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Institutional environment quality and the longevity of billionaire entrepreneurs

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ABSTRACT

Using self-made billionaire entrepreneurs in China as a proxy for large entrepreneurs, we examine the impact of institutional environment quality on the longevity of such entrepreneurs. While property rights institutions and contracting institutions are important in explaining macroeconomic growth and small firm growth, we find no evidence that they matter to the longevity of billionaire entrepreneurs. However, we find access to finance to be important to the longevity of billionaire entrepreneurs. Our results help better understand the relative importance of various institutional environment forces to the continuous success of billionaire entrepreneurs.

1. Introduction

The past few decades have witnessed the rapid rise of numerous billionaire entrepreneurs from around the world, especially from emerging market economies, such as China, India and former communist countries in

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East Europe (Freund, 2016). Many such large entrepreneurs are genuine entrepreneurs, who started their businesses from scratch, developed innovative products or business models and grew rapidly (Schumpeter, 1934; Henrekson and Sanandaji, 2014). However, the turnover of such billionaire entrepreneurs is also quite high, especially in many emerging market economies (Wang, 2015; Treisman, 2016). One could argue that such high turnover is normal and consistent with Schumpeter's (1942) "gale of creative destruction," in which successful entrepreneurial companies become more complacent and less innovative over time.[1] The high turnover could also reflect the challenging institutional environments in which large entrepreneurs operate. Research shows that self-made large entrepreneurs make significant contributions to employment, innovation and economic growth in emerging markets (Morck et al., 2000; Li et al., 2006). Hence, it is important to understand the institutional environment drivers behind the fall of such entrepreneurs.

Using a large sample of self-made Chinese billionaires compiled by two publishers, namely Forbes and Hurun, for the 2000–2013 period, our objective in this study is to examine the importance of local institutional environment factors to the longevity of large entrepreneurs. We consider two distinct dimensions of the institutional environment factors in the province of an entrepreneur's headquarters. First, we consider the importance of two key factors identified by Acemoglu and Johnson (2005) as important in explaining macroeconomic outcomes across countries: property rights institutions, which protect citizens against expropriation by the government and powerful elites, and contracting institutions, which enable private contracts between citizens. Second, we consider the importance of access to finance, a frequently cited impediment to entrepreneurship development (Cull and Xu, 2005).

Institutional environment factors have long been recognized as important to macroeconomic growth (e.g., Knack and Keefer, 1995; Mauro, 1995; Levine, 1997; Rajan and Zingales, 1998; Acemoglu et al., 2001; Claessens and Laeven, 2003). However, finance and economics research on the impact of institutional environment factors on the behavior of individual firms and entrepreneurs remains limited (Johnson et al., 2002; Cull and Xu, 2005; Berkowitz et al., 2015). Despite the growing entrepreneurship literature, Tolbert et al. (2011) note that much prior entrepreneurship research focuses on the personal traits and dispositions of founders as keys to explaining entrepreneurial outcomes and tends to neglect the importance of institutions to entrepreneurship. In addition, the entrepreneurship literature suffers from two important shortcomings. First, most studies use proxies such as small business activity, the self-employment rate or the number of startups to measure the rate of entrepreneurship (e.g., Evans and Leighton, 1989; Gentry and Hubbard, 2000; Djankov et al., 2006; Guiso et al., 2006; Djankov et al., 2010). Henrekson and Sanandaji (2014) show that such common proxies are not reliable measures of entrepreneurship because many small entrepreneurial businesses are mom-and-pop shops that are not innovative and would never expand to the scale of companies such as Google or Facebook. However, Henrekson and Sanandaji (2014) find that self-made billionaires are a good proxy for Schumpeterian entrepreneurs.

Second and more importantly, the literature on the impact of institutional environment factors on entrepreneurship has not distinguished small versus large entrepreneurs. In fact, most entrepreneurship studies examine small entrepreneurs only. It is important to understand the effects of institutional environment factors on the success of small entrepreneurs; it is equally important to understand the effects of the same factors on the continuous success of large entrepreneurs who have already achieved initial success, as the failure of such large entrepreneurs has broader social and economic externalities in emerging markets (Morck et al., 2000; Li et al., 2006). In addition, the impact of institutional environment factors could be fundamentally different for small versus large entrepreneurs. For example, due to their status, resources, market power and political connections, large entrepreneurs may find it easier to alter the terms of their formal and informal contracts to avoid the adverse effects of institutional frictions in a weak institutional environment (Klein and Leffler, 1981; Allen et al., 2005). In addition, to promote local economic growth (Li and Zhou, 2005; Xu, 2011), local government officials may also have a stronger incentive to protect and support large entrepreneurs who make a greater contribution to local employment and economic growth. Hence, institutional environment factors may not matter much to the continuous success of large entrepreneurs.

[1] According to Schumpeter (1942, pp. 82–83), the "gale of creative destruction" describes the "process of industrial mutation that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one.".

Following Henrekson and Sanandaji (2014), we use self-made billionaires as a proxy for large entrepreneurs. Our sample comes from the annual ranking of Chinese billionaires compiled by Forbes and Hurun for the 2000–2013 period.[2] The Chinese setting offers several unique advantages for testing our research question. First, China has observed the rapid rise of thousands of self-made and innovative billionaires consistent with the notion of Schumpeterian entrepreneurs (e.g., Alibaba's Jack Ma and Tencent's Pony Ma). Second, the turnover of ranked billionaires is very high in China. For example, among all of the billionaires who have been included on the combined Forbes and Hurun list at least once, only approximately-one third of them remained on the list as of the end of our sample period in 2013. Third, Chinese billionaires are scattered among different provinces with very diverse local institutional environments. Hence, China creates a powerful setting in which to test our research question in a single country, which helps mitigate the common concern of correlated omitted variables for cross-country studies (Ke, Lennox and Xin, 2015).

We adopt a hazard regression approach by following a billionaire entrepreneur, starting from the first year in which she is ranked by Forbes or Hurun and lasting to the year in which she drops out of the combined annual billionaire list. In other words, failure to make the annual billionaire list is a failure event in the hazard model. It is important to note that an entrepreneur's failure to make the billionaire list does not necessarily imply that the entrepreneur has encountered serious business troubles, such as bankruptcy (referred to as Type 1 billionaires). It is also possible that the entrepreneur's business has not grown fast enough relative to those of her peers and as a result she fails to make the annual billionaire list, which has an increasing minimum threshold over time (referred to as Type 2 billionaires). Due to data limitations, we do not attempt to distinguish between the two types of billionaires. However, this data limitation does not affect our inferences because both types of billionaires are failures relative to their peers in China.[3]

We use the provincial public administration index (*PROPERTY_RIGHTS*) of Wang et al. (2013) to proxy for property rights institutions, and we use their provincial legal environment of business enterprises index (*CONTRACTING*) to proxy for contracting institutions. We use two proxies for access to finance: (a) Wang et al.'s (2013) index of the development of formal and informal financial intermediaries in the province of a billionaire's headquarters (FINANCE), which is a province-level proxy and (b) a dummy variable indicating whether a billionaire controls at least one publicly listed firm (LISTED), which is a billionaire-level proxy. Following Djankov et al. (2006), we also control for other determinants of billionaire entrepreneurs' longevity, including their relationship networks, political connections, personal characteristics and local resource endowment, such as human capital, infrastructure, economic development and government industrial policy.

Our results can be summarized as follows. First, we find no evidence that property rights institutions or contracting institutions play a role in maintaining the longevity of billionaire entrepreneurs. Second and surprisingly, access to finance continues to be important to the longevity of billionaire entrepreneurs. We find that billionaire entrepreneurs domiciled in provinces with underdeveloped financial intermediaries (FINANCE) and billionaire entrepreneurs who control no listed firms (LISTED) are more likely to drop out of the combined annual Forbes and Hurun billionaire list.

To further illustrate the importance of access to finance, we also examine whether the effect of access to a specific external financing channel (i.e., LISTED) differs for the billionaire entrepreneurs domiciled in provinces with strong versus weak external financing environments (FINANCE). We find that in provinces with less developed financial intermediaries, controlling a publicly listed firm helps prolong the longevity of a bil-

[2] It is likely that some entrepreneurs included in the initial billionaire list in 1999 (the first year of the Hurun list) were already billionaires before 1999, resulting in a left truncation of the analysis time for our Cox hazard analysis. Fortunately, this problem should not be severe, as most of the included entrepreneurs in our sample became billionaires after 1999. In addition, Pan and Cappbell (2002) show that this left truncation would not affect the Cox regression coefficient estimation, although the baseline hazard rate would be understated.

[3] Among the billionaires who dropped out of the billionaire list as of the end of our sample period, 37% of them are Type 1 billionaires (i.e., they encountered severe business troubles around the failure time). No media reports on the status of the remaining drop-out billionaires (referred to as unclassified billionaires) are available. Untabulated analysis shows that the ranking of the unclassified billionaires is significantly lower than the ranking of the Type 1 billionaires, suggesting that the status of the unclassified billionaires is less newsworthy and therefore may not be covered by the media, even for dropouts due to severe business troubles. Another possibility is that the unclassified billionaires are Type 2 billionaires (i.e., they experienced significant slowdown or stagnation in business growth but not severe business troubles).

lionaire entrepreneur. However, in provinces with better developed financial intermediaries, the importance of controlling a publicly listed firm becomes less important to the longevity of billionaire entrepreneurs, presumably due to the availability of alternative financing channels.

Our primary regression results are robust to a variety of sensitivity checks. First, we control for industry × year fixed effects to rule out the possibility of our results being due to significant industry shocks that occurred in a few specific years. Second, we limit our sample to the 2006–2013 period, during which we expect the billionaire list's data quality to be significantly improved. Third, we use alternative institutional environment proxies based on the World Bank's 2005 investment climate survey of 120 Chinese cities (World Bank, 2006). Finally, to assess the impact of measurement error in the billionaire ranking on our inferences, we use a higher yearly total wealth cutoff to define billionaire entrepreneurs' fall and obtain similar inferences.

Some of our billionaire entrepreneurs operate in regulated industries that are plagued by corruption and cronyism. Such billionaire entrepreneurs may not represent genuine entrepreneurs. As such, we also try to replicate our key regression results by excluding the billionaire entrepreneurs operating in regulated industries. We find similar inferences.

One could argue that our failure to find significant impacts of contracting institutions and property rights on billionaire entrepreneurs' longevity could be due to greater measurement errors for *PROPERTY_RIGHTS* and *CONTRACTING* than for *FINANCE*. This alternative explanation seems unlikely, particularly considering that Wang et al. (2013) follow the same measurement approach for the three institutional factors. In addition, Cull and Xu (2005) find that all three factors matter to the growth of small Chinese firms. To further rule out this concern, we use a large sample of small Chinese entrepreneurial firms and show that all three factors matter to the longevity of small Chinese entrepreneurs.

We contribute to several streams of literature. First, we contribute to the entrepreneurship literature by performing the first micro-level study on the determinants of large (billionaire) entrepreneurs' longevity. Due to data availability constraints, most studies in the entrepreneurship literature focus on small business owners rather than large entrepreneurs (e.g., Blanchflower and Oswald, 1998). We conduct one of the very few studies analyzing the behavior of self-made, large (billionaire) entrepreneurs. We contribute to the literature by demonstrating the importance of various institutional environment factors to the continuous success of billionaire entrepreneurs.

Second, we contribute to the new institutional economics literature, following the pioneering works of Nobel laureates Ronald Coase, Oliver Williamson and Douglas North. Although the importance of institutional environment factors to aggregate economic development has long been recognized, research on the impact of such institutional factors at the individual entrepreneur or firm level remains scant. Notable exceptions include the studies by Johnson et al. (2002) and Cull and Xu (2005), but they focus on the impact of institutional environment factors for small private firms. Both Johnson et al. (2002) and Cull and Xu (2005) find that property rights affect small private firms' incentives to reinvest retained profits. Cull and Xu (2005) also find a positive effect of access to finance on small private firms' reinvestment decisions. The different results between these studies and our study suggest that the effects of property rights and contracting institutions differ for small and large entrepreneurs. We further show that access to finance remains critical to the longevity of both small and large entrepreneurs.[4]

Third, our study is also related to the law and finance literature, following La Porta et al. (1998). The law and finance literature primarily focuses on the protection of minority shareholders in publicly listed companies from expropriation by controlling shareholders. Our study differs in that we focus on large (billionaire) entrepreneurs rather than their owned firms. This is important because all billionaire entrepreneurs in emerging markets own multiple and often interrelated business entities (listed or non-listed), and it is therefore necessary to adopt a portfolio approach to obtain comprehensive insight into the behavior of billionaire entrepreneurs. Our results identify the important local institutional environment factors that still matter to the prosperity of billionaire entrepreneurs.

[4] Berkowitz et al. (2015) find that access to finance but not property rights protection affects the stock prices of publicly listed private Chinese firms. As stock prices reflect the cash flow rights of all shareholders, including minority shareholders and controlling shareholders, the focus of Berkowitz et al. (2015) is different from ours.

The remainder of this paper is organized as follows. Section 2 introduces the billionaire entrepreneur sample. Section 3 presents our research design and defines our variables. Section 4 discusses the primary regression results. Section 5 reports a series of robustness checks. Finally, Section 6 concludes the paper.

2. Billionaire entrepreneur sample

We hand collect the list of billionaire entrepreneurs over the 1999–2013 period from two influential publication sources: (a) the annual billionaire list compiled by the Hurun report and (b) the annual billionaire list compiled by Forbes magazine. The Hurun list starts from 1999, whereas the Forbes list starts from 2003. We end the sample in 2013, the year in which our initial data collection started. Private property ownership was banned before the start of China's economic reforms in the late 1970 s. Thus, almost all of the billionaire entrepreneurs included in the Forbes and Hurun lists started from scratch by adopting innovative products or business models rather than from inheritance, making them genuine entrepreneurs.

Both Forbes and Hurun compile their billionaire lists based on publicly available information (e.g., domestic and international media reports, periodic corporate filings with securities regulators around the world and financial databases) and their own independent research and interviews with relevant parties (e.g., journalists, business executives and government officials) around the country. Forbes and Hurun compute a billionaire's total wealth using similar methodologies. Specifically, the market value of a billionaire's ownership in publicly listed firms is based on publicly quoted stock prices. As no readily quoted market prices are available for non-listed stocks, the market value of a billionaire's ownership in non-publicly listed firms is computed using the comparable publicly listed company valuation approach.[5]

Given the inherent difficulty in obtaining information on an entrepreneur's entire investment portfolio, both Forbes' and Hurun's annual billionaire lists could contain measurement errors. However, we are not aware of any systematic bias or omission from Forbes' or Hurun's annual billionaire lists. The first type of measurement error is the unintended omission of billionaire entrepreneurs from the list due to a lack of information about some billionaire entrepreneurs' investment ownership. Determining the severity of this omission is difficult, but we do not believe this omission bias to be severe for several reasons. First, once someone has reached billionaire status, it is difficult to hide her wealth. Second, both Forbes and Hurun appear to do a reasonable job in identifying all possible billionaire entrepreneurs. For example, approximately 77 % of the billionaires on the combined Forbes and Hurun list do not control any publicly listed entities (untabulated). Given the fact that information for billionaires without any publicly listed entities is more difficult to acquire, this evidence suggests that Forbes and Hurun have done a good job in identifying billionaires. Third, we use the billionaire lists from both Forbes and Hurun to significantly reduce the likelihood of billionaire omission. Finally, as a robustness check, we also rerun our main regression analyses using only the years since 2006. As we show below, the coverage and quality of research by Forbes and Hurun improve over time as they gain more experience, resources and credibility in China.

The second type of measurement error is the incorrect calculation of a billionaire's annual total wealth. However, determining the effect of this measurement error on the annual ranking is difficult because the error could go in either direction (i.e., calculated as more or less than the actual amount). To mitigate this potential measurement error, we avoid using the lists' detailed ranking information and instead focus on simply whether a person is included in the annual ranking or not. In addition, we include year fixed effects and industry fixed effects as well as industry $\times$ year fixed effects to account for potential valuation difficulties in volatile years and industries, respectively. Finally, as a robustness check, we also use a higher yearly cutoff than the official cutoff to define a billionaire's fall, such that any small deviation in a billionaire's wealth due to such measurement error would not affect our inferences.

Panel A of Table 1 shows the number of billionaires every year from 2000 to 2013 and lists the minimum wealth cutoff for each annual ranking. The Hurun billionaire list was first released in 1999, and compiling the very first annual list could have involved significant measurement errors (Hoogewerf and Dongfang, 2008). As such, our sample starts in 2000 to avoid such errors. Examining Panel A leads to a few interesting findings.

[5] The following links provide more discussions of Forbes' and Hurun's methodologies, respectively: https://news.163.com/14/1028/15/A9LGGGPO00014JB5.html and https://finance.china.com.cn/roll/20140119/2133553.shtml.

Table 1
The sample of billionaire entrepreneurs.

Panel A The annual billionaire list

Year	The Hurun list	The Forbes list	The combined list	Only in the Hurun list	Only in the Forbes list	In both lists	The cutoff for the Hurun list (in 100 million yuan)	The cutoff for the Forbes list (in 100 million yuan)	The cutoff for the combined list (in 100 million yuan)
2000	50		50	50			3.5		3.5
2001	100		100	100			5		5
2002	100		100	100			7		7
2003	100	100	128	28	28	72	9	8.28	8.28
2004	100	200	214	14	114	86	12.5	6.54	6.54
2005	400	400	557	157	157	243	5	5	5
2006	500	400	623	223	123	277	8	8	8
2007	812	400	878	478	66	334	8	15	8
2008	1011	400	1062	662	51	349	7	12.2	7
2009	1015	400	1060	660	45	355	10	20.5	10
2010	1362	400	1399	999	37	363	10	28.5	10
2011	1004	400	1031	631	27	373	20	32	20
2012	1024	400	1062	662	38	362	18	29.6	18
2013	1017	399	1048	649	31	368	20	36.6	20

Panel B The billionaire list by province

Province	Number of billionaire-years	Percent	Number of unique billionaires	Percent
Anhui	65	0.70	26	1.11
Beijing	1080	11.61	295	12.60
Chongqing	153	1.64	28	1.20
Fujian	466	5.01	109	4.65
Gansu	27	0.29	7	0.30
Guangdong	1647	17.71	399	17.04
Guangxi	42	0.45	15	0.64
Guizhou	44	0.47	12	0.51
Hainan	14	0.15	7	0.30
Hebei	218	2.34	61	2.60
Henan	173	1.86	53	2.26
Heilongjiang	75	0.81	20	0.85
Hubei	109	1.17	25	1.07
Hunan	146	1.57	53	2.26
Jilin	63	0.68	19	0.81
Jiangsu	890	9.57	231	9.86
Jiangxi	88	0.95	21	0.90
Liaoning	259	2.78	68	2.90
Neimenggu	187	2.01	46	1.96
Ningxia	16	0.17	5	0.21

Table 1 (*continued*)

Panel B The billionaire list by province				
Province	Number of billionaire-years	Percent	Number of unique billionaires	Percent
Qinghai	6	0.06	4	0.17
Shandong	491	5.28	126	5.38
Shanxi	214	2.30	53	2.26
Shaanxi	96	1.03	24	1.02
Shanghai	873	9.39	190	8.11
Sichuan	279	3.00	65	2.78
Tianjing	132	1.42	32	1.37
Xizang	12	0.13	4	0.17
Xinjiang	68	0.73	14	0.60
Yunnan	68	0.73	20	0.85
Zhejiang	1301	13.99	310	13.24
Total	9302	100	2342	100

Note: a billionaire's province is defined based on the province in which the billionaire's primary holding company is headquartered.

