.581				
		(−0.307)				
Exit			−19.649***			
			(−16.101)			
IO				0.069*		
				(1.790)		
DA					−0.125	
					(−0.171)	
AO						−0.779**
						(−2.354)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	254	254	254	246	245	245
R-squared	0.255	0.265	0.291	0.246	0.216	0.231
Adj. R-squared	0.174	0.184	0.213	0.160	0.143	0.158

Note: This table reports the tests on the channels affecting the relationship between the IPO suspension and CSR, including the financial constraint channel (columns (1) and (2)), the exit channel (columns (3) and (4)), and the accounting information quality channel (columns (5) and (6)). *ROE* is a firm's return on equity. *Hightech* is a dummy variable that equals 1 if a firm is certified as a high technology firm. *Exit* is a dummy variable that equals 1 if there is any VC/PE exit during the IPO. *IO* is the percentage of institutional investors. *DA* and *AO* are two variables measuring accounting information quality following Qu et al. (2018). "Controls" indicates whether this regression contains the control variables, including *Size*, *Lev*, *ROA*, *PPER*, *VC*, *PERatio*, *CEODep*, and *IndepR*. "Industry FE" and "Year FE" indicate whether this regression includes industry and listing year fixed effects, respectively. The t-statistics are based on standard errors clustered at the industry level and reported in brackets. The definitions of the other variables are provided in Table 1. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

financial pressure and increasing their access to capital. We test for these in Table 7, columns (1) and (2), respectively. The results show that more profitable firms with high-technology certification are much less affected by the IPO suspension than firms with greater financial constraints. Overall, the financial constraint channel can explain why firms affected by the IPO suspension show less CSR activities.

6.1.2. Exit channel

An IPO is one of the most common exits for VC/PE investors. Exiting through an IPO can help them recover funds, build a reputation, and attract more investors. An IPO suspension hinders the exit of VC/PEs, so after the end of the suspension, they are more likely to sell their shares to recover capital and invest in other unlisted firms. Meanwhile, VC/PEs pay more attention to a firm's CSR to retain the firm's stakeholders and build their own reputation (Scholtens, 2006). Related research suggests that institutional shareholders increase firms' CSR activities (Dyck et al., 2019; Chen et al., 2020). Therefore, the end of the IPO suspension may ease the exit of VC/PE or institutional investors, reducing their positive effect on CSR.

To test the reliability of the exit channel, we use two related variables as moderators: *Exit*, which shows whether there is any VC/PE exit after the IPO, and *IO*, which represents the percentage of shares held by institutional shareholders. The IPO exit channel predicts a greater effect on firms with a VC/PE exit and larger stakes held by institutional shareholders. Table 7, columns (3) and (4) show the results and find non-significant effects on these moderators, which suggests that the exit channel may not be established.

6.1.3. Accounting information quality channel

Qi and Huang (2016) suggest that earnings management may be an issue in some Chinese firms before an IPO. An IPO suspension prolongs the application process, which means that firms affected have to disclose more corporate information, hindering their ability to manage earnings. Meanwhile, the IPO suspension is accompanied by the CSRC's financial inspection, which also improves the quality of accounting information. Firms with low-quality accounting information are more likely to use CSR activities to conceal difficulties and bad news (e.g., Hemingway and Maclagan, 2004; Quan et al., 2015). The inspection carried out by the CSRC means that firms affected by an IPO suspension have less space to manage earnings, so they may have less to conceal and therefore less motivation to engage in CSR activities.

To test the accounting information quality channel, following Qu et al. (2018), we use discretionary accruals (*DA*) calculated using the modified Jones model and the ratio of total accruals to operating cash flow (*AO*) to measure accounting information quality. The accounting information quality channel suggests that firms with higher accounting information will be more influenced by the IPO suspension. We test this channel in Table 7, columns (5) and (6) and find no effect of the quality of accounting information on the relationship between the IPO suspension and CSR.

Overall, our empirical results suggest that the financial constraint channel, instead of the exit and accounting information quality channels, can better explain the relationship between the IPO suspension and CSR. The reason for the failure of the exit channel may be that Chinese VC/PE or institutional investors refuse to promote the firm's long-term investments (Wen and Feng, 2018). The negative relationship between *VC* and *CSR* shown in Table 4 also supports this view. Accounting information quality may not explain our results because CSR cannot hide bad news during an IPO suspension, which is a noticeable event in the Chinese stock market. Investors will pay more attention to firms affected by an IPO suspension, which is not conducive to manipulation through CSR. Table 6, column (1) shows no significant relationship between the stock market situation and CSR during the IPO suspension, suggesting that the masking effect of CSR may not be applicable in our paper.