First, due to the explosive growth of China's private economy, the yearly cutoff for the billionaire list has been steadily increasing over time.[6] Second, the Hurun list and the Forbes list are complementary, with some billionaires appearing on the Hurun list but not on the Forbes list and *vice versa*. This evidence suggests that it is better to use both lists to mitigate the possibility of omitting billionaire entrepreneurs. Third, we find that the quality of Hurun's coverage has increased significantly since 2006. Specifically, we find in untabulated analyses that by requiring the yearly cutoff for both the Hurun and Forbes lists to be identical (i.e., taking the higher of the two cutoffs), the number of billionaires only on the Forbes list as a percentage of the total number of billionaires on the Hurun list drops steadily from 25 % in 2003 (the first year in which both ranking lists are published) to 6 % in 2013.

Panel B of Table 1 shows the geographic distribution of the billionaires based on the headquarters location of their primary holding companies over the 2000–2013 period. We exclude four billionaires from Panel B because the their company headquarters locations are either overseas or unknown. The provinces with at least 100 unique billionaires during the 2000–2013 period are Beijing, Guangdong, Jiangsu, Shanghai, Fujian, Shandong and Zhejiang.

3. Research design

We adopt a Cox hazard regression model to examine the factors that affect the longevity of billionaire entrepreneurs. A billionaire's failure to make the combined annual Forbes and Hurun billionaire list represents a failure event in our hazard analysis. Hazard analysis (sometimes referred to as event history analysis) examines how the hazard rate $h(t)$ evolves as a function of time t and other explanatory variables (commonly referred to as covariates in hazard analysis). In its most general form, the hazard function with time-varying covariates is expressed as follows:

$$h(t|x(t)) \;=\; h_o(t)\; e^{[x(t)\beta]}$$

where $x(t)$ is a vector of the time-varying explanatory variables discussed below; β is a vector of unknown parameters to be estimated; and $h_o(t)$ is the baseline hazard rate independent of $x(t)$. If $h_o(t)$ is left unspecified, the model becomes the semi-parametric Cox proportional hazards model (Cox, 1972).[7] The regression coefficient β in the Cox model can be interpreted in the same way as ordinary least square regression coefficients. For example, a positive β implies that the hazard rate $h(t)$ increases by $(e^{\beta} - 1)$ for a 1-unit increase in an explanatory variable, holding everything else constant. Note that a high hazard rate corresponds to lower billionaire entrepreneur longevity.

For each billionaire entrepreneur, the sample used by the hazard analysis retains all of the yearly observations, starting from the first year in which the billionaire makes the annual billionaire list to the earlier of the year in which the billionaire fails to make the annual billionaire list or 2013 (i.e., the end of our sample period). Due to how hazard analysis is constructed, the billionaires who made the combined Forbes and Hurun list in 2013 (i.e., the final sample year) for the first time would be automatically excluded from the hazard analysis. Hence, the number of unique billionaires included in the subsequent hazard regression analysis is 2,218, which is less than the number of unique billionaires reported in Table 1. As our annual billionaire list starts from 2000 as noted in the previous section, the longest sample period for a billionaire spans 2000–2013. Although relatively rare, the same billionaire could enter and drop out of the combined annual list more than once. For example, a billionaire could join the annual billionaire list in 2000, drop out in 2004 and join again in 2008 all the way up to 2013, the end of our sample period. In this case, our hazard analysis would treat 2000–2004 and 2008–2013 as two separate episodes.

Table 2 shows the distribution of billionaires' failure to make the combined annual Forbes and Hurun billionaire list for the 2,218 billionaires included in the hazard regression analysis. Two interesting patterns can be observed. First, it is difficult to remain on the billionaire list every year. Only 36.34 % of the billionaires

[6] The definition of a billionaire in China (*Yi Wan Fu Weng* in Chinese) refers to someone who has a total net worth of at least RMB100 million.

[7] We use the Cox model because it does not assume any structure on the baseline hazard rate and thus is less likely to be misspecified than parametric hazard models.

Table 2
Frequency of billionaire failures.

Billionaire types	Definition	Number	Percent
1A	The person experienced one episode of the billionaire ranking and was still on the list as of 2013	806	36.34
1B	The person experienced one episode of the billionaire ranking but was no longer on the list as of 2013	1105	49.82
2A	The person experienced two episodes of the billionaire ranking and was still on the list as of 2013	152	6.85
2B	The person experienced two episodes of the billionaire ranking but was no longer on the list as of 2013	129	5.82
3A	The person experienced three episodes of the billionaire ranking and was still on the list as of 2013	14	0.63
3B	The person experienced three episodes of the billionaire ranking but was no longer on the list as of 2013	11	0.50
4A	The person experienced four episodes of the billionaire ranking and was still on the list as of 2013	1	0.05
4B	The person experienced four episodes of the billionaire ranking but was no longer on the list as of 2013	0	0
Total		2218	100

An episode refers to the interval from the first year when a person, who is not on the billionaire list, is included in the combined billionaire list to the year when the person drops off the combined billionaire list, or the end of the sample period 2013, whichever is earlier. For example, let's assume that a person ABC joined the annual billionaire list in 2000 and then dropped out of the list in 2004. Then ABC joined the list again in 2008 all the way up to 2013, the end of our sample period. For this example, ABC experienced two separate episodes of the billionaire ranking, 2000–2004 and 2008–2013, respectively.

remain on the billionaire list (without dropping out during the sample period) after their initial inclusion on the list. Second, it is also difficult for a billionaire to re-enter the list after dropping out, with only 13.84 % (i.e., 100 – 36.34 – 49.82) of the billionaires appearing on the combined billionaire list for more than one episode.

Following Djankov et al. (2006), we classify the determinants of billionaire entrepreneurs' longevity into three broad types. The first type focuses on the role of institutional environment factors emphasized in the economics literature in fostering or restricting entrepreneurship. The second type focuses on the relationship network variables emphasized in the sociology literature, as political and social networks are often believed to play an important role in fostering entrepreneurship. The third type focuses on the role of personal characteristics emphasized in the psychology literature in fostering or restricting entrepreneurship. Below we discuss the measurement and rationale for the dependent variable and explanatory variables. Unless stated otherwise, we measure all of the explanatory variables at the beginning of an observation year t (i.e., lagged values).

3.1. Institutional environment factors

Following existing economics research, we consider three categories of institutional environment factors. As argued in Section 1, the impact of local institutional environment factors on large entrepreneurs' longevity is an empirical question, as large entrepreneurs may have effective ways to mitigate the constraints imposed by local institutional environments.

The first category of institutional environment factors is property rights institutions and contracting institutions proposed by Acemoglu and Johnson (2005). Acemoglu and Johnson (2005) show that property rights institutions, which protect citizens from expropriation by the government and powerful elites, are important for long-run aggregate economic growth, investment and financial development, whereas contracting institutions, which enable private contracts between citizens, are only important for financial intermediation. The importance of property rights institutions and contracting institutions has also been confirmed in China. For example, using the World Bank's 2003 survey data, Cull and Xu (2005) find that both expropriation risk by the government and contract enforcement play a role in small private Chinese firms' profit reinvestment decisions. However, neither Acemoglu and Johnson (2005) nor Cull and Xu (2005) investigate the effects of property rights and contracting institutions on large entrepreneurs.

We use the provincial business operating environment indices developed by Wang et al. (2013) to proxy for property rights institutions and contracting institutions. These indices are based on a biannual survey of approximately 4,000–6,000 randomly chosen business owners across China, approximately 70 % of whom are private business enterprise owners. We use the public administration index (*PROPERTY_RIGHTS*) to proxy for property rights institutions and the legal environment of business enterprises index (*CONTRACTING*) to proxy for contracting institutions. Consistent with Acemoglu and Johnson (2005), *PROPERTY_RIGHTS* measures various dimensions of the government's public administration, including transparency and fairness, efficiency, government interference in business and government corruption. *CONTRACTING* measures the judicial system's fairness and efficiency and the protection of a business enterprise's legitimate rights (e.g., business contract execution, intellectual property rights and personal and property safety). To mitigate measurement errors, we convert the values of the two indices into dichotomous variables that equal 1 for the top 20 % ranked provinces each year and 0 otherwise. We use a cutoff of 20 % to achieve a more balanced distribution of the provinces with high versus low index values. The survey data of Wang et al. (2013) are available for 2006, 2008, 2010 and 2012. As our sample starts from 2000, we use the values of the indices in 2006 for the earlier years, namely 2000–2005. We use the 2008 index values for 2007 and 2008, the 2010 index values for 2009 and 2010 and the 2012 index values for 2011–2013.

The second category of institutional environment factors is access to finance. Using the World Bank's 2003 survey data, Cull and Xu (2005) find that access to external finance in the form of bank loans is positively associated with their survey firms' (small private firms') earnings reinvestment. We examine whether access to finance is also important to the longevity of billionaire entrepreneurs. We use two distinctive proxies for access to finance. Our first proxy is the financial services index (*FINANCE*) of Wang et al. (2013), which measures the quality of a province's financing environment, including both formal and informal financing channels. To mitigate measurement errors, we convert the index into a dichotomous variable that equals 1 for the top 20 % ranked provinces each year and 0 otherwise. Our second proxy is a billionaire-specific dummy variable indicating whether a billionaire entrepreneur controls at least one publicly listed company measured at the beginning of an observation year (*LISTED*). Controlling a publicly listed company may help increase an entrepreneur's access to finance through at least two channels. First, a publicly listed firm can raise equity financing more easily than a privately held firm. Second, due to the liquidity of publicly traded shares, a controlling shareholder of a publicly listed firm should find it easier to obtain bank loans by pledging her shares as collateral. *FINANCE* and *LISTED* are complementary measures of access to finance, with the former capturing the overall external financing environment in a province and the latter measuring a specific financing channel available to a billionaire entrepreneur.

3.2. Control variables

We include several types of control variables subject to data availability: relationship networks (including both political connections and social networks), personal characteristics and other miscellaneous controls.

3.2.1. Political connection

Political relations play an important role in business management in China. Hence, we control for the effect of political connection. Measuring political connection is difficult because it is often invisible. Following prior research, we use two distinctive proxies for political connection. The first proxy is a dummy variable indicating whether a billionaire is a representative of the national or provincial People's Congress or a member of the national or provincial Chinese People's Political Consultative Conference (CPPCC) at the beginning of an observation year (*POLITICAL_CONNECTION*). Following Piotroski and Zhang (2014), the second proxy is a dummy variable indicating whether turnover of the provincial governor or party secretary occurs in the province of a billionaire's headquarters during the observation year t or t–1 (*POLITICAL_TURNOVER*).[8] Both political connection proxies have strengths and weaknesses. *POLITI-*

[8] POLITICAL_TURNOVER could also proxy for something other than political connection. For example, it is common to observe significant nationwide government policy changes associated with routine nationwide top provincial official turnovers that favor some industries over others (see Chen et al., 2017). Such significant government policy changes could affect the fortunes of some billionaires caught in the affected industries due to increased uncertainty. Although such policy changes could be the result of changing political connections, they do not have to be. To control for this alternative explanation, we also include industry×year fixed effects in the regression and obtain similar inferences (see Table 5).

CAL_CONNECTION is a direct but partial measure of a billionaire's political connection, as it does not capture less visible forms of political connection. *POLITICAL_TURNOVER* is more comprehensive, as it can capture less visible forms of political connection. In addition, *POLITICAL_TURNOVER* is more exogenous, as top official turnovers at the provincial level are typically carefully planned by central government leadership (Piotroski and Zhang, 2014). However, *POLITICAL_TURNOVER* is less direct because some billionaires in a province may not be politically connected with the provincial governor or party secretary and therefore the latter's turnover may not necessarily affect the longevity of such billionaires in the province.

Political connection is an integral part of doing business in many emerging market economies, including China. However, there is an ongoing debate among China's business elites on the costs and benefits of political connection (Page and Spegele, 2012; Wu, 2013). Political connection can certainly bring tangible benefits to business owners. For example, it can help business owners secure bank loans, government contracts and subsidies (Goldman et al., 2013; Feng et al., 2015). It may also help shield business owners from the risk of expropriation by the government. However, political connection may also cause troubles for business owners. For example, the downfall of an important government official may implicate business owners who have past connections with the official (Page and Spegele, 2012). For billionaire entrepreneurs, however, the effect of political connection is less clear. Due to their deep pockets, politically connected billionaire entrepreneurs may be able to quickly reestablish their political connections with newly appointed provincial leaders after turnover. Therefore, the turnover of political leaders may be not critical to the longevity of billionaire entrepreneurs.

3.2.2. Social networks

Sociologists study the role of social networks in promoting or discouraging entrepreneurial activities (e.g. Peng, 2004). Social networks, such as family, friends or ethnic groups, play an important role in China, making the country an interesting context in which to study whether social networks affect the longevity of billionaire entrepreneurs. We measure a person's social networks using a dummy variable (*HOME*) that equals 1 if a billionaire entrepreneur's headquarters and birth place are located in the same province.

3.2.3. Personal characteristics

The psychology-based entrepreneurship literature recognizes the importance of personal traits (e.g., overconfidence, gender and education) to the success of entrepreneurs (Brockhaus, 1982; Sexton and Bowman-Upton, 1990; Hayward et al., 2006). However, it is unclear whether personal traits remain relevant to the success of billionaire entrepreneurs, as they represent the most successful surviving entrepreneurs. Even billionaire entrepreneurs with some undesirable personal traits should have a better ability than smaller entrepreneurs to overcome their personal shortcomings (e.g., overconfidence or lack of education), for example, through the employment of high-caliber business advisors.

Due to a lack of data, we can only measure the listed billionaire entrepreneurs' personal traits using publicly observable data. We consider three personal traits: gender (*GENDER*), age (*AGE*) and education. For education, we consider three different measures. The first measure is *COLLEGE*, a dummy variable that equals 1 if a billionaire entrepreneur has received full-time university education as evidenced by a bachelor degree, a master degree other than an MBA or a Ph.D. degree.[9] The second measure is *MBA*, a dummy variable that equals 1 if a billionaire entrepreneur has an MBA degree based on publicly available data sources. The third measure is *EMBA*, a dummy variable that equals 1 if a billionaire entrepreneur has an EMBA degree based on publicly available data sources. Due to data limitations, we do not know the exact year in

[9] Relevant Chinese regulations require students to be enrolled full-time to receive a bachelor degree. Although Chinese regulations do not require master (other than MBA) and Ph.D. students to have a bachelor degree as a prerequisite, we find that most universities do have this implicit requirement. Hence, we also assume that a billionaire has received full-time university education if she has a master (other than MBA) or Ph.D. degree, despite that publicly available data sources do not report a bachelor degree.

which a billionaire entrepreneur received her degrees. Therefore, the coefficients on the education variables could be subject to the concern of reverse causality. This concern is more likely for *EMBA* than for *COLLEGE* and *MBA*, as many Chinese EMBA programs cater to successful individuals.

3.2.4. Other control variables

We also include a miscellaneous list of other controls. Local resource endowment, such as local per capita GDP (*GDP*), transportation infrastructure (*ROAD*), human capital (*POP*) and industrial parks (*IPS*), could still matter to a large entrepreneur's longevity and therefore should be controlled for. We also control for retirement (*RETIRE*) to account for the effect of inter-generational wealth transfer. We include *WEALTH* to control for the fact that billionaires with more wealth are less likely to drop out of the combined annual Forbes and Hurun billionaire list. We include *SMALL* to control for the fact that some billionaires may drop out of the annual billionaire list simply because Forbes and Hurun increase their minimum requirements for inclusion on their lists. *SMALL* is a dummy variable that equals 1 if a billionaire's wealth in year t–1 is less than the wealth of the lowest ranked billionaire in year t. We include both industry and year fixed effects. If a billionaire controls businesses in multiple industries, industry fixed effects are set to 1 for all of those industries.

4. Regression results

4.1. Descriptive statistics

Panel A of Table 3 reports the descriptive statistics for the explanatory variables used in the hazard regression. It shows that 32.8 % of the billionaires have at least one publicly listed firm. The mean of *POLITICAL_CONNECTION* indicates that 36.4 % of the billionaires are either People's Congress representatives or CPPCC members. The mean of *POLITICAL_TURNOVER* is 0.602, suggesting frequent turnover of top provincial political leaders. Among the billionaires, 33.3 % have received full-time undergraduate education and 6.4 % (6.5 %) have an MBA (EMBA) degree. The mean age of the billionaires is approximately 49 years and 4.1 % of the billionaires are female.

Panel B of Table 3 shows the correlations among the regression variables. With the exception of *PROPERTY_RIGHTS*, *CONTRACTING* and *FINANCE*, none of the pairwise correlations among the explanatory variables exceeds 0.50.

4.2. Primary regression results

Table 4 shows the primary regression results for the determinants of billionaire entrepreneurs' longevity. The reported significance levels in this and subsequent hazard regressions are based on standard errors clustered by billionaire.[10] Column (1) of Table 4 shows the regression results without *AGE*, whereas column (2) of Table 4 shows the regression results with *AGE* included. Due to missing values on *AGE*, the sample size in column (2) is smaller. As the inferences are similar for both columns (1) and (2), we omit AGE in the subsequent regression models to maintain a larger sample.

Focusing on the results in column (1), we find that not all institutional environment factors are important in explaining billionaire entrepreneurs' longevity. First, the coefficients on *PROPERTY_RIGHTS* and *CONTRACTING* are insignificant, suggesting no evidence that property rights institutions or contracting institutions matter to the longevity of billionaire entrepreneurs. This conflicts with the findings of Acemoglu and Johnson (2005) and Cull and Xu (2005).

The insignificant coefficients on *PROPERTY_RIGHTS* and *CONTRACTING* are unlikely to be due to lack of power because, as Cull and Xu (2005) show, both property rights and contracting institutions exhibit significant variation across China's provinces. In addition, Cull and Xu (2005) find significant effects of

[10] As a robustness check, we also cluster standard errors by province and find similar results (untabulated), although the asymptotic properties of such standard errors could be invalid as we only have a small number of provinces (Woodridge, 2010).

Table 3
Descriptive statistics for the hazard regression sample Panel A Descriptive statistics for the regression variables.

Variable	N	Mean	Std. dev.	Q1	Median	Q3
FAILURE	8256	0.191	0.393	0.000	0.000	0.000
PROPERTY_RIGHTS	8256	0.517	0.500	0.000	1.000	1.000
CONTRACTING	8256	0.427	0.495	0.000	0.000	1.000
FINANCE	8256	0.395	0.489	0.000	0.000	1.000
LISTED	8256	0.328	0.469	0.000	0.000	1.000
POLITICAL_CONNECTION	8256	0.364	0.481	0.000	0.000	1.000
POLITICAL_TURNOVER	8256	0.602	0.490	0.000	1.000	1.000
HOME	8256	0.726	0.446	0.000	1.000	1.000
GENDER	8256	0.041	0.198	0.000	0.000	0.000
COLLEGE	8256	0.333	0.471	0.000	0.000	1.000
MBA	8256	0.064	0.244	0.000	0.000	0.000
EMBA	8256	0.065	0.247	0.000	0.000	0.000
GDP	8256	10.535	0.536	10.229	10.625	10.899
ROAD	8256	0.535	0.313	0.290	0.516	0.806
POP	8256	0.779	0.216	0.677	0.839	0.968
IPS	8256	0.729	0.262	0.484	0.839	0.935
RETIRE	8256	0.034	0.181	0.000	0.000	0.000
AGE	7746	3.889	0.161	3.784	3.871	4.007
WEALTH	8256	3.097	0.749	2.526	3.030	3.555
SMALL	8256	0.138	0.345	0.000	0.000	0.000

Panel B Pearson correlation table for the regression variables (two-tailed p values in parentheses)

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19	20
1.FAILURE	1.00																			
2.PROPERTY_RIGHTS	−0.01	1.00																		
3.CONTRACTING	−0.01	**0.61**	1.00																	
4.FINANCE	−0.01	**0.65**	**0.71**	1.00																
5.LISTED	**−0.04**	**0.03**	**0.03**	0.01	1.00															
6.POLITICAL_CONNECTION	**−0.10**	**−0.17**	**−0.11**	**−0.10**	**0.08**	1.00														
7.POLITICAL_TURNOVER	**0.03**	**0.08**	**0.14**	**0.12**	**0.04**	**−0.02**	1.00													
8.HOME	**0.02**	**−0.04**	**−0.05**	**0.12**	**−0.07**	**0.09**	**0.04**	1.00												
9.GENDER	0.02	−0.01	−0.02	−0.01	**−0.03**	**−0.03**	0.01	0.01	1.00											
10.COLLEGE	**−0.03**	**−0.03**	−0.01	**−0.11**	**0.08**	**−0.04**	**−0.03**	**−0.23**	**0.03**	1.00										
11.MBA	**−0.05**	**0.05**	**0.07**	**0.04**	0.01	**0.04**	−0.01	**−0.03**	−0.01	**0.02**	1.00									
12.EMBA	−0.01	0.01	0.01	−0.01	**0.06**	**0.02**	**0.02**	0.00	−0.01	**0.03**	**−0.03**	1.00								
13.GDP	**−0.04**	**0.43**	**0.45**	**0.28**	**0.06**	**−0.21**	**0.05**	**−0.27**	0.00	**0.07**	**0.05**	**0.02**	**1.00**							
14.ROAD	0.02	**−0.29**	**−0.43**	**−0.33**	**0.03**	**0.06**	**0.04**	**0.34**	**−0.02**	**−0.10**	**−0.06**	0.00	**−0.45**	1.00						
15.POP	0.01	**0.23**	**0.12**	**0.05**	**0.06**	**−0.19**	**−0.05**	−0.02	**−0.03**	**0.05**	0.01	0.00	**0.36**	**0.30**	1.00					
16.IPS	0.01	**0.30**	**0.10**	**0.33**	**0.04**	**−0.11**	**0.05**	**0.32**	**−0.03**	**−0.11**	**−0.03**	0.00	−0.01	**0.49**	**0.61**	1.00				
17.RETIRE	−0.01	**0.02**	**0.04**	**0.04**	**0.04**	**−0.05**	**0.02**	**0.05**	0.00	**−0.05**	**−0.04**	**−0.05**	**0.04**	0.01	0.00	0.02	1.00			
18.AGE	**−0.04**	−0.01	**0.04**	**0.06**	**0.05**	**0.09**	**0.06**	**0.15**	0.00	**−0.23**	**−0.09**	**−0.11**	**0.06**	**0.10**	−0.03	**0.05**	**0.42**	1.00		
19.WEALTH	**−0.30**	0.02	0.02	**−0.04**	**0.14**	**0.06**	**0.15**	**−0.10**	**0.04**	**0.06**	**0.04**	0.00	**0.35**	−0.03	**0.06**	**−0.03**	**0.06**	**0.14**	1.00	
20.SMALL	**0.41**	**−0.04**	**−0.03**	0.00	−0.02	**−0.06**	**−0.09**	**0.03**	0.02	−0.01	−0.02	0.00	**−0.06**	0.01	**−0.04**	**−0.03**	**−0.02**	**−0.03**	**−0.42**	1.00

The correlations highlighted in bold are significant at the 5% significance level or lower.

Table 4
Regression results of the Cox hazard model.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
PROPERTY_RIGHTS	0.029	0.056	−0.031			
	(0.643)	(0.396)	(0.542)			
CONTRACTING	0.057	0.087		−0.032		
	(0.379)	(0.220)		(0.525)		
FINANCE	−0.190**	−0.204**			−0.135**	−0.197***
	(0.017)	(0.018)			(0.021)	(0.002)
LISTED	−0.151***	−0.115**	−0.151***	−0.150***	−0.149***	−0.240***
	(0.001)	(0.013)	(0.001)	(0.001)	(0.001)	(0.000)
POLITICAL_CONNECTION	−0.214***	−0.159***	−0.212***	−0.211***	−0.214***	−0.215***
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
POLITICAL_TURNOVER	0.089*	0.070	0.076	0.080*	0.093*	0.084*
	(0.067)	(0.182)	(0.108)	(0.097)	(0.054)	(0.083)
HOME	0.002	0.013	−0.014	−0.012	0.002	−0.004
	(0.972)	(0.835)	(0.794)	(0.820)	(0.968)	(0.938)
GENDER	0.164*	0.150	0.160*	0.159*	0.162*	0.164*
	(0.057)	(0.102)	(0.063)	(0.065)	(0.060)	(0.057)
COLLEGE	−0.080*	−0.077*	−0.072*	−0.072	−0.079*	−0.074*
	(0.068)	(0.096)	(0.099)	(0.100)	(0.071)	(0.091)
MBA	−0.341***	−0.341***	−0.343***	−0.342***	−0.339***	−0.341***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
EMBA	−0.104	−0.112	−0.103	−0.104	−0.105	−0.101
	(0.259)	(0.231)	(0.262)	(0.256)	(0.253)	(0.275)
GDP	−0.214**	−0.206*	−0.209**	−0.212**	−0.186*	−0.187*
	(0.039)	(0.063)	(0.041)	(0.036)	(0.057)	(0.054)
ROAD	−0.389***	−0.316**	−0.289**	−0.297**	−0.382***	−0.383***
	(0.005)	(0.035)	(0.027)	(0.024)	(0.006)	(0.005)
POP	0.321*	0.305	0.425**	0.429**	0.330*	0.329*
	(0.072)	(0.107)	(0.017)	(0.016)	(0.067)	(0.067)
IPS	0.208	0.169	0.036	0.029	0.187	0.196
	(0.152)	(0.276)	(0.771)	(0.813)	(0.190)	(0.170)
RETIRE	−0.048	0.122	−0.052	−0.051	−0.049	−0.048
	(0.719)	(0.391)	(0.692)	(0.696)	(0.710)	(0.715)
WEALTH	−1.285***	−1.337***	−1.282***	−1.283***	−1.287***	−1.284***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
SMALL	0.281***	0.299***	0.283***	0.281***	0.279***	0.283***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
AGE		−0.350**				
		(0.031)				
LIST × FINANCE						0.219***
						(0.009)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	8,256	7,746	8,256	8,256	8,256	8,256
Pseudo R^2	0.0500	0.0534	0.0498	0.0498	0.0499	0.0501

See the appendix for all variable definitions. For each billionaire entrepreneur, the sample used by the hazard analysis keeps all the yearly observations starting from the first year when the billionaire makes the annual billionaire list to the earlier of the year when the billionaire fails to make the annual billionaire list or the year 2013, the end of our sample period. Because our annual billionaire list starts from 2000, the longest sample period for a billionaire covers 2000–2013. Though relatively rare, we allow the same billionaire to enter and drop out of the annual list for more than once. The two-tailed p values are in parentheses and are based on heteroskedasticity-consistent standard errors adjusted for billionaire clustering. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

PROPERTY_RIGHTS, *CONTRACTING* and *FINANCE* on the corporate reinvestment decisions of small private Chinese firms. Consistent with Cull and Xu (2005), we also report in Section 5.8 that *PROPERTY_-RIGHTS* and *CONTRACTING* matter to the longevity of small entrepreneurs.

Second, consistent with Cull and Xu (2005), we find strong evidence that access to finance continues to matter to the longevity of billionaire entrepreneurs. The coefficients on *LISTED* and *FINANCE* are both significantly negative.[11]

The contrasting results for *PROPERTY_RIGHTS* and *CONTRACTING* versus access to finance (*FINANCE* and *LISTED*) are interesting because they capture different dimensions of provincial institutional environment factors. Our results suggest that billionaire entrepreneurs have the ability to mitigate the negative effects of property rights institutions (*PROPERTY_RIGHTS*) and contracting institutions (*CONTRACTING*), but they cannot nullify the negative effects of financing constraints (*FINANCE* and *LISTED*). These findings suggest that government policies that increase entrepreneurs' access to finance are likely to be more effective than government policies that enhance property rights and contracting institutions in promoting the longevity of billionaire entrepreneurs.

We find evidence that political connection matters to the longevity of billionaire entrepreneurs. Specifically, billionaire entrepreneurs are less likely to fail if they are representatives of the People's Congress or members of the CPPCC (*POLITICAL_CONNECTION*).[12] However, billionaire entrepreneurs are more likely to fail if they are located in provinces where either the provincial governor or party secretary or both turned over in year t and t–1 (*POLITICAL_TURNOVER*). These results suggest that political connection still matters to billionaire entrepreneurs.

With regard to the social network factors, the coefficient on *HOME* is insignificant, suggesting that social networks do not matter for the longevity of billionaire entrepreneurs.

We find evidence that personal characteristics matter to the success of billionaire entrepreneurs. Specifically, we find that female billionaires are more likely to fail. We also find weak evidence that full-time university education (*COLLEGE*) matters to the longevity of billionaire entrepreneurs. Interestingly, the coefficient on *MBA* is significantly negative and large in magnitude, whereas the coefficient on *EMBA* is insignificant.

With regard to the other control variables in column (1), we note that the coefficients on *GDP* and *ROAD* are significantly negative, suggesting that the per capita GDP and transportation infrastructure of a province still make a positive contribution to the success of billionaire entrepreneurs. The coefficients on *WEALTH* and *SMALL* are both significant and as predicted.

Regarding the regression in column (2), which includes *AGE*, the inferences for the aforementioned institutional environment factors remain qualitatively the same. In addition, the coefficient on *AGE* is significantly negative, with a p value of 0.031, suggesting that older billionaire entrepreneurs are more likely to maintain their success.

4.3. Multicollinearity concern

The pairwise correlations among *PROPERTY_RIGHTS*, *CONTRACTING* and *FINANCE* all exceed 0.60 (Table 3, Panel B). Thus, multicollinearity is a potential concern for the regression results reported in column (1). To address this concern, we report the regression results including *PROPERTY_RIGHTS*, *CONTRACT-*

[11] One could argue that the significantly negative coefficient on *LISTED* is due to either a higher valuation of a billionaire's assets after listing or a more accurate valuation of a billionaire's assets due to better information disclosure of many previously hidden assets. This alternative explanation is unlikely because we control for each billionaire's *WEALTH* in the regression. The coefficient on *LISTED* remains significantly negative even after we recode *LISTED* as 0 for the first year of stock listing (untabulated).

[12] The coefficient on *POLITICAL_CONNECTION* could be subject to reverse causality: billionaire entrepreneurs who are expected to be successful are more likely to be selected as representatives of the People's Congress or members of the CPPCC. To rule out this alternative explanation, we break *POLITICAL_CONNECTION* into two parts, namely *POLITICAL_CONNECTION1*, a dummy variable that equals 1 if a person was elected to be a representative of the national or provincial People's Congress or a member of the national or provincial CPPCC (5-year term) in the most recent 2 years (i.e., t–1 and t–2) and 0 otherwise, and *POLITICAL_CONNECTION2*, a dummy variable that equals 1 if a person was elected to be a representative of the national or provincial People's Congress or a member of the national or provincial CPPCC in years t–3 to t–5 and 0 otherwise. To the extent that the coefficient on *POLITICAL_CONNECTION* is due to reverse causality, we should expect the coefficient on *POLITICAL_CONNECTION1* to be significantly negative and the coefficient on *POLITICAL_CONNECTION2* to be insignificant because it is difficult to predict a billionaire entrepreneur's future 3–5 years down the road. Untabulated regression results show that the coefficients on *POLITICAL_CONNECTION1* and *POLITICAL_CONNECTION2* are both significantly negative. This evidence suggests that the coefficient on *POLITICAL_CONNECTION* is unlikely to be driven by reverse causality.

ING and *FINANCE* one at a time. Columns (3) and (4) of Table 4 continue to show no evidence that *PROPERTY_RIGHTS* and *CONTRACTING* matter in explaining billionaire entrepreneurs' longevity. The coefficient on *FINANCE* in column (5) remains significantly negative and similar in magnitude to the same coefficient in column (1). As the inference for *FINANCE* is similar regardless of whether *PROPERTY_RIGHTS* and *CONTRACTING* are included, we omit them in the subsequent regression analyses to simplify the model and avoid any multicollinearity concerns.

4.4. Closer examination of access to finance

The results in columns (1) and (5) of Table 4 suggest the importance of access to finance to the longevity of billionaire entrepreneurs. To better understand how access to finance (*FINANCE* and *LISTED*) affects billionaire entrepreneurs' longevity, we further allow the coefficient on *LISTED* in the column (5) model to vary with *FINANCE*. Both *LISTED* and *FINANCE* are proxies for access to finance, but *LISTED* captures a specific external financing channel available to an individual billionaire, whereas *FINANCE* captures the local external financing environment in the province of a billionaire's headquarters.

Corporate governance research in economics (La Porta et al., 1998) emphasizes the importance of the macro-level institutional environment to the welfare of individual business enterprises. Following this line of reasoning, we argue that the availability of a specific external financing channel (i.e., *LISTED*) should not matter much in regions with strong external financing environments (i.e., *FINANCE*) because a billionaire entrepreneur without a publicly listed entity as a financing channel can still raise capital from other financing channels at reasonable costs. In contrast, in regions with weaker external financing environments, the availability of a specific financing channel (e.g., a publicly listed entity) may matter a lot to a billionaire entrepreneur due to the lack of access to other alternative financing channels. Hence, we expect the coefficient on *LISTED* × *FINANCE* to be significantly positive.

Column (6) of Table 4 shows that the coefficient on *LISTED* × *FINANCE* is significantly positive. This additional analysis provides further support for the importance of access to finance to billionaire entrepreneurs' longevity.

5. Robustness checks

We perform a series of robustness checks to rule out a variety of potential alternative explanations for the regression results reported in Table 4.

5.1. Industry × year fixed effects

The model specification so far includes industry fixed effects and year fixed effects. However, certain industry effects may also vary over time. For example, as noted in footnote 7, the coefficient on *POLITICAL_TURNOVER* could be confounded by national government industry policy changes associated with routine top national and provincial leadership turnover unrelated to political connection (Chen et al., 2017). To control for this and many other potential alternative explanations, we include industry × year fixed effects for the regression model in column (5) of Table 4. As shown in column (1) of Table 5, we find no evidence that the inferences in column (5) of Table 4 are affected after the inclusion of industry × year fixed effects.

5.2. Limiting the sample to 2006–2013

We reconduct the hazard regression in column (5) of Table 4 by limiting the sample to the 2006–2013 period. This analysis is motivated by two considerations. First, *FINANCE* is missing for the years before 2006, with the 2006 values used for these years in Table 4. Second, as noted in Section 2, the coverage and quality of the combined annual Forbes and Hurun ranking increase over time with the increased experience and visibility

Table 5
Robust tests based on the Cox hazard model in column (5) of Table 4.

	(1)	(2)	(3)	(4)
Variables	Include year × industry fixed effects	Keep years since 2006 only	Use billionaire family as unit of observation	Keep first-generation billionaires only
FINANCE	−0.116*	−0.132**	−0.140**	−0.166***
	(0.051)	(0.030)	(0.018)	(0.006)
LISTED	−0.152***	−0.141***	−0.122***	−0.164***
	(0.001)	(0.002)	(0.007)	(0.001)
POLITICAL_CONNECTION	−0.230***	−0.230***	−0.179***	−0.224***
	(0.000)	(0.000)	(0.000)	(0.000)
POLITICAL_TURNOVER	0.111**	0.109**	0.108**	0.093*
	(0.024)	(0.032)	(0.027)	(0.064)
HOME	0.008	0.014	0.004	−0.008
	(0.887)	(0.813)	(0.946)	(0.883)
GENDER	0.159*	0.182**	0.130	0.178**
	(0.057)	(0.037)	(0.161)	(0.041)
COLLEGE	−0.092**	−0.068	−0.060	−0.074
	(0.033)	(0.136)	(0.177)	(0.103)
MBA	−0.330***	−0.299***	−0.327***	−0.350***
	(0.001)	(0.003)	(0.001)	(0.001)
EMBA	−0.105	−0.118	−0.135	−0.173*
	(0.259)	(0.221)	(0.138)	(0.070)
GDP	−0.208**	−0.189*	−0.121	−0.202**
	(0.038)	(0.076)	(0.195)	(0.044)
ROAD	−0.403***	−0.391***	−0.325**	−0.416***
	(0.003)	(0.006)	(0.020)	(0.004)
POP	0.311*	0.349*	0.230	0.294
	(0.098)	(0.076)	(0.196)	(0.109)
IPS	0.205	0.189	0.201	0.258*
	(0.158)	(0.201)	(0.171)	(0.079)
RETIRE	−0.036	−0.103	−0.159	−0.019
	(0.788)	(0.448)	(0.252)	(0.894)
WEALTH	−1.305***	−1.371***	−1.467***	−1.269***
	(0.000)	(0.000)	(0.000)	(0.000)
SMALL	0.275***	0.253***	0.220***	0.268***
	(0.000)	(0.002)	(0.004)	(0.001)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
N	8,256	7,665	8,092	7,928
Pseudo R^2	0.0584	0.0520	0.0543	0.0502

See the appendix for all variable definitions. The two-tailed p values are in parentheses and are based on heteroskedasticity-consistent standard errors adjusted for billionaire clustering. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

of both publishers. As shown in column (2) of Table 5, we find no evidence that the inferences in column (5) of Table 4 are affected when the sample period is limited to the 2006–2013 period. In particular, the coefficient on *FINANCE* remains significantly negative and comparable in magnitude to the same coefficient in column (5) of Table 4.