6.2. Does the IPO suspension affect firms' liquidity and profitability?

In Section 3.2, we argue that an IPO suspension may affect firms' liquidity and profitability. To verify this view, we test the relationship between the IPO suspension and a firm's level of cash, current liabilities, and returns in its listing year. Table 8, columns (1), (2), and (3) show that firms affected by the IPO suspension are more likely to have a lower cash ratio, more current liabilities, and lower ROA, respectively. In columns

Table 8
IPO suspension and firms' liquidity and profitability.

Dependent variable	(1) Cash	(2) CurLiability	(3) ROA	(4) ROCA	(5) ROFA
Sus	−0.229***	0.110**	−0.023*	−0.024**	0.701
	(−(−3.635)	(2.293)	(−1.999)	(−2.674)	(0.385)
Controls	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	254	252	254	251	254
R-squared	0.520	0.355	0.467	0.291	0.456
Adj. R-squared	0.472	0.290	0.414	0.223	0.402

Note: This table reports the regression estimates of the IPO suspension and firms' liquidity and profitability in the listing year. *Cash* is the ratio of a firm's cash to total assets. *CurLiability* is the ratio of a firm's current liabilities to total liabilities. *ROA*, *ROCA*, and *ROFA* are a firm's earnings scaled by total assets, current assets, and fixed assets, respectively. "Controls" indicates whether this regression contains the control variables, including *Size*, *Lev*, *ROA*, *PPER*, *VC*, *PERatio*, *CEODep*, and *IndepR*. "Industry FE" and "Year FE" indicate whether this regression includes industry and listing year fixed effects, respectively. The t-statistics are based on standard errors clustered at the industry level and reported in brackets. The definitions of the other variables are provided in Table 1. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

(4) and (5), we find that the suspension has an adverse impact on the profitability of a firm's current assets but has no effect on the profitability of its fixed assets.

6.3. How long can the effect of an IPO suspension last?

Our empirical results show that an IPO suspension can affect CSR in the listing year. Can the effect of the suspension last for a long time? We use CSR in the first, second, and third years after the IPO as our new dependent variables and test this issue in Table 9. Our results show that there is also a negative relationship between the IPO suspension and CSR in the first year after the IPO. However, this effect disappears in the

Table 9
Duration of the effect of the IPO suspension.

Dependent variable	(1) CSR_t + 1	(2) CSR_t + 2	(3) CSR_t + 3
Sus	−8.931***	−4.813	−0.058
	(−6.787)	(−1.454)	(−0.053)
Controls	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	254	254	248
R-squared	0.257	0.231	0.186
Adj. R-squared	0.183	0.154	0.107

Note: This table presents the effect of the IPO suspension on CSR in the three years after the IPO. The dependent variables, *CSR_t + 1*, *CSR_t + 2*, and *CSR_t + 3*, are the CSR rating score from Hexun.com on the first, second, and third years after the IPO, respectively. "Controls" indicates whether this regression contains the control variables, including *Size*, *Lev*, *ROA*, *PPER*, *VC*, *PERatio*, *CEODep*, and *IndepR*. "Industry FE" and "Year FE" indicate whether this regression includes industry and listing year fixed effects, respectively. The t-statistics are based on standard errors clustered at the industry level and reported in brackets. The definitions of the other variables are provided in Table 1. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

second and third years after the IPO. These results further support our view that the decrease in CSR is caused by the IPO suspension because the effect disappears shortly after the suspension ends.

7. Conclusions

This paper investigates how stock market restrictions can affect CSR. Based on the suspension of IPOs on the Chinese stock market between 2012 and 2014, we compare CSR scores between firms listed before the IPO suspension and firms with similar approval dates but a later listing date due to the suspension. Our results provide evidence that the IPO suspension has an adverse impact on CSR activities. For firms affected by the suspension, the later their listing date after the suspension ends, the greater the reduction in CSR performance. Otherwise, for firms listed before the suspension, we find that the number of days from the IPO suspension has no impact on CSR.

We propose three possible channels to explain the relationship between the IPO suspension and CSR: financial constraints, VC/PE exit, and accounting information quality. Our empirical results suggest that the evidence for the financial constraint channel is stronger than for the other two channels. That is, firms decrease their CSR investments after the IPO suspension because finance is restricted. Our results also indicate that the IPO suspension can affect firms' liquidity and profitability. However, the suspension does not have a long-term effect. After firms are publicly listed for 1–2 years, their CSR performance is no longer significantly lower than that of unaffected firms.

Our results have two policy implications. First, CSR is generally considered a decision made by the firms themselves based on business ethics. However, this paper finds that a reduction in CSR may be involuntary and the result of stock market restrictions. Thus, improving CSR requires not only the efforts of firms themselves but, more importantly, a suitable environment for business operations, including the healthy development of the stock market. Second, the original intention of the CSRC's IPO suspension policy is to maintain the stability of the stock market and protect the interests of investors. However, the balance of gains and losses brought about by an IPO suspension remains to be settled. It is essential that both government departments and scholars pay attention to the balance between marketization and stock market regulations in the future.

Declaration of Competing Interests

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

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