5.3. Billionaire families

The unit of observation in Table 4 is a billionaire year. However, some billionaires in our sample belong to the same families and thus may not represent independent observations. Hence, we redefine the unit of

observation based on the concept of billionaire families rather than individual billionaires. We deem two or more billionaires to belong to the same family if they are close family members or relatives, including spouses, parents, children or siblings.[13] Untabulated descriptive statistics show that approximately 3.6 % of the billionaire entrepreneurs in our sample belong to the same billionaire families. As shown in column (3) of Table 5, none of the inferences in column (5) of Table 4 is affected by using billionaire family as the unit of analysis.

5.4. First-generation entrepreneurs

Our primary research subject of interest is self-made billionaire entrepreneurs. Hence, we also redo the regression analysis in column (5) of Table 4 by retaining only the billionaires who are first-generation entrepreneurs. As discussed in Section 1, first-generation billionaires are genuine entrepreneurs due to China's unique history, whereas second-generation billionaires are not necessarily so. We exclude 19 billionaires who are the children of first-generation entrepreneurs. We also exclude 103 billionaires who became billionaires through the privatization of Chinese state-owned enterprises (SOEs) rather than through starting their businesses from scratch. As shown in column (4) of Table 5, none of the inferences in column (5) of Table 4 is affected using this more refined sample of billionaire entrepreneurs.

5.5. Alternative measures of PROPERTY_RIGHTS, CONTRACTING and FINANCE

Instead of using *PROPERTY_RIGHTS*, *CONTRACTING* and *FINANCE* from Wang et al. (2013) to proxy for property rights institutions, contracting institutions and access to finance, respectively, we use an alternative set of indices (*PROPERTY_RIGHTS_WB*, *CONTRACTING_WB* and *FINANCE_WB*, respectively) independently developed by the World Bank based on a city-level investment climate survey of 120 Chinese cities (covering 12,400 firms across all provinces other than Tibet) in 2005 (see World Bank, 2006).[14] *PROPERTY_RIGHTS_WB* is the average of the following three indices: taxes, entertainment expenditure and the number of days in a year interacting with the government. *CONTRACTING_WB* is the survey respondent's confidence in the judicial system. *FINANCE_WB* is the average of two indices: private firms' ease of access to bank loans and the transaction costs required to obtain a bank loan. The values of *PROPERTY_RIGHTS_WB*, *CONTRACTING_WB* and *FINANCE_WB* in a province are the average values of the same variables for all of the cities in the province. As the World Bank's survey data are available for 2005 only, we assume that the values of *PROPERTY_RIGHTS_WB*, *CONTRACTING_WB* and *FINANCE_WB* do not change over time.

Table 6 shows the regression results that replicate the results in columns (1) and (3) to (6) of Table 4 using the three alternative proxies. The coefficients on *PROPERTY_RIGHTS_WB* and *CONTRACTING_WB* remain insignificant and the coefficient on *FINANCE_WB* is significantly negative. These results are consistent with those in Table 4. However, the coefficient *on LISTED* × *FINANCE_WB* in column (5) of Table 6 is not significant.

5.6. Using a higher yearly cutoff to define billionaire failure

The reported hazard regressions so far use a billionaire's delisting from the combined annual Forbes and Hurun billionaire list as a failure event. The annual minimum cutoff for the list is determined by the two publishers themselves. As discussed in Section 3, some billionaires close to these annual minimum cutoffs in one year could drop out of the list the following year simply because of an inherent measurement error in the billionaires' total wealth. So far, the regression model includes *WEALTH* as a control for this concern. To test the robustness of our inferences, we also define billionaire failure using a yearly cutoff that is at least 20 %

[13] When collapsing the individual billionaire observations that belong to the same family in a year into a single billionaire family observation, we use the average value for *ROAD*, *IPS*, *POP* and *FINANCE*, the largest value for *LISTED*, *POLITICAL_CONNECTION*, *COLLEGE*, *MBA*, *EMBA*, *GENDER*, *HOME*, *POLITICAL_TURNOVER* and *RETIRE* and the sum of the individual values for *WEALTH* and *SMALL*.

[14] An earlier 2003 version of the same World Bank survey covering 18 cities is used in Cull and Xu (2005).

Table 6
Robustness checks using World Bank data for PROPERTY_RIGHTS, CONTRACTING, and FINANCE.

Variables	(1)	(2)	(3)	(4)	(5)
PROPERTY_RIGHTS_WB	−0.055	−0.170			
	(0.743)	(0.107)			
CONTRACTING_WB	−0.043		−0.181		
	(0.816)		(0.112)		
FINANCE_WB	−0.196*			−0.227**	−0.205*
	(0.053)			(0.014)	(0.061)
LISTED	−0.149***	−0.150***	−0.150***	−0.150***	−0.102
	(0.001)	(0.001)	(0.001)	(0.001)	(0.376)
POLITICAL_CONNECTION	−0.217***	−0.215***	−0.214***	−0.215***	−0.215***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
POLITICAL_TURNOVER	0.068	0.069	0.067	0.070	0.071
	(0.151)	(0.148)	(0.158)	(0.138)	(0.132)
HOME	−0.008	−0.020	−0.015	−0.007	−0.006
	(0.880)	(0.719)	(0.779)	(0.893)	(0.906)
GENDER	0.161*	0.164*	0.165*	0.162*	0.160*
	(0.061)	(0.058)	(0.056)	(0.059)	(0.062)
COLLEGE	−0.076*	−0.071	−0.070	−0.076*	−0.077*
	(0.081)	(0.105)	(0.106)	(0.081)	(0.078)
MBA	−0.344***	−0.343***	−0.347***	−0.345***	−0.345***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
EMBA	−0.104	−0.099	−0.099	−0.107	−0.108
	(0.259)	(0.282)	(0.281)	(0.241)	(0.240)
GDP	−0.238**	−0.242**	−0.269***	−0.225**	−0.225**
	(0.015)	(0.011)	(0.005)	(0.018)	(0.018)
ROAD	−0.343**	−0.291**	−0.268**	−0.355***	−0.356***
	(0.011)	(0.025)	(0.040)	(0.006)	(0.006)
POP	0.411**	0.460***	0.406**	0.405**	0.406**
	(0.026)	(0.009)	(0.022)	(0.020)	(0.020)
IPS	0.152	0.121	0.161	0.093	0.092
	(0.306)	(0.365)	(0.281)	(0.453)	(0.458)
RETIRE	−0.052	−0.055	−0.047	−0.052	−0.053
	(0.696)	(0.676)	(0.720)	(0.692)	(0.685)
WEALTH	−1.277***	−1.276***	−1.276***	−1.279***	−1.280***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
SMALL	0.279***	0.284***	0.282***	0.277***	0.278***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LIST × FINANCE_WB					−0.078
					(0.660)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
N	8,248	8,248	8,248	8,248	8,248
Pseudo R^2	0.0499	0.0498	0.0498	0.0499	0.0499

See the appendix for all variable definitions. The two-tailed p values are in parentheses and are based on heteroskedasticity-consistent standard errors adjusted for billionaire clustering. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

higher than the official yearly cutoff and then repeat all of the regression results in Table 4. As shown in Table 7, our inferences are qualitatively similar using this alternative definition.

5.7. Excluding billionaires operating in regulated industries

The primary interest of this study is large entrepreneurs who can make a positive contribution to China's economic growth. However, one could argue that the longevity of some Chinese billionaires could hinder rather than stimulate economic growth if they gained their wealth through corruptive means. Such a concern would be strong for firms operating in regulated industries (e.g., the oil industry), where government agencies and powerful SOEs control the scarce resources and private entrepreneurs have to bribe government officials

Table 7
Replication of Table 4 using a higher annual cutoff to define a billionaire failure.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
PROPERTY_RIGHTS	0.053	0.046	0.008			
	(0.357)	(0.450)	(0.867)			
CONTRACTING	0.059	0.076		−0.001		
	(0.322)	(0.234)		(0.978)		
FINANCE	−0.162**	−0.182**			−0.093*	−0.138**
	(0.029)	(0.024)			(0.099)	(0.026)
LISTED	−0.092**	−0.056	−0.092**	−0.092**	−0.090**	−0.150***
	(0.035)	(0.213)	(0.035)	(0.035)	(0.038)	(0.006)
POLITICAL_CONNECTION	−0.193***	−0.157***	−0.191***	−0.191***	−0.194***	−0.194***
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
POLITICAL_TURNOVER	0.001	−0.006	−0.010	−0.010	0.003	−0.001
	(0.979)	(0.900)	(0.825)	(0.834)	(0.958)	(0.989)
HOME	0.032	0.043	0.019	0.019	0.032	0.025
	(0.542)	(0.437)	(0.716)	(0.707)	(0.544)	(0.625)
GENDER	0.049	0.003	0.043	0.043	0.044	0.043
	(0.547)	(0.969)	(0.592)	(0.594)	(0.583)	(0.594)
COLLEGE	−0.098**	−0.082*	−0.091**	−0.092**	−0.097**	−0.094**
	(0.020)	(0.069)	(0.030)	(0.029)	(0.022)	(0.026)
MBA	−0.225**	−0.201**	−0.227***	−0.226***	−0.218**	−0.222**
	(0.011)	(0.023)	(0.009)	(0.010)	(0.012)	(0.011)
EMBA	−0.040	−0.046	−0.040	−0.040	−0.041	−0.040
	(0.590)	(0.546)	(0.587)	(0.588)	(0.580)	(0.588)
GDP	−0.178*	−0.172*	−0.172*	−0.167*	−0.140	−0.141
	(0.052)	(0.080)	(0.056)	(0.063)	(0.105)	(0.104)
ROAD	−0.312***	−0.288**	−0.236**	−0.239**	−0.307**	−0.307**
	(0.010)	(0.028)	(0.036)	(0.035)	(0.011)	(0.011)
POP	0.296*	0.275	0.381**	0.377**	0.302*	0.303*
	(0.065)	(0.105)	(0.017)	(0.020)	(0.062)	(0.061)
IPS	0.069	0.075	−0.071	−0.064	0.054	0.057
	(0.598)	(0.589)	(0.537)	(0.581)	(0.683)	(0.662)
RETIRE	−0.105	0.003	−0.109	−0.109	−0.107	−0.108
	(0.453)	(0.986)	(0.437)	(0.436)	(0.444)	(0.438)
WEALTH	−1.514***	−1.553***	−1.514***	−1.514***	−1.516***	−1.515***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
SMALL	0.051	0.076	0.053	0.053	0.049	0.050
	(0.470)	(0.318)	(0.450)	(0.454)	(0.486)	(0.482)
AGE		−0.184				
		(0.248)				
LIST × FINANCE						0.149*
						(0.075)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	6,922	6,557	6,922	6,922	6,922	6,922
Pseudo R^2	0.0480	0.0516	0.0479	0.0479	0.0480	0.0481

See the appendix for all variable definitions. We define billionaire failure using a cutoff each year that is at least 20% higher than the cutoff used in Table 4. The two-tailed p values are in parentheses and are based on heteroskedasticity-consistent standard errors adjusted for billionaire clustering. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

or have special connections to win business. Hence, we also repeat the results in Table 4 by excluding the billionaires whose businesses operate in regulated industries. Following Fan et al. (2007), we define the following industries as regulated: natural resources, public utilities, finance and real estate. Table 8 shows the regression results. The sample size in Table 8 is about 60 % of that in Table 4. Still, all of our inferences remain unchanged for the results reported in Table 8.

Table 8
Replication of Table 4 excluding billionaires operating in regulated industries.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
PROPERTY_RIGHTS	0.065	0.078	0.001			
	(0.378)	(0.313)	(0.983)			
CONTRACTING	0.088	0.128		−0.006		
	(0.260)	(0.119)		(0.922)		
FINANCE	−0.226**	−0.242**			−0.127*	−0.216***
	(0.015)	(0.013)			(0.053)	(0.003)
LISTED	−0.140***	−0.106**	−0.140***	−0.140***	−0.138***	−0.255***
	(0.005)	(0.044)	(0.005)	(0.005)	(0.006)	(0.000)
POLITICAL_CONNECTION	−0.153***	−0.116**	−0.150***	−0.150***	−0.154***	−0.154***
	(0.004)	(0.039)	(0.005)	(0.005)	(0.004)	(0.004)
POLITICAL_TURNOVER	0.111**	0.088	0.098*	0.099*	0.118**	0.105*
	(0.046)	(0.135)	(0.067)	(0.071)	(0.030)	(0.055)
HOME	0.110*	0.127*	0.090	0.091	0.111*	0.104
	(0.093)	(0.073)	(0.170)	(0.166)	(0.090)	(0.112)
GENDER	0.126	0.132	0.123	0.123	0.125	0.122
	(0.194)	(0.187)	(0.206)	(0.205)	(0.195)	(0.212)
COLLEGE	−0.038	−0.032	−0.025	−0.025	−0.038	−0.031
	(0.448)	(0.550)	(0.620)	(0.614)	(0.457)	(0.541)
MBA	−0.324***	−0.309***	−0.321***	−0.321***	−0.319***	−0.323***
	(0.005)	(0.009)	(0.006)	(0.006)	(0.006)	(0.005)
EMBA	−0.103	−0.103	−0.096	−0.096	−0.103	−0.094
	(0.317)	(0.324)	(0.347)	(0.346)	(0.312)	(0.362)
GDP	−0.201	−0.181	−0.197	−0.194	−0.150	−0.143
	(0.114)	(0.174)	(0.119)	(0.120)	(0.214)	(0.236)
ROAD	−0.451***	−0.381**	−0.356**	−0.360**	−0.445***	−0.438***
	(0.007)	(0.033)	(0.025)	(0.025)	(0.007)	(0.008)
POP	0.347	0.336	0.483**	0.480**	0.370*	0.361*
	(0.107)	(0.132)	(0.026)	(0.026)	(0.089)	(0.097)
IPS	0.106	0.059	−0.087	−0.083	0.076	0.082
	(0.531)	(0.742)	(0.550)	(0.569)	(0.649)	(0.621)
RETIRE	−0.234	−0.149	−0.231	−0.231	−0.231	−0.227
	(0.136)	(0.359)	(0.142)	(0.142)	(0.139)	(0.143)
WEALTH	−1.408***	−1.455***	−1.404***	−1.405***	−1.410***	−1.406***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
SMALL	0.082	0.085	0.082	0.081	0.078	0.088
	(0.365)	(0.381)	(0.364)	(0.368)	(0.391)	(0.331)
AGE		−0.134				
		(0.462)				
LIST × FINANCE						0.282***
						(0.003)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	4,976	4,694	4,976	4,976	4,976	4,976
Pseudo R^2	0.0489	0.0525	0.0487	0.0487	0.0488	0.0491

See the appendix for all variable definitions. Following Fan et al. (2007), regulated industries are defined as follows: natural resources, public utilities, finance and real estate. The two-tailed p values are in parentheses and are based on heteroskedasticity-consistent standard errors adjusted for billionaire clustering. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

5.8. Institutional environment factors and small entrepreneurs

We find no evidence in Table 4 that property rights institutions and contracting institutions matter to the longevity of billionaire entrepreneurs. A natural concern one could have about this result is whether our proxies, namely *PROPERTY_RIGHTS* and *CONTRACTING*, are simply too noisy. We do not believe this explanation to be credible because all three institutional factors are collected using the same survey methodology. To further rule out this possibility, we use the same proxies to examine the impact of institutional environment

Table 9
Cox hazard regression results on the impact of institutional environment factors on the longevity of small entrepreneurial firms.

Variables	(1)	(2)	(3)	(4)
PROPERTY_RIGHTS	−0.1475***	−0.2071***		
	(-9.344)	(-20.931)		
CONTRACTING	−0.0589***		−0.1674***	
	(-4.262)		(-17.939)	
FINANCE	−0.0196			−0.1670***
	(-1.330)			(-17.011)
SALES	−0.2615***	−0.2613***	−0.2589***	−0.2592***
	(-60.801)	(-60.735)	(-60.116)	(-60.272)
FIRM_AGE	0.0880***	0.0873***	0.0846***	0.0844***
	(11.137)	(11.049)	(10.682)	(10.664)
GDP	0.4004***	0.3994***	0.3662***	0.3281***
	(24.167)	(24.466)	(22.822)	(21.113)
ROAD	0.7120***	0.7234***	0.7343***	0.6960***
	(32.043)	(33.069)	(33.397)	(31.008)
POP	0.0353	0.0385	0.1059***	0.0190
	(0.950)	(1.055)	(2.990)	(0.513)
IPS	−0.7584***	−0.7680***	−0.8417***	−0.6997***
	(–23.004)	(–25.194)	(-29.003)	(-21.420)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
N	560,150	560,150	560,150	560,150

We obtained the sample of small entrepreneurial firms in China over the period 2000–2010 from the Annual Industrial Survey database provided by China's National Statistical Bureau (NSB). Due to missing data, the data for Shanxi and Hunan end in 2009. We define small entrepreneurial firms as privately owned domestic Chinese firms whose annual sales revenues from continuing operations in the year immediately after the company's registration year are below RMB300 million, a cutoff used by NSB to define small and medium enterprises. We require the small entrepreneurial firms to be registered no earlier than 2000. A firm is defined to have failed when it exits from the NSB database, which happens when a firm's annual sales revenues from continuing operations fall below RMB5 million. SALES is the natural logarithm of sales revenues from continuing operations in year/t. FIRM_AGE is the natural logarithm of a firm's age since registration year measured in year/t. See the appendix for all other variable definitions. The two-tailed p values are in parentheses and are based on heteroskedasticity-consistent standard errors adjusted for firm clustering. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

factors on the longevity of small entrepreneurs. We argue that small entrepreneurs are unlikely to have the status, resources and power to circumvent the adverse effects of weak institutional environment factors. Hence, we predict that *PROPERTY_RIGHTS* and *CONTRACTING* should still matter to the longevity of small entrepreneurs.

We test our prediction using a sample of small entrepreneurial firms from the Annual Industrial Survey database provided by China's National Statistical Bureau (NSB). Small entrepreneurial firms are defined as privately owned domestic Chinese firms whose annual sales revenues from continuing operations in the year immediately after their registration year are below RMB300 million, a cutoff used by the NSB to define small and medium-sized enterprises.[15] We assume that each small entrepreneur owns only one small entrepreneurial firm, which seems to be a reasonable assumption for small entrepreneurs. Once we have identified a small entrepreneurial firm as of the registration year, we follow the firm over time till it drops out of the NSB database—our definition of a failure event. We allow small entrepreneurial firms to fail multiple times. During our sample period the NSB database covers only firms whose annual sales revenues from continuing operations are at least RMB5 million. Hence, dropping out of the NSB database does not necessarily imply that a small entrepreneurial firm suffers a complete failure, just as our failure definition for billionaire entrepreneurs does not.

As the sample period for our Table 4 covers 2000–2013 and the NSB data we have only cover 1999–2010, we limit the NSB data to the 2000–2010 period. We require a firm's registration year to be no earlier than 1999 because we need a firm's sales revenue in the year following the registration year for the definition of small

[15] We use the year after a company's registration year to define small entrepreneurial firms because the annual sales for the year of registration may not represent a full year.

firms. The final sample used in the regression analysis contains 560,150 firm years, representing 185,894 unique firms.

Table 9 shows the Cox hazard regression results on the impact of institutional environment factors on the longevity of small entrepreneurial firms.[16] To the extent possible, we include the same control variables as in Table 4. As firms with higher sales revenues are less likely to fail, we include lagged sales revenues (SALES) as a control. We also include lagged firm age (FIRM_AGE) to control for potential effects related to a firm's history. In addition, we control for standard year and industry fixed effects. The key variables of interest are *PROPERTY_RIGHTS*, *CONTRACTING* and *FINANCE*. The coefficients on all three institutional factors are negative as predicted, but only the coefficients on *PROPERTY_RIGHTS* and *CONTRACTING* are significant. Due to the potential collinearity of the three factors, we also include them one by one and find that all three coefficients are significantly negative. Overall, the results reported in Table 9 rule out the alternative explanation that the lack of results for *PROPERTY_RIGHTS* and *CONTRACTING* in Table 4 is due to noise in these two institutional factor proxies.

6. Conclusion

Despite the significance of large entrepreneurs to economic growth in many economies, little attention is paid to the challenges facing large entrepreneurs. This represents a significant gap in the literature, as institutional environment factors could also matter to the continuous success of large entrepreneurs. The objective of this study is to examine the importance of institutional environment factors to the longevity of large entrepreneurs. We consider the following types of institutional environment factors based on prior economics research: (a) the two key factors identified by Acemoglu and Johnson (2005) as important in explaining macroeconomic outcomes across countries (i.e., property rights institutions and contracting institutions) and (b) access to finance. We test our research question using a large sample of self-made billionaire entrepreneurs from a combined version of the annual Forbes and Hurun billionaire lists in China over the 2000–2013 period. A billionaire entrepreneur loses her longevity when she drops out of the combined annual billionaire list by Forbes and Hurun.

We find that access to finance is important in explaining billionaire entrepreneurs' longevity. Whereas property rights institutions and contracting institutions matter to the longevity of small entrepreneurs, we find no evidence that they matter to the longevity of billionaire (i.e., large) entrepreneurs. Our results suggest the importance of distinguishing small versus large entrepreneurs in future economics research.

We contribute to several streams of literature. First, we contribute to the entrepreneurship literature. Most entrepreneurship studies focus on small business owners, but little research has been conducted on large entrepreneurs. By conducting the first micro-level study on the importance of institutional environment factors to large entrepreneurs' longevity, we broaden the understanding of such entrepreneurs. Second, we contribute to the new institutional economics literature, following the pioneering works of Nobel laureates Ronald Coase, Oliver Williamson and Douglas North. Although it has long been recognized that economic, political and legal institutions are significant determinants of aggregate economic outcomes, research on the roles of various institutions at the entrepreneur level, especially for large entrepreneurs, remains limited. We contribute to this literature by providing the first evidence on the relative roles of various institutions in explaining the longevity of large entrepreneurs. Third, our study is also related to the law and finance literature, following La Porta et al. (1998). This stream of literature primarily focuses on the protection of minority shareholders in publicly listed firms from expropriation by controlling shareholders. In contrast, we study the welfare of large entrepreneurs, who could be the controlling shareholders of many publicly listed firms. Our results show that the importance of certain institutional environment factors, such as property rights and contracting institutions, differs for minority investors versus large entrepreneurs as controlling shareholders.

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.

[16] We wish to thank Na Liu for helping us perform the analysis in Table 9.

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Appendix. Variable definitions

Variable	Definition and Data Source
FAILURE	1 if a billionaire drops out of the billionaire list in year t, and zero otherwise. Source: The Forbes and Hurun billionaire lists.
PROPERTY_RIGHTS	A dummy variable that measures the quality of property rights protection in the province of a billionaire entrepreneur's business headquarters. We use Wang et al.'s (2013) index of "public administration" to proxy for property rights institutions. Consistent with Acemoglu and Johnson (2005), PROPERTY_RIGHTS measures various dimensions of the government's public administration (i.e., expropriation risk by the government and powerful elites), including transparency and fairness, efficiency, government interference in business, and government corruption. To mitigate measurement errors, we convert the index into a dichotomous variable that is one for the top 20 % ranked provinces each year and zero otherwise. We use a cutoff of 20 % in order to have a more balanced distribution of the provinces with high versus low index values. Wang et al.'s (2013) survey data are available for 2006, 2008, 2010, and 2012. Because our sample starts from 2000, we use the values of the indices in 2006 for the early years 2000–2005. We use the indices in 2008 for the years 2007 and 2008, the indices in 2010 for 2009 and 2010, and the indices in 2012 for 2011–2013. Two underdeveloped provinces, Tibet and Qinghai, are excluded from Wang et al.'s indices and therefore PROPERTY_RIGHTS is automatically coded as zero for these two provinces. Source: Wang et al.'s (2013).
CONTRACTING	A dummy variable that measures the quality of contracting institutions in the province of a billionaire entrepreneur's business headquarters. We use Wang et al.'s (2013) index "legal environment of business enterprises" to proxy for contracting institutions. Consistent with Acemoglu and Johnson (2005), CONTRACTING measures the judicial system's fairness and efficiency and the protection of a business enterprise's legitimate rights such as business contract execution, intellectual property rights, and personal and property safety. To mitigate measurement errors, we convert the index into a dichotomous variable that is one for the top 20 % ranked provinces each year and zero otherwise. We use a cutoff of 20 % in order to have a more balanced distribution of the provinces with high versus low index values. Wang et al.'s (2013) survey data are available for2006, 2008, 2010, and 2012. Because our sample starts from 2000, we use the values of the indices in 2006 for the early years 2000–2005. We use the indices in 2008 for the years 2007 and 2008, the indices in 2010 for 2009 and 2010, and the indices in 2012 for 2011–2013. Two underdeveloped provinces, Tibet and Qinghai, are excluded from Wang et al.'s

(*continued*)

Variable	Definition and Data Source
	indices and therefore CONTRACTING is automatically coded as zero for these two provinces. Source: Wang et al.'s (2013).
FINANCE	A dummy variable that measures the financing environment in the province of a billionaire entrepreneur's business headquarters. FINANCE is based on Wang et al.'s (2013) index "financial services", which measures the quality of a province's financing environment, including both formal and informal financing channels. To mitigate measurement errors, we convert the index into a dichotomous variable that is one for the top 20 % ranked provinces each year and zero otherwise. Wang et al.'s (2013) survey data are available for 2006, 2008, 2010, and 2012. Because our sample starts from 2000, we use the values of the indices in 2006 for the early years 2000–2005. We use the indices in 2008 for the years 2007 and 2008, the indices in 2010 for 2009 and 2010, and the indices in 2012 for 2011–2013. Two underdeveloped provinces, Tibet and Qinghai, are excluded from Wang et al.'s indices and therefore FINANCE is automatically coded as zero for these two provinces. Source: Wang et al.'s (2013).
LISTED	1 if a billionaire controls a publicly listed firm as of beginning of year t and zero otherwise. Source: Manual collection and China Stock Market & Accounting Research Database (CSMAR).
POLITICAL_CONNECTION	1 if a billionaire is a representative of the national or provincial People's Congress or a member of the national or provincial Chinese People's Political Consultative Conference at the beginning of an observation year t and zero otherwise. Source: Manual collection.
POLITICAL_TURNOVER	A dummy variable indicating whether there is a turnover of the provincial governor or party secretary in the province of a billionaire's headquarters in year t or t-1. We require an official to have served in the position for at least two years before the turnover. Source: Manual collection.
HOME	A dummy variable that equals one if a billionaire entrepreneur's headquarters and birth place are located in the same province and zero otherwise. We could not locate the birth place information for 84 billionaires and therefore the values of HOME for these 84 individuals take the values of HOME for the majority of the billionaires whose business headquarters are located in the same province. Source: Manual collection.
GENDER	1 if a billionaire entrepreneur is female and zero otherwise. Source: Manual collection.
AGE	The natural logarithm of a billionaire's age at the beginning of year t. Source: Manual collection.
COLLEGE	A dummy variable that equals one if a billionaire entrepreneur has received full-time university education or higher and zero otherwise. COLLEGE is coded as zero for 826 billionaires who did not disclose any information about their educational background. Source: Manual collection.
MBA	1 if a billionaire entrepreneur has an MBA degree and zero otherwise. Source: Manual collection.

(*continued on next page*)

(*continued*)

Variable	Definition and Data Source
EMBA	1 if a billionaire entrepreneur has an EMBA degree and zero otherwise. Source: Manual collection.
GDP	The natural logarithm of provincial per capita GDP measured in year t-1. Source: CSMAR database.
ROAD	The annual ranking of the total mileage of high-ways, railroads, and water-ways in a province at end of year t-1. The ranking is scaled by the number of provinces included in the ranking. Source: CSMAR database.
POP	The annual ranking of the number of people with a diploma degree or higher measured in year t-1. The ranking is scaled by the number of provinces included in the ranking. Source: CSMAR database.
IPS	The annual ranking of the output produced by a province's national economic development zones and high-tech development zones in year t-1. The ranking is scaled by the number of provinces included in the ranking. The annual output figures for the national economic development zones are available only for the years 2001–2009. Hence, we use the 2001 values for year 2000 and the 2009 values for the post-2009 years. Source: China Development Zones Yearbook.
RETIRE	1 if a billionaire's age is greater than 65 at the beginning of year t. RETIRE is coded as zero for the 235 billionaires with missing age information. Source: Manual collection.
WEALTH	The natural logarithm of a billionaire's wealth in year t-1. Source: The Forbes and Hurun billionaire lists.
SMALL	1 if a billionaire's wealth in year t-1 is less than the wealth of the lowest ranked billionaire in year t and zero otherwise. Source: The Forbes and Hurun billionaire lists.
PROPERTY_RIGHTS_WB	An alternative proxy for property rights institutions based on World Bank's city-level investment climate survey of 120 Chinese cities in 2005. PROPERTY_RIGHTS_WB is developed using the following three indices: taxes, entertainment expenditure and the number of days in a year interacting with the government. The values of the three indices in a province are the average values of the same variables for all the cities in the province. We compute PROPERTY_RIGHTS_WB as follows: (i) rank all the provinces based on each of the three individual indices so that higher values imply better property rights institutions; (ii) compute the average rank of the three indices and then rank all the provinces again based on the average rank of the three indices. The ranking is scaled by the number of provinces included in the ranking. Tibet is excluded due to missing values. Source: World Bank(2006).
CONTRACTING_WB	An alternative proxy for contracting institutions based on World Bank's city-level investment climate survey of 120 Chinese cities in 2005. CONTRACTING_WB is developed using the survey respondents' confidence in the judicial system. CONTRACTING_WB is the ranking of all the provinces based on the index so that higher values imply better contracting institutions. The ranking is scaled by the number of provinces included in the ranking. Tibet is excluded due to missing values. Source: World Bank(2006).

(*continued*)

Variable	Definition and Data Source
FINANCE_WB	An alternative proxy for a province's financing environment based on World Bank's city-level investment climate survey of 120 Chinese cities in 2005. FINANCE_WB is developed using the following indices: private firms' ease of access to bank loans and the transaction costs required to obtain a bank loan. The values of the two indices in a province are the average values of the same variables for all the cities in the province. We compute FINANCE_WB as follows: (i) rank all the provinces based on each of the two individual indices so that higher values imply better financing environment; (ii) compute the average rank of the two indices and then rank all the provinces again based on the average rank of the two indices. The ranking is scaled by the number of provinces included in the ranking. Tibet is excluded due to missing values. Source: World Bank (2006).

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How to improve IFRS for intangible assets? A milestone approach

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ABSTRACT

This study focuses on the decreasing relevance of financial information associated with current financial reporting standards for intangible assets. We summarize and compare three approaches to improving financial reporting standards for internally generated intangibles—the recognition approach, the fair value approach and the disclosure approach, among which we focus on the recognition approach. We investigate the impact of current International Accounting Standard 38 on the R&D capitalization policies of the high-tech industry, particularly among medical device firms in China. We conclude that the current recognition criteria are so stringent that they disincentivize firms from capitalizing their R&D investments. A large variation exists in capitalization timing within the medical device industry. Accordingly, we propose the milestone approach to revising financial reporting standards for intangible assets. We suggest that determining the capitalization criteria for intangibles based on the R&D cycle and capitalization timing should be moved forward.

1. Introduction

With the surge of high-tech firms around the globe, the financial reporting of intangible assets, particularly internally generated assets, has become a hot issue in recent years. Related studies pay substantial attention to the debate about whether an increased number of internally generated intangibles should be recognized as assets. Because of the uncertain nature of research and development (R&D) projects, the financial reporting of intangibles represents a tradeoff between the relevance and the reliability of accounting information. In her literature review, Wyatt (2008) concludes that in general, R&D is not reliably measured, whereas financial and

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non-financial disclosures on R&D are value-relevant. Current International Accounting Standards (IAS) 38 on Intangible Assets prohibits capitalizing R&D expenditures during the research phase and only allows the capitalization of development costs when certain criteria are met. Because it usually takes years or even decades to achieve breakthroughs in frontier technology, the current IAS 38 results in a significant mismatch between R&D-related revenues and R&D-related expenses (Lev, 2018, 2019; Barker and Penman, 2020; Barker et al., 2022). Thus, the relevance and usefulness of accounting information are consistently decreasing over time, particularly among high-tech companies (Lev and Gu, 2016; Xie and Zhang, 2022). Barth et al. (2022) oppose revising IAS 38, arguing that the value relevance of accounting information is not declining in the new economy. Skinner (2008) contends that under current financial reporting standards, financial markets work efficiently and effectively in financing high-tech companies and R&D projects. He also argues that expanding the recognition criteria for intangible assets is infeasible in the sense that doing so cannot be accomplished without reducing the reliability of accounting information.

Additionally, sacrificing relevance may not necessarily improve reliability. Under performance pressure, management has a strong incentive to manage earnings through discretionary accounts. The literature extensively documents that managers take advantage of their discretion in R&D capitalization to push earnings above a specific threshold (Perry and Grinaker, 1994; Shust, 2015; Dinh et al., 2016). Empirical evidence shows that R&D capitalization is negatively associated with stock prices and returns (Cazavan-Jeny and Jeanjean, 2006). Jones (2011) finds that aggressively capitalizing firms are more likely to go bankrupt and default on their debt than firms that adopt conservative accounting policies. Zhang et al. (2017), on the basis of empirical evidence from China's A-share listed firms, suggest that under strong incentives for earnings management such as stock compensation and CEO turnover, inflated R&D capitalization barely contributes to long-term corporate value.

In contrast, if recognition criteria are too stringent, most R&D investments should be expensed, which directly reduces the company's profit in the same period. Management may opportunistically cut R&D spending to boost short-term financial performance, particularly when institutional investors have high portfolio turnover, the CEO is approaching retirement or the company is approaching a specific earnings benchmark (Baber et al., 1991; Dechow and Sloan, 1991; Bushee, 1998; Cheng, 2004). Graham et al. (2005) provide survey evidence that to meet an earnings target, CFOs cut discretionary spending, including R&D investment, at the cost of the firm's long-term value. As a consequence, a lack of R&D investment may jeopardize the productivity and competitiveness of a country generally and a firm specifically.

The capitalization debate on R&D investment is also the focus of attention by standard-setters and regulators. In response to the International Accounting Standards Board's (IASB) request for views on the 2015 Agenda Consultation (IASB, 2015), the European Securities and Markets Authorities (ESMA) agreed that there is a need for a comprehensive review of the financial reporting standards on intangible assets and R&D activities (ESMA, 2015). ESMA suggested that the review of accounting for intangible assets should be added to IASB's medium- to long-term research agenda as a separate item. In 2018, the UK's Financial Reporting Council (FRC) initiated a research consultation to review current requirements for reporting intangibles and to develop proposals for their improvement. In 2019, the FRC issued a discussion paper entitled *Business Reporting of Intangibles* to gather stakeholder views and provide a reference for IASB's future work agenda (FRC, 2019). According to a feedback statement, the respondents agreed that the importance of financial reporting on intangibles is increasing in the knowledge-based economy (FRC, 2021, para. 4). However, the stakeholders were divided on whether the accounting standards for intangibles should be revised, and if so, how. Some of the respondents argued that IAS 38 worked well in presenting useful financial information and that there was no need for a fundamental revision. As an alternative, they suggested that standard-setters should focus on improving narrative disclosures of intangibles and R&D activities. In contrast, the majority of stakeholders favored revisiting the definition and recognition criteria of intangible assets (FRC, 2021, para. 15). Along these lines, the European Financial Reporting Advisory Group (EFRAG) proposed a new research topic regarding improving the information on intangible assets in its 2018 research agenda (EFRAG, 2018). In March 2021, IASB published a Request for Information entitled *Third Agenda Consultation*, seeking stakeholder views on whether intangible assets should be added to its work plan for 2022–2026 and discussing possible approaches (IASB, 2021a). Based on feedback from its stakeholders, the Board shortlisted intangible

assets and six other topics as potential projects (IASB, 2022a). At its April 2022 meeting, intangible assets were finally added as one of the two research pipeline projects for the coming five years (IASB, 2022b).

Since the beginning of this century, China has been experiencing a significant transformation from a traditional low-value-added manufacturing-driven economy to a high-value-added knowledge-based economy. Reforms are in progress in the Chinese capital market to accommodate the increasing financing needs of high-tech startups and increasingly risk-tolerant investors who expect high abnormal returns. In October 2009, the Growth Enterprise Market (ChiNext market) was launched on the Shenzhen Stock Exchange, expanding financing channels for innovative and entrepreneurial firms. In July 2019, the Shanghai Stock Exchange launched the Sci-Tech Innovation Board market (STAR market), a new trading platform independent of the two exchanges' Main Board and ChiNext markets and focusing exclusively on high-tech and strategic emerging sectors. For those high-tech companies, continuous and sustainable R&D investment is an essential prerequisite for technological innovation. Accounting policies on R&D activities and internally generated intangibles have profound influences on both the strategic decision-making of firms and capital market efficiency in this type of macro environment.

We summarize the historical development and main requirements of the current financial reporting standards on intangible assets. We compare different approaches to improving these standards, including the recognition approach, the fair value approach and the disclosure approach. This paper focuses on the recognition approach, based on which we develop our case study. We provide a general picture of the R&D capitalization policies of high-tech medical device firms in both the ChiNext market and the STAR market. Using listing applications, we further investigate the stage of the R&D cycle at which firms capitalize all subsequent R&D expenditures. We conclude that the current capitalization criteria for R&D investments discourage the recognition of internally generated intangible assets, thus decreasing the decision-usefulness of accounting information. In addition, there is a large variation of capitalization timing within the medical device industry that varies from project approval to clinical trial stage of the R&D cycle. Finally, we propose that capitalization criteria for intangibles should be determined on the basis of the R&D cycle and that capitalization timing should be moved forward (we call this the milestone approach). In this way, the relevance and comparability of financial information would be significantly improved while proper revenue-cost matching is restored.

2. Evolution and basic requirements of related financial reporting standards

2.1. Evolution of financial reporting standards on intangible assets

Financial reporting standards on intangible assets that are internally generated or acquired through business combinations are constantly evolving and affecting each other over time.

2.1.1. Evolution of related US GAAP

The development of accounting standards for intangible assets in the US can be traced back to the early 1900 s. At the inception of the accounting standards, goodwill and intangible assets were discussed and treated as one, although we now exclude goodwill from the scope of intangible assets. Around the beginning of the 20th century, goodwill became recognized through corporate acquisitions when the consideration paid exceeded the market value of the identifiable tangible assets received minus that of the identifiable liabilities assumed. The excess was considered a payment to the former owner(s) for the entity's reputation, i.e., its goodwill. However, at that time, the common practice was to immediately write off the goodwill, possibly because of the stereotype that goodwill was personal in nature and thus not really an asset (Andrews, 1981). Although the American Institute of Accountants (AIA, the predecessor of the American Institute of Certified Public Accountants, or AICPA) entered the accounting standard-setting arena in the late 1930 s, the accounting profession did not officially take action on the reporting of goodwill and intangible assets until 1944, when Accounting Research Bulletin (ARB) 24 was released by the Committee on Accounting Procedure of the AIA.

ARB 24 addresses purchased intangibles with either a separable specified price or a lump-sum price together with other assets but ignores assets developed in the regular course of business, i.e., internally

generated intangible assets. Instead of formally defining intangible assets, the Bulletin broadly classifies intangibles into the following three categories: (a) intangibles with finite useful lives, (b) intangibles with infinite useful lives and (c) goodwill. ARB 24 requires the measurement of intangibles on a historical-cost basis. After their initial recognition, type (a) intangibles shall be systematically amortized over their estimated useful life, and type (b) intangibles are not subject to systematic amortization, although they should be written down if they have become worthless (AIA, 1944).

The issuance of ARB 24 and fast-growing business combination transactions triggered heated discussions on the recognition and valuation of goodwill and intangible assets during the 1950 s and 1960 s (Andrews, 1981). Following intense lobbying by industry and the government, in 1970, the Accounting Principles Board (APB) of the AICPA published Opinion 17, *Intangible Assets*. The Board concluded that all intangible assets shall be initially recognized on a historical-cost basis and subsequently amortized (AICPA, 1970, paras. 24–28). Specifically, it required the amortization period not to exceed 40 years (AICPA, 1970, para. 29), which was intended to provide an arbitrary maximum time period in which to remove intangible assets from the books. More importantly, APB 17 clarified that the costs of developing, maintaining or restoring intangible assets should be expensed when incurred (AICPA, 1970, para. 24), indicating that the capitalization of internally generated intangibles was prohibited. Shortly after its establishment in 1973, the U.S. Financial Accounting Standards Board (FASB) issued Statement of Financial Accounting Standards (SFAS) No. 2, *Accounting for Research and Development Costs*, which followed the main principles of APB 17. SFAS 2 formally distinguished between research costs versus development costs and reaffirmed that R&D costs should be recognized as expenses were incurred (FASB, 1974, paras. 7–12).

Until now, from a conservative perspective, US GAAP has continued to prohibit firms from capitalizing R&D investment as intangible assets except for some computer software development costs. According to SFAS 86, costs incurred internally in creating a computer software product should be expensed until technological feasibility has been established. After the completion of a detailed program design or a working model, all of the subsequent development costs of the product shall be capitalized. Those capitalized intangibles are subject to amortization with an annual minimum equal to the straight-line amortization over their useful lives (FASB, 1985). SFAS 86 pushes the accounting standards for intangible assets further by allowing the capitalization of development costs, albeit with strict limitations.

In a 2001 attempt to bring US GAAP and IFRS together, the FASB issued SFAS No. 141, *Business Combination*, and SFAS No. 142, *Goodwill and Other Intangible Assets*. Recognizing that pooling-of-interest had been seriously abused by firms, the FASB proposed to disallow pooling-of-interests and to reduce the maximum life for amortizing goodwill and other intangibles to 20 years, as required by the IAS at that time. Because of strong opposition from firms, especially those in the fast-growing information technology industry, the FASB promulgated SFAS 141 and SFAS 142 as the result of a political compromise (Zeff, 2005; Ramanna, 2008). SFAS 141 disallows the pooling-of-interest method and requires all business combinations to be accounted for using the purchase method (FASB, 2001a). Although SFAS 142 represents an evolution from APB 17, the two methods are significantly different. APB 17 presumes that all intangible assets have finite lives and thus should be amortized to zero with an arbitrary ceiling of 40 years. In contrast, SFAS 142 distinguishes between finite-lived intangible assets and infinite-lived intangible assets. Intangible assets with finite useful lives shall be amortized systematically, albeit without the arbitrary ceiling of 40 years. Instead of being amortized, infinite-lived intangible assets are subject to an annual impairment test (FASB, 2001b). The FASB published SFAS 141(R) at the end of 2007 as a result of its convergence efforts with IASB. However, that standard does not make any major changes to the Board's requirements on intangible assets (FASB, 2007).

2.1.2. Evolution of related IFRS

After its formation in 1973, the International Accounting Standards Committee (IASC) issued several standards on intangible assets. In 1978, IAS 9, *Accounting for R&D Activities*, was released, which, consistent with SFAS 2, required both R&D costs to be expensed (IASC, 1978). In 1993, IASC issued an updated version of IAS 9 that emphasized the distinction between research costs and development costs and required development costs to be recognized as an asset under certain conditions. Additionally, IAS 9 allowed the reversal of previously recognized impairment losses when the circumstances and events leading to the write-off or

write-down ceased to exist (IASC, 1993). In 1998, after extensive consultation and discussion, the IASC formulated and published IAS 38, *Intangible Assets*, which further clarified the capitalization criteria of development costs and specified the amortization method of recognized intangibles. Unlike IAS 9, IAS 38 requires the recognition of more intangible assets through business combinations than through internal generation (IASC, 1998).

Shortly after it was restructured in 2001 into its current form, IASB started a series of convergent projects with FASB. In 2004, IASB promulgated IFRS 3, *Business Combination*, to replace IAS 22, which was originally issued by the IASC. IFRS 3 was further revised in 2008 to bring the US GAAP and IFRS requirements on business combination transactions closer together. Similar to SFAS 141(R), IFRS 3 requires those transactions to be accounted for using the purchase method, including recognizing and fair-valuing in consolidated financial statements more intangible assets that were acquired but previously not recognized by the acquiree, and it requires an annual impairment test for goodwill. However, there are two major differences between IFRS 3 and SFAS 141(R). The first difference is that IFRS 3 does not cover business combinations under common control, whereas SFAS 141(R) specifies accounting requirements for such transactions that meet very strict criteria (FASB, 2007, para. D8-14). The second difference is that IFRS 3 allows a choice between the partial and the full goodwill methods, whereas SFAS 141(R) only allows the full goodwill method. The reasons for the two boards' decisions are summarized in SFAS 141(R) (FASB, 2007, para. B205-221). Subsequently, IASB made several amendments to IAS 38, particularly alongside the revision of IFRS 3, but the basic accounting concepts and principles concerning intangible assets in IAS 38 have changed little and have been adopted ever since.

2.1.3. Evolution of related Chinese accounting standards

Learning from the Soviet Union, China began to adopt uniform accounting systems to facilitate its planned economy in 1949. These systems did not have any intangible assets-related clauses. After China started its economic reform and opening-up policy in 1978, the concept of technical development expenses was used, albeit without any clear definition or accounting requirement. The only exception was *The Accounting System for the Joint Ventures Using Chinese and Foreign Investment* issued by the Chinese Ministry of Finance (MFPRC, 1985). This document has a separate chapter on intangible assets, which requires finite intangible assets to be amortized based on their useful life, whereas infinite intangible assets are required to be amortized over 10 years. In both cases, the amortization period should not exceed the contracted joint venture time limit, if any.

In late 1990, both Shanghai and Shenzhen opened stock exchanges. The next year, China started to transform itself into a market-oriented economy. By the end of 1992, based on accounting principles generally accepted in developed market-oriented economies, the MOF promulgated its *Accounting Standards for Business Enterprises* (ASBE) and *General Principles for Business Finance*, which marked a fundamental reform to the accounting regime in China (MFPRC, 1992a,b). The MOF also published rules requiring intangible assets purchased or acquired to be capitalized and amortized over their useful lives. However, these requirements were not as detailed and specific as those in IAS 9 and IAS 38.

In 2001, the MOF issued ASBE 6, *Intangible Assets*. Similar to US GAAP, the standard basically requires expenditures on internally generated intangible assets to be fully expensed except when they are used to pay for registration and lawyers (MFPRC, 2001). In 2005, the MOF made a second fundamental reform to China's accounting regime to establish a set of new ASBEs, which substantially converged with IFRS. These standards were formally published in February 2006 and started to be implemented among all listed firms in 2007. These standards have been continuously revised following the revisions in the relevant IFRS.

The 2006 version of ASBE 6 (MFPRC, 2006a) converges substantially with IAS 38, with only limited differences between them that are discussed in the next subsection. Unlike IFRS 3, the 2006 version of ASBE 20, *Business Combination*, distinguishes between business combinations under common control and business combinations not under common control and requires the former to be accounted for under the predecessor method and the latter to be accounted for under the purchase method. ASBE 20 only allows the partial goodwill method, whereas IFRS 3 allows a choice between the partial and the full goodwill methods, and SFAS 141 (R) only allows the full goodwill method (MFPRC, 2006b).

Because the accounting treatment of intangible assets under ASBE substantially converges with related IFRSs, we quote IFRS rather than ASBE requirements in the following discussion unless otherwise noted.

2.2. Current IFRS requirements on intangible assets

IAS 38 prescribes accounting treatments for all types of intangible assets, including those acquired through business combinations, separate purchases, government grants and internal generation (IASB, 2021b, para. 2). Compared with other types of assets, the standard sets many rigid criteria for recognizing intangible assets acquired through internal generation. To assess whether an internal project meets the criteria for capitalization, an entity should classify the generation of its internally generated project into either the research phase or the development phase (IASB, 2021b, para. 52). All expenditures during the research phase shall be expensed as incurred (IASB, 2021b, para. 54). Expenditures arising from the development phase shall be capitalized as intangible assets under certain conditions (IASB, 2021b, para. 57). IASB applies the ability to generate future economic benefits to distinguish between the research phase and the development phase. To demonstrate whether an intangible asset will generate future economic benefits, management should use reasonable and supportable assumptions to estimate the economic conditions that will exist over the useful life of the intangible asset (IASB, 2021b, para. 22). In practice, it is rather difficult for entities to use reasonable and supportable assumptions to demonstrate the probability of expected future economic benefits.

Specifically, IAS 38 stipulates that an intangible asset arising from the development phase of an internal project shall be recognized if and only if an entity can demonstrate all of the following:

> (a) the technical feasibility of completing the intangible asset so that it will be available for use or sale; (b) its intention to complete the intangible asset and use or sell it; (c) its ability to use or sell the intangible asset; (d) how the intangible asset will generate probable future economic benefits. Among other things, the entity can demonstrate the existence of a market for the output of the intangible asset or the intangible asset itself or, if it is to be used internally, the usefulness of the intangible asset; (e) the availability of adequate technical, financial and other resources to complete the development and to use or sell the intangible asset; and (f) its ability to measure reliably the expenditure attributable to the intangible asset during its development (IASB, 2021b, para. 57).

Among other things, the requirement of technical feasibility filters out a majority of projects, leaving only a small portion of development costs to be capitalized.

Currently, IAS 38 prescribes that all intangible assets should be measured initially at cost (IASB, 2021b, para. 24). The initial cost consists of all directly attributable costs necessary to create, produce and prepare the asset to be capable of operating. Any retrospective adjustment of previously recognized R&D expenses is prohibited (IASB, 2021b, paras. 65, 66 and 71). In accordance with IFRS 3, *Business Combinations*, if an intangible asset is acquired in a business combination, the initial cost of that asset is measured at its fair value on the acquisition date (IASB, 2021c, para. 18).

After the initial recognition of an intangible asset, firms have discretion in choosing either the cost model or the revaluation model for measuring it (IASB, 2021b, para. 72). Under the cost model, the carrying value of an intangible asset should be consistently adjusted for subsequent amortization and impairment. For this purpose, an intangible asset should be categorized as finite-lived or infinite-lived based on whether there is a foreseeable limit to the period over which it is expected to generate economic benefits (IASB, 2021b, para. 88). A finite-lived intangible asset should be systematically amortized over its useful life (IASB, 2021b, para. 97). The previous version of IAS 38 required the recoverable amount of an intangible asset that was amortized over a period exceeding 20 years from the date it was available for use to be estimated at least at each financial year-end even if there was no indication that the asset was impaired. This requirement has been removed. Therefore, an entity must determine the recoverable amount of an intangible asset with a finite useful life that is amortized over a period exceeding 20 years from the date that it is available for use only when there is an indication that the asset may be impaired (IASB, 2016b, para. IN12).

However, in accordance with current IAS 38, instead of being amortized, infinite-lived intangible assets are only subject to an annual impairment test (IASB, 2021b, paras. 107, 108). IAS 38 allows the use of the revaluation model under the condition that the accounting for all of the other assets in the same class shall also use the same model unless there is no active market for those assets. Under the revaluation model, an intangible asset shall be carried at a revalued amount less any subsequently accumulated amortization and accumulated

impairment losses. The revalued amount should be measured by reference to an active market (IASB, 2021b, paras. 72, 75–87).

It is worth noting that current ASBE 6 on intangible assets converges substantially with related IFRS, with two exceptions. The first exception is that IAS 38 gives entities the option to use the revaluation model in the subsequent measurement of intangible assets, whereas ASBE 6 does not. The second exception is that IAS 36, *Impairment of Assets*, requires that an impairment loss previously recognized for an asset other than goodwill shall be reversed when the asset's recoverable amount significantly changes (IASB, 2021c, para. 114). However, the ASBE on impairment of assets prohibits firms from reversing an impairment loss recognized in prior periods, mainly because of the concern that doing so encourages earnings management (Zhang and Ye, 2020). In this aspect, the ASBE is in line with the related requirements of US GAAP.

Based on the above discussions, we summarize the comparisons of intangibles-related accounting requirements for US GAAP, IFRS and China ASBE in Table 1.

3. Approaches to improving related financial reporting standards

As discussed above, financial reporting standards on intangible assets have been evolving for approximately-one century. Recent debates concentrate on whether more internally generated intangible assets should be recognized, and if so, how. During IASB's first agenda consultation, the Board proposed to put extractive activities, intangible assets and R&D activities together as one project, but the proposal failed to attract the interest of its stakeholders (IASB, 2011). Based on the feedback in its second agenda consultation, the Board only included extractive activities in its work plan as a research project, while regarding intangible assets-related issues as part of a broad disclosure project (IASB, 2016a).

In March 2021, IASB issued *Request for Information: Third Agenda Consultation*, seeking stakeholder views on whether intangible assets should be added to its medium-term research agenda. The Board expressed concern that IAS 38 might be outdated in various ways. Firstly, IAS 38 may fail to provide useful information about R&D-related activities, transactions and assets in the new economy. Secondly, IAS 38 may be too restrictive about when internal projects can be recognized as intangible assets and when fair value measurement is permitted for those assets. Thirdly, the difference in how internal R&D projects and acquired intangibles are treated reduced the comparability of financial statements between firms that grow organically and those that grow through acquisitions. Finally, narrative reporting on R&D expenditures that are not capitalized as intangible assets may provide limited useful information to users (IASB, 2021a). Based on the feedback from its stakeholders, the Board shortlisted intangible assets and six other topics as potential projects (IASB, 2022a). As of IASB's April 2022 meeting, revisiting financial reporting standards on intangible assets is finally considered to be a research pipeline project for the coming five years (IASB, 2022b).

Discussion about the possible approaches to tackling the issues highlighted by IASB should be based on fundamental accounting theory. In a semi-strong efficient securities market, as defined by Fama (1970), securities prices should reflect all publicly available information, including public financial information. In other words, an efficient market is expected to incorporate a firm's accounting information as soon as it is publicly released. However, as first documented by Ball and Brown (1968), for firms that report good news in their quarterly earnings, their abnormal stock returns tend to drift upward for some time following the earnings announcement dates and vice versa. This post-announcement-drift anomaly provides empirical evidence that the stock market fails to reflect all public information on a timely basis. It also drives much research on efficient market anomalies and their sources. Under these circumstances, financial reporting plays a significant

Table 1
Comparisons of accounting standards on intangibles for US GAAP, IFRS and China ASBE.

	US GAAP	IFRS	China ASBE
Scope of capitalization	Narrow	Broad	Broad
Revaluation method	Not permitted	Permitted	Not permitted
Reversal of impairment	Not permitted	Permitted	Not permitted

role in reducing market inefficiencies. High-quality financial information can help behaviorally biased investors improve their decisions and speed up the corrections to mispricing caused by noise trading (Scott, 2015).

The objective of financial reporting is to provide financial information about the reporting entity that is useful to stakeholders in making decisions about providing resources to that entity (IASB, 2018, para. 1.2). To meet the needs of its users, financial reporting has developed from a historical cost basis approach to a mixed measurement model that consists of both a historical cost basis and a current value basis (IASB, 2018, Chapter 6). In many cases, a historical cost measurement is less costly and more verifiable than a current value measurement. However, the use of a historical cost basis can reduce the comparability of financial information both from period to period for the same reporting entity and in a single period across different entities (IASB, 2018, paras. 6.69–6.71). In contrast, under fair value measurement, identical assets or liabilities are measured as the same amount by different companies that have access to the same markets. This can enhance comparability in both dimensions. If there is no active market for an asset or liability, valuation techniques are extensively used in estimating its current value, thus increasing subjectivity and reducing verifiability (IASB, 2018, paras. 6.72–6.76). In some cases, limited by valuation techniques, neither a historical cost basis nor a current value basis can provide a faithful representation of an asset or liability. In such cases, these items should not be recognized in an entity's financial statements even though they are relevant (IASB, 2018, para. 5.7). Because of these difficulties in recognition and measurement, disclosure in the footnotes to financial statements is an alternative method. Appropriate disclosures may partially compensate for non-comparability (IASB, 2018, para. 2.38).

Along with the recognition, measurement and disclosure issues, three proposed approaches to improving financial reporting standards for intangible assets, particularly internally generated, are widely discussed. These three approaches accommodate stakeholders' views in ways that make them incompatible with each other.

3.1. The recognition approach

Currently, firms apply the requirements and guidance of IAS 38 to all internally generated intangible assets. An entity shall capitalize expenditures arising from development-phase R&D projects when certain criteria are met. In particular, the entity should demonstrate the probability of generating future economic benefits and the technical feasibility of completing the intangible asset. These recognition criteria filter out a majority of projects, leaving only a small portion of development costs to be capitalized.

In 2019, the Association of Chartered Certified Accountants (ACCA), together with Deloitte, published a report on the capitalization debate on R&D investment. They find that more than 60 % of firms expense all R&D investment. They argue that the current recognition criteria for internally generated intangible assets in IAS 38 are so stringent that they militate against capitalization (Mazzi et al., 2019). Huang (2020) argues that current financial reporting standards on intangible assets systematically underestimate the financial performance of new economy firms in both China and the U.S. Xie and Zhang (2022) illustrate that the non-capitalization of R&D investment has led to a wide gap between the book value and the market capitalization of new economy firms.

The recognition approach loosens the definition and recognition criteria for intangible assets, recognizing more internally generated intangible assets and/or at an earlier stage. For example, Lev (2018, 2019) suggests relaxing the criteria for the capitalization of R&D expenditures to match expense with revenue in the income statement. He argues that the feasibility test should not be a necessary condition for intangibles' capitalization. Instead, firms' R&D expenditures should be initially capitalized and then amortized. He proposes a new set of criteria for intangibles capitalization that differs from the current IAS 38 in significant ways. First, it allows for capitalizing expenditures in the research phase, and thus the company does not need to demonstrate that the intangibles will generate expected cash inflows in the future. Additionally, it no longer requires a feasibility test for the capitalization of intangibles. By capitalizing intangibles' costs from inception and amortizing or writing off when appropriate, this proposal restores proper revenue-cost matching in the income statement.

Along with this idea, Barker and Penman (2020) suggest that assets be recognized with respect to a threshold for uncertainty. They argue that under a desirable financial reporting system, the likelihood of both write-downs and write-ups shall be minimized, resulting in reduced *ex post* reporting of uncertainty. However, under

current IAS 38, write-downs are taken *ex ante* by expensing R&D costs immediately. Under Barker and Penman's (2020) proposal, assets shall be recognized as long as there is a significant probability of generating economic benefits. They suggest that as a project exceeds a threshold for uncertainty, all subsequent expenditures should be capitalized and prior period expenses should be reversed and recognized as intangible assets. Similarly, Huang (2020) suggests that R&D investments be capitalized as intangible assets unless it is evident that they are incapable of generating any economic benefits for the entity. He also agrees about removing the requirements for distinguishing between the research phase and the development phase because, in his view, there is no essential difference.

Incorporated with the above suggestions, in August 2021, EFRAG published a discussion paper entitled *Better Information on Intangibles*. The paper considers the following recognition approaches for expenditures related to internally generated intangibles: (a) recognizing all internally generated intangibles with no specified conditions or thresholds, (b) recognizing an intangible asset if specified conditions are met at the start of the project (i.e., the threshold for recognition), (c) recognizing an intangible asset when specified conditions are met (i.e., conditional recognition) and (d) not recognizing internally generated intangibles (EFRAG, 2021, para. 3.11). The paper also compares the advantages and disadvantages of these approaches (EFRAG, 2021, para. 3.68).

As a fundamental revision to IAS 38, the first approach would capitalize most R&D expenditures and recognize more internally generated intangible assets. This would significantly enhance the comparability of intangible assets-related financial information regardless of whether the assets come from an asset purchase, a business combination, shareholders' capital injection or internal generation.

The second approach suggests that an internally generated R&D project be recognized as an intangible asset if specified thresholds are met at the start of the project, which differs from current IAS 38 fundamentally in both the definition and the recognition criteria for intangible assets. As an essential component of its definition, an intangible asset is required to be "identifiable" under current IAS 38. This recognition approach suggests thresholds that would remove the criterion of identifiability from the definition of intangible assets. Moreover, IAS 38 currently requires a set of recognition criteria for development costs and explicitly prohibits the capitalization of some types of intangibles. Under this approach, the recognition criteria should be loosened, avoiding the complete expensing of R&D-related costs. The explicit prohibitions of recognition on types of intangibles shall also be removed (EFRAG, 2021, para. 3.41). Another option for this approach could be to use the recognition criteria in IFRS 3 and recognize all internally generated intangibles that would have been recognized as if they had been acquired through a business combination (EFRAG, 2021, para. 3.68).

Unlike the second approach, the third approach requires an entity to continuously assesses whether the recognition criteria are met. If they are, all subsequent R&D costs will be recognized as intangible assets. EFRAG also discusses the following three variances of this approach to how to account for the expenditure before the recognition criteria are met: (i) all R&D investments are expensed as incurred until the recognition criteria are met and should not be reversed, (ii) R&D expenditures should be capitalized and fully impaired until the internal project meets the criteria, at which point the impairment loss is reversed and (iii) all R&D investments are recognized in other comprehensive income (OCI) as incurred until the recognition criteria are met. When the criteria are met, those recognized expenses in OCI shall be capitalized as an intangible asset. If the R&D project turns out to be unsuccessful, recognized expenses in OCI shall be recognized as an expense in profits or losses (EFRAG, 2021, para. 3.49).

As discussed in the previous section, IASB has decided to add intangible assets to its next five-year work plan. Acknowledging that a comprehensive review of IAS 38 would be complex and time-consuming for IASB and its stakeholders, the Board may divide the project into stages. For example, those stages could consist of (a) developing enhanced requirements for the qualitative disclosures of R&D activities, most of which may be unrecognized intangibles, (b) reviewing and revising the scope of IAS 38, (c) reviewing and revising the definition and recognition criteria for intangible assets and (d) reviewing and revising subsequent measurements of intangible assets, including when fair value measurement is permitted (IASB, 2022c, para. 37).

Among the issues considered by IASB in the third stage are (i) the definition of an asset in IAS 38, which is not aligned with the asset definition in the revised *Conceptual Framework* (IASB, 2018), (ii) the recognition criteria for internally generated assets, (iii) comparability between firms that grow organically and those that grow through business combination and (iv) specific practice issues, such as those considered by the IFRS

Interpretations Committee on software as a service (SaaS) arrangements (IASB, 2022c, para. 37). These are essentially definition and recognition issues.

3.2. The fair value approach

The fair value approach radically argues that intangible assets should be measured on a fair value basis. The debate on cost versus fair value exists in both the initial recognition and the subsequent measurement of all kinds of intangible assets. However, the initial measurement of internally generated intangible assets and the subsequent measurement of all kinds of intangible assets at fair value are more controversial.

According to IAS 38, intangible assets acquired in a business combination shall be recognized at fair value on the acquisition date regardless of whether the assets had been recognized previously by the acquiree. In other words, an acquirer should recognize the acquiree's in-process R&D project as an intangible asset if the project meets the definition of an intangible asset, which no longer requires satisfaction of the six criteria on capitalization that apply to internally generated intangible assets. IAS 38 asserts that "if an intangible asset acquired in a business combination is separable or arises from contractual or other legal rights, sufficient information exists to measure reliably the fair value of the asset" (IASB, 2021b, para. 33). In 2008, the Australian Accounting Standards Board (AASB) issued a discussion paper entitled *Initial Accounting for Internally Generated Intangible Assets*, which provides a basis for the debate on R&D capitalization. Some stakeholders argue that determining the fair value of an internal project is less onerous for a firm than determining the fair value of an acquired intangible asset because the firm presumably knows its own R&D project better than an R&D project acquired in a business combination (AASB, 2008, para. 154). Therefore, the majority of AASB's interviewees believe that intangible assets, whether internally generated or acquired through a business combination, should apply the same recognition and measurement principles (AASB, 2008, para. 161). The paper concludes that internally generated projects that satisfy the definition of an intangible asset should be subject to the same recognition requirements as those acquired in a business combination and measured at fair value by using the revaluation model allowed by IAS 38 (AASB, 2008, para. 113). The paper refers to this approach as "a technique based on a hypothetical business combination" (AASB, 2008, para. 52).

Wang (2022a, b) favors the proposal by the AASB (2008) and suggests recognizing all intangible assets as long as they meet specific conditions, which could be further elaborated. He also proposes to recognize all intangibles that fail to satisfy the capitalization criteria as internally generated goodwill. He believes that under the cost model, many internally generated intangible assets cannot be faithfully represented in financial statements. Hence, he agrees that intangible assets shall be measured at fair value with subsequent adjustments to other comprehensive income. However, Xie and Zhang (2022) express doubt about the proposal of AASB (2008) and Wang (2022a,b). Their paper argues that to some extent, periodically fair valuing intangibles in such a way is similar to measuring acquired goodwill in a business combination by using the purchase method, but without any external transaction. Doing so would require a periodical revaluation of the entity as a whole, which in their view is inconsistent with IASB's revised *Conceptual Framework*, which clearly states that financial statements are not intended to show the value of a reporting entity (IASB, 2018, para. 1.7).

He and Calder (2020) propose a practical approach to evaluating brand value as a contribution to cash flows based on an experimental measurement of brand strength. They contend that evaluating and recognizing brands as assets rather than expenses in such a way helps firms to closely align their marketing and finance around internal investment and to provide investors with more useful financial information.

Nevertheless, opponents of fair-valuing intangible assets argue that this approach may induce opportunistic earnings management and bring price bubbles into financial statements, both of which reduce the reliability of accounting information (Penman, 2007; Skinner, 2008). Using a case study, Barker and Schulte (2017) find that fair value representations of non-financial assets are expedient and unstable. FRC (2019) argues that for many intangibles, the measurement uncertainty of fair value is so great that it raises concerns about whether it could provide a faithful representation. Xie and Zhang (2022) identify many thorny issues that could arise if firms are required to measure internally generated intangible assets at fair value, such as identifiability, the separability and units of the account, the source and reliability of fair value measures and in which account to put periodical changes in fair value under a double-entry bookkeeping system.

EFRAG (2021) summarizes the advantages and disadvantages of measuring internally generated intangible assets on a fair-value basis. Arguments in favor of this approach include that it would increase the relevance of accounting information by capturing the expectations of future cash flows generated by an intangible asset. It could also result in a consistent treatment of internally generated intangibles versus those acquired in business combinations, thus improving the comparability of financial information. However, arguments against fair value measurement also exist. because of the nature of intangibles, there are few or no active markets for those assets. Under such circumstances, the reported "fair value" would unavoidably contain a high degree of subjectivity and uncertainty, which could raise concerns about whether it provides a faithful representation. Additionally, fair value measurement may result in issues of double-counting future cash flows. Furthermore, differences in how fair value is estimated could reduce comparability between items (EFRAG, 2021, paras. 3.94–100). A lack of reliable external inputs may also leave wide room for earnings management.

Two findings about the fair value measurement of intangible assets deserve special attention. Firstly, IAS 38 requires the separate recognition of identifiable intangibles acquired in a business combination at fair value to provide a better basis for understanding what a firm has paid for; this approach results in finite-lived intangible assets being amortized rather than being recognized as goodwill, which is not amortized. In reality, acquirers opportunistically recognize acquirees' less identifiable intangibles and pay a premium for goodwill. Inflated goodwill provides such acquirers with more room for earnings management through periodic goodwill impairment. Among the reasons given by IASB's stakeholders for doing so are the following: (1) valuing intangible assets is complex, subjective and costly; (2) distinguishing some intangible assets, such as brands and customer lists, from the rest of a business is difficult because doing so requires an arbitrary allocation of cash flows; and (3) applying the separability criterion is often difficult. As a result, they question the usefulness of information about intangible assets in a business combination that are difficult to value reliably (IASB, 2020, paras. 5.8–9).

Secondly, Christensen and Nikolaev (2013) report a study of 1,539 firms in Germany, where historical cost is the only measurement basis permitted for intangible assets, and the U.K., where both the cost and the revaluation models are allowed. According to their results, when listed firms in the EU were required to apply IFRS to consolidated financial statements in 2005, all of the sample firms measured intangible assets at historical cost regardless of whether they had subsequently measured such assets by using the revaluation model, as allowed by their local GAAP before the transition.

The above findings tell us that even though IAS 38 requires the initial recognition of an increased amount of intangible assets acquired from business combinations at fair value and allows the subsequent measurement of intangible assets at fair value using the revaluation model, firms have not done so. Under such conditions, it is difficult to predict that a fair value approach for all intangible assets, for either initial or subsequent measurement, would be supported by most of IASB's stakeholders.

3.3. The disclosure approach

The disclosure approach suggests enhancing the narrative or quantitative reporting on R&D projects and investments in the notes to financial statements or in other public corporate documents. In response to the FRC's discussion paper on the business reporting of intangibles, PricewaterhouseCoopers LLP (2019) and ICAEW (2019) recommend that standard-setters should concentrate on finding ways to improve the narrative reporting and disclosure of information on intangibles rather than revisit existing accounting requirements. Mazzi et al. (2019) find that the narrative reporting of R&D is minimal in firms' annual reports. They suggest that if IAS 38 continues to not mandate disclosures, advanced requirements for disclosing the risks of potential R&D failure and the prospects of firms' R&D projects should be introduced. Lev and Gu (2016), in their book *The End of Accounting*, propose an information system—the Strategic Resources & Consequences Report—that is intended to complement and partially supplement financial statements. The Report aims to provide essential information that investors need to evaluate the business model of a company and the extent of its execution by management.

Since 2007, the World Intellectual Capital/Assets Initiative (WICI) has advocated for better representation of intangibles in the context of value creation. The 2016 WICI Intangibles Reporting Framework aims to foster and facilitate reporting on how entities create, identify, manage and utilize their unique intangibles

to create value and achieve business sustainability. The Framework encourages entities to disclose the suggested narrative and quantitative information in their corporate reporting documents (WICI, 2016).

The International Integrated Reporting Council's (IIRC) 2021 revised *International Integrated Reporting Framework* aims to provide investors with insight into the resources and relationships used and affected by an organization. The Framework categorizes these resources and relationships into financial, manufactured, intellectual, human, social and relationship and natural capital, all of which are closely related to an organization's ability to create value (IIRC, 2021).

In May 2021, IASB published an exposure draft, *Management Commentary*, setting out its proposals for revised IFRS Practice Statement 1, *Management Commentary*. It is proposed that management commentary focus on the firm's key resources and relationships, including intangibles and those that are not recognized as assets in the financial statements. Moreover, the firm's management commentary may provide information about the processes involved in obtaining, maintaining or enhancing its intangible resources and relationships (IASB, 2021d).

As discussed in the recognition approach subsection, IASB proposes undertaking the intangible assets project in stages. The first stage is to develop enhanced requirements for qualitative disclosures, including disclosures of unrecognized intangible assets. As stated by the Board, although not all stakeholders agree with a fundamental revision of IAS 38, they do agree that there is a need for improvements in the narrative reporting of intangibles. Starting with disclosure issues would be beneficial for IASB's medium-term work plan because a fundamental review of IAS 38, including scope, definition and recognition criteria, is likely to be sophisticated and time-consuming. Doing so would also help provide insights into recognition and measurement issues (IASB, 2022c, para. 38).

In contrast, the Board points out that starting the proposed intangible assets project by reviewing the current definition of and recognition criteria for intangible assets has the following advantages: (a) accelerating the process of solving practice issues with IAS 38, (b) increasing the efficiency with which preparers and auditors can accommodate the new standards and (c) assisting with managing the interactions with the work of the newly established International Sustainability Standards Board (ISSB) on related topics by considering disclosure requirements later (IASB, 2022c, para. 39).

As a drastic and significant move, the IFRSF (2021) announced the establishment of ISSB alongside IASB. The intention is for ISSB to deliver a comprehensive global baseline of sustainability-related disclosure standards that provide investors and other capital market participants with information about companies' sustainability-related risks and opportunities to help them make informed decisions. Therefore, the interaction between IASB's project and the work of ISSB on related topics including intangible assets-related issues should be considered as part of project planning (IASB, 2022c, paras. 36, 39(c), 41).

To facilitate the discussion of possible solutions to a perceived financial statements information gap relating to intangible assets, the AASB recently issued a staff paper focusing on disclosures about unrecognized internally generated intangible assets. The paper analyses (1) a spectrum of possible disclosures, whether of a financial (cost or fair value) or a non-financial (quantitative, non-quantitative or narrative) nature, or a combination of all or some thereof, that could be made in financial statements; (2) the types of entities that should be subject to the disclosures; and (3) whether the disclosures should be mandated or encouraged. The AASB puts forward many proposals around the above three areas (AASB, 2022). Its paper should be helpful to IASB in its forthcoming project on how to improve accounting standards for internally generated intangible assets, particularly if the Board decides to start with a disclosure-only project.

We do not think that IASB will radically revise IAS 38 in the foreseeable future by following the fair value approach. Related theoretical controversies, significant consequences for financial information, operational complexity and severe earning management risk hinder the fair value measurement from becoming IASB's first choice in its endeavor to tackle intangible assets-related issues. We fully support any endeavor to improve the related IFRS by following the disclosure approach. In our view, the recognition approach would be the most meaningful road for IASB to follow.

To provide input into IASB's endeavor to revise its standards on intangible assets in the coming years, we conduct a case study of how Chinese listed firms apply accounting standards to their internally generated intangible assets, focusing on their choice of timing to capitalize R&D expenditures. We present the results of our study in the next section. In the following section, we propose how to improve the related standards.

4. Case analysis

This section summarizes the result of our case study of how capitalization policies for R&D expenditures are implemented among high-tech firms in China. Our case analysis focuses on the medical device industry in the Growth Enterprise Market and the Sci-Tech Innovation Board market.

4.1. Growth Enterprise market and Sci-Tech Innovation Board market

The Growth Enterprise Market (ChiNext market) was launched on the Shenzhen Stock Exchange in October 2009. Unlike the Exchange's Main Board market, the ChiNext market is aimed at expanding financing channels for innovative and entrepreneurial firms, supporting the deep integration of traditional industries with cutting-edge technologies and new business forms. In the past decade, a group of innovative enterprises has successfully raised funds through this emerging capital market. As of Q3 2022, 1,200 firms are listed on the ChiNext market, with a total market capitalization of more than 10 trillion yuan. The ChiNext market plays an important role in accelerating the transformation of economic development modes and stimulating growth in emerging industries of strategic importance in China.

In 2019, the Shanghai Stock Exchange launched the Sci-Tech Innovation Board market (STAR market), a new trading platform independent of the Exchange's Main Board market. The purpose of the STAR market is to enhance the capability of serving technology innovation and promote the market-oriented reform of the Chinese capital market. The STAR market mainly supports high-tech industries and strategic emerging sectors such as new-generation information technology, high-end equipment, new materials and biomedicine. The STAR market has more inclusive listing criteria than the Main Board market, allowing high-tech firms with periodic or accumulated losses to be listed. As of Q3 2022, 473 firms are listed in the STAR market, with a total market capitalization of 5.5 trillion yuan. The establishment of the STAR market has improved the multi-tiered capital market and provided an alternative financing channel for high-tech industries.

Although both the ChiNext market and the STAR market focus on high-tech companies, the firms listed in these emerging markets generally adopt conservative R&D capitalization policies. As of Q3 2022, only 5.81 % (98 out of 1,687) of firms capitalize some of their R&D expenditures in their applications to make an initial public offering (IPO). Specifically, 6.34 % (30 out of 473) of the IPO firms in the STAR market capitalize some R&D costs, whereas 5.60 % (68 out of 1,214[3]) of the IPO firms in the ChiNext market capitalize some R&D costs, with their counterparts expensing all of their R&D investments. For early-stage high-tech firms, continuous R&D expenditures are a prerequisite for achieving technological breakthroughs. However, if capitalization criteria are too stringent to meet, investment in R&D directly reduces periodic net income, disincentivizing firms from engaging in R&D activities. Additionally, if compliance concerns encourage firms to continue to expense R&D expenditures extensively, then the emerging markets' focus on the high-tech knowledge-based sector will aggravate the distortion of the incentives for R&D expenditures. The accounting standards for R&D expenditures and their actual enforcement have a profound influence on the strategic decision-making of high-tech firms and thus on the efficiency of the market. A case study on the R&D capitalization policies of firms in these emerging capital markets may give us insights into how to improve the relevant accounting standards.

4.2. Reasons for selecting the medical device industry

Our case analysis focuses on the medical device industry in the ChiNext market and STAR market for the reasons set forth below.

Firstly, the clear and consistent R&D cycle of the medical device industry makes it possible to justify the timing of R&D capitalization, providing the perfect research setting for our analysis. As in any other country, the R&D of medical devices is subject to regulations of the State Food and Drug Administration (SFDA) that divide the process into several stages (see Table 2). Clear milestones from project approval to product

[3] We identify 1,214 observations on financial information during IPO from CSMAR database, including those being delisted afterwards.

Table 2
General R&D cycle of the medical device industry in China.

No.	Stage	Details
1	Project approval	Based on the firm's technological innovation needs, the R&D department prepares an initiating report. The R&D, production, quality control, regulatory and marketing departments shall jointly review the initiating report and approve the project if there is a consensus.
2	Design and development planning	The R&D department prepares a design and development plan and product design specifications. The production and regulatory departments review the documents and estimate the project's feasibility.
3	Design validation and verification	The R&D department conducts product performance testing, biocompatibility testing, package verification and sterilization verification, and it should obtain a verification report from institutions approved by SFDA.
4	Animal experiments	The R&D and regulatory departments coordinate and supervise the experimental process of the animal laboratory.
5	Ethical approval	The firm cooperates with clinical trial institutions authorized by SFDA. Animal experiment results, clinical trial plans and informed consent forms are submitted to the ethics committee and approval for clinical trials is obtained.
6	Clinical trials	Clinical trials are conducted with the authorized clinical trial institution and a summary report is completed.
7	Product approval	The product is registered with and approved by the SFDA.

Source: Firms' prospectuses.

approval facilitate our investigation of R&D capitalization timing, and specifically from which stage of the cycle a firm recognizes all of its subsequent R&D costs as intangible assets. A case study of capitalization policy among such firms may help us determine how to loosen the recognition criteria by taking advantage of milestones in the R&D cycle as benchmarks for deciding when R&D expenditure should be capitalized.

Secondly, special listing standards may help us identify the relationship between the regulatory system for IPOs and the accounting standards for internally generated intangible assets. China's stock market has long adopted an approval-based IPO system, under which the China Securities Regulatory Commission (CSRC) has the absolute power to approve or reject an IPO application. The Main Board market and the ChiNext market use the approval-based IPO system. The essence of this regulatory mechanism is that regulators are supposed to review the application materials and identify qualified listed companies that have both stable profitability and high growth potential. Thus, profitability is one of the listing criteria for firms seeking an IPO. Given the strictness of the regulatory system and the rigidity of the listing standards, IPO firms have strong incentives to manage earnings upward through capitalizing relatively more R&D expenditures, which can be achieved by adjusting the capitalization timing earlier.

The most significant breakthrough of the newly established STAR market is its adoption of a registration-based IPO system, under which the CSRC and Shanghai Stock Exchange solely focus on an issuer's compliance with information disclosure requirements. Provided with substantial disclosures of fundamentals and risks, investors are expected to make independent and rational investment decisions. Consistent with the reform, the STAR market has listing standards that are more inclusive than those of the Main Board market (see Table 3 for details). An issuer applying for an IPO shall meet at least one of the listing standards. For example, the fifth set of listing standards allows firms with neither net income nor sales revenue to go public. However, the compensating condition is that such firms' main business or products must be approved by an authorized third party and have achieved phased outcomes. This condition explicitly states that pharmaceutical firms should have at least one main product that has been approved in the approval of phase Ⅱ clinical trials. By April 2022, 16 pharmaceutical firms were successfully listed in the STAR market under the fifth set of listing standards. Most recently, the listing application of a medical device company using this set of standards, MicroPort EP, was approved. The fifth set of listing standards is a significant breakthrough for the registration-based IPO system in China, which regards the pharmaceutical industry as a test field whose listing standards are expected to be generalized to other industries. The successful IPOs of medical device firms following these listing standards provide an opportunity to investigate the milestone approach to financial reporting standards on intangibles. In addition, possible differences in R&D capitalization policies between

Table 3
Listing Standards of the Sci-Tech Board Innovation Board Market.

No.	Expected Market Cap.	Revenue and Profitability
1	No less than 1 billion yuan	Net income in the last year is positive and accumulated net income is no less than 50 million yuan, or the net income in the most recent year is positive, and sales revenue is no less than 100 million yuan.
2	No less than 1.5 billion yuan	Sales revenue in the last year is no less than 200 million yuan and accumulated R&D investment is no less than 15 % of the accumulated sales revenue in the last three years.
3	No less than 2 billion yuan	Sales revenue in the last year is no less than 300 million yuan and accumulated net cash flow from operating in the last three years is no less than 100 million yuan.
4	No less than 3 billion yuan	Sales revenue in the last year is no less than 300 million yuan.
5	No less than 4 billion yuan	Main businesses or products have been approved by the authority and have achieved phased outcomes with large market potential.

Source: *Rules for Stock Issuance and Listing in the STAR Market*.

firms in the ChiNext market and firms in the STAR market may help us reveal the impact of different listing systems on firms' choice of capitalization timing.

Thirdly, the medical device industry is one of the strategically emerging sectors that has been officially addressed by the Chinese government. In 2017, the Ministry of Science and Technology issued the *13th Five-Year Plan for Sci-Tech Innovation in Medical Device Industry*. The Plan points out that the medical industry is experiencing fierce competition around the globe while the medical device industry in China is still catching up with cutting-edge technology. China's demand for high-end medical equipment heavily relies on imports from foreign firms, which aggressively acquire local firms to expand their market share at the same time. Under these circumstances, the Plan proposes five key research areas for domestic firms, encouraging the R&D of high-end products and the establishment of independent brands. Most of the medical device firms in the STAR and ChiNext markets focus on the key research areas and have gradually achieved technological breakthroughs in medical imaging, *in vitro* diagnosis and biomedical materials. Because of the COVID-19 pandemic, demand for medical devices is consistently growing worldwide. According to the *Blue Book for Development of Medical Device Industry in China 2021*, China has become the second-largest market in the world for medical devices. The medical device industry is expected to become the next red ocean market[4] (CSDR, 2021). Thus, in addition to this study's potential contribution to accounting standards setting, it has economic significance.

4.3. Choice of capitalization timing among the medical device firms

Based on the industry classification benchmark promulgated by the CSRC and Wind, we identify 46 medical device firms listed in the ChiNext and STAR markets. In Fig. 1, we summarize the proportion of capitalized R&D expenditure to total R&D expenditure of all of the medical device firms in the fiscal year ending 31 December 2021. Thirty-four (out of 46) firms expense all of their R&D investments, whereas 12 firms recognize part of their R&D expenditures as intangible assets. Among the latter group, only two firms' capitalization proportion exceeds 30 %.

Medical device products experience a long and rigid R&D cycle, starting with market research and project approval and ending with product approval and mass production (see Table 2 for details). For example, the R&D cycle of class III medical devices is approximately 4–6 years. The R&D cycle is subject to strict regulatory approval mechanisms, through which authorized third-party organizations are involved. According to *Regulations on Supervision and Administration of Medical Devices*, medical devices are subject to the validation of quality specifications before their clinical trials, which can only be conducted with the approval of the Ethics Committee.

Our analysis focuses on companies that proportionately capitalize R&D expenses instead of those that expense all R&D investments. A general picture of the R&D capitalization policies for medical device firms'

[4] Red ocean markets refer to those with known market space and intense competition.

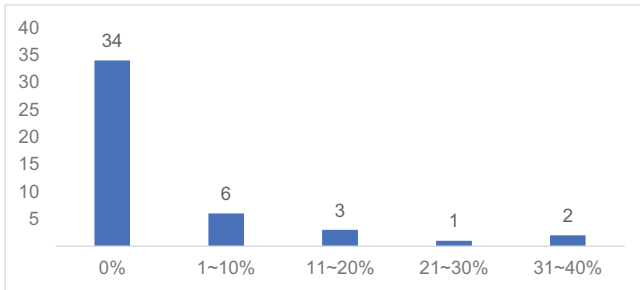

Fig. 1. The proportion of capitalized R&D expenditure to total R&D expenditure of 46 medical device firms in the ChiNext and STAR markets. Source: Wind Financial Terminal.

listing applications is presented in Table 4. We choose the accounting policies during the IPO because disclosures during the listing application are subject to strict regulation, with some differences between the ChiNext and the STAR markets as discussed above, and thus contain a more detailed and complete description of R&D capitalization than those in the periodic filings. Nine (out of 46) firms recognize some R&D expenditures as internally generated intangible assets; four of these firms are listed on the ChiNext market, and the other five are listed on the STAR market.

Three STAR market companies, Endovastec (688016.SH), Eyebright (688050.SH) and MicroPort EP (688351.SH), appear to be the most conservative in the sense that they do not capitalize R&D investment until Stage 6, the completion of the first human clinical trial. Those companies argue that a product cannot reach clinical trials until after it passes the project approval, design validation and verification, animal experiment and ethical approval stages. Completion of the first human clinical trials indicates the safety and effectiveness of the product. In other words, once clinical trials are complete, there is sufficient evidence to demonstrate the technical feasibility of completing the intangible asset, thus satisfying the most important capitalizing criteria. Detailed supporting evidence for meeting the capitalization criteria in the accounting standards for intangible assets is presented in Table 5.

One ChiNext market firm, Sanxin Medtec (300453.SZ), and two STAR market firms, Sinomed (688108.SH) and United Imaging (688271.SH), capitalize R&D investment as soon as they obtain ethical approval from the Ethics Committee, that is, Stage 5. Ethical approval is the key highly uncertain step in the R&D cycle. Obtaining the ethics committee's approval for clinical trials marks significant research progress and outcomes. However, some degree of uncertainty still exists from approval for clinical trials to the completion of the first human clinical trials, raising the question among regulators of whether it is legitimate to capitalize R&D investment from the ethical approval stage. Under the registration-based IPO system, the Shanghai Stock Exchange examines and verifies issuers' applications through rounds of comment letters. Firms applying to

Table 4
R&D capitalization policies of medical device firms in the STAR market and the ChiNext market.

Capitalization Timing	ChiNext Market	STAR Market
Stage 1-Project approval	Improve Medical (300030.SZ), Mindray (300760.SZ)	
Stage 2-Design and development planning		
Stage 3-Design validation and verification		
Stage 4-Animal experiments	Lepu Medical (300003.SZ)	
Stage 5-Ethical approval	Sanxin Medtec (300453.SZ)	Sinomed (688108.SH), United Imaging (688271.SH)
Stage 6-Clinical trials		Endovastec (688016.SH), Eyebright (688050.SH), MicroPort EP (688351.SH)
Stage 7-Product approval		

Source: Firms' prospectuses.

Table 5
Justification for choosing the clinical trial stage as the time of capitalization.

No.	Criterion	Demonstration
1	The technical feasibility of completing the intangible asset so that it will be available for use or sale.	Only by successfully passing project approval, design validation and verification, animal experiments and ethical approval can a product reach the clinical trial stage. Completion of the first human clinical implementation indicates the safety and effectiveness of the product.
2	The intention to complete the intangible asset and use or sell it.	The firm focuses on the development, manufacture and marketing of medical devices. As a market-oriented manufacturer, it conducts R&D activities aimed at realizing economic benefits through successful R&D outcomes. Thus, its R&D project is highly relevant to its main business and is intended to complete and use or sell the intangible asset.
3	How the intangible asset will generate probable future economic benefits.	At the stage of project approval, the R&D and marketing departments comprehensively consider the specific demand for the product, its potential market size, competing products and business and technical feasibility. Only through comprehensive evaluation, demonstration of an existing market for the product and clarification of how it generates economic benefits can a project be approved. After the project starts, the firm continues to follow the overall trend of its target market, the emergence of new technologies and the competitiveness of the project to ensure that the project will ultimately achieve economic benefits.
4	The availability of adequate technical, financial and other resources to complete the intangible asset's development and to use or sell it.	The firm has established and mature R&D, production and marketing departments, with corresponding R&D, production and marketing capabilities. The firm has obtained authorized patents in its research area. Additionally, during the reporting period, the firm has abundant operating cash flows. Overall, the firm is equipped with adequate technical, financial and other resources to complete the development of the project.
5	The ability to reliably measure the expenditure attributable to the intangible asset during its development.	The firm has established an integrated internal control system and accounting system under which R&D investment is independently recognized as it occurs. Thus, expenditures attributable to the intangible asset can be reliably measured.

Source: Firms' prospectuses.

be listed in the STAR market upload correspondence to the official website as soon as they submit their responses. Disclosure of R&D capitalization policies, particularly capitalization timing, is quite limited in periodic financial statements or listing applications under an approval-based IPO system. Comment letters and responses between the Exchange and firms in a registration-based IPO system provide us with a channel to discover not only a firm's choice of capitalization timing but also the regulator's attitude toward that choice, along with how the firm justifies it.

During its application for listing in the STAR market, Sinomed (688108.SH) was repeatedly challenged by the Shanghai Stock Exchange in comment letters regarding the capitalization timing. The Exchange required Sinomed to further illustrate the existence of technical barriers between its capitalization timing (i.e., ethical approval stage) and the clinical trial stage and to provide external evidence supporting its choice. Accordingly, Sinomed explained that it invited authoritative industry experts to be their main researchers, who are responsible for developing clinical research plans and conducting clinical trials. The medical institutions where the main researchers work are designated the main hospitals. The main hospitals have comprehensive specialties, outstanding research capabilities and nationwide influence. Thus, the main hospital's Ethics Committee is independent of the firm and competent to act as a supervisory third party. Regarding external evidence, when applying to the Ethics Committee to conduct clinical trials, the firm is required to submit verification reports, animal experiment results, clinical trial plans and the researchers' manual. As a result, the firm is incapable of obtaining prior ethics approval through manipulation. Following supplementary disclosures, the Shanghai

Stock Exchange was convinced that Sinomed's choice of capitalization timing satisfied the criteria of recognizing internally generated intangible assets and approved its listing application.

The other three ChiNext market firms—Improve Medical (300030.SZ), Mindray (300760.SZ) and Lepu Medical (300003.SZ)—adopt more aggressive R&D capitalization policies. Most radically, Improve Medical and Mindray take the project approval, that is, Stage 1 of the R&D cycle, as the starting point for capitalization. As noted above, obtaining project approval marks the beginning of the R&D cycle. From project approval to product approval and mass production, the internal project needs to go through the stages of design validation and verification, animal experimentation, ethics approval and clinical trials, all of which are inherently uncertain. It would be rather farfetched to argue that project approval could demonstrate both the technical and the business feasibility of the project, thus satisfying the capitalization criteria.

The key findings from the above analysis are summarized as follows.

1) Although R&D-based and innovation-oriented, recognizing R&D expenditure as internally generated intangible assets is rare among medical device firms in both the ChiNext and STAR markets. Distorted incentives for R&D investment among growth-stage knowledge-based firms are not mitigated by the introduction of emerging trading markets.
2) There is a large variation of capitalization timing among the medical device firms varying from project approval to the clinical trial stage of the R&D cycle. Compared with firms in the ChiNext market, firms in the newly established STAR market generally adopt a more conservative R&D capitalization policy. This may be driven by the STAR market's loosened listing standard with respect to earnings. The incentive to manage earnings upward before the IPO may be mitigated because of the new listing standards.
3) The registration-based system is a stock issuance and listing system that is centered on information disclosure. Rounds of comment letters and more detailed disclosure criteria jointly construct a more effective regulatory mechanism, which avoids earnings management by capitalizing increased R&D expenditures. At the same time, comment letters and responses provide investors with increased information about the progress, outcomes and capitalization timing of firms' R&D projects in comparison with other firms in the same industry.

Overall, the above analysis of R&D capitalization policies in the medical device industry provides a reference for our further proposal. To tackle the related issues, we propose the milestone approach to improving the financial reporting of internally generated intangible assets in the following section.

5. Our proposal

As discussed in Section 2, financial reporting and related accounting standards for internally generated intangible assets should be improved. Our case study further proves the need to do so. Among the three approaches to improving the related standards discussed in Section 3, we are in favor of the recognition approach rather than the fair value approach. In addition, we support any efforts to require more qualitative and/or quantitative disclosure such as those proposed by AASB (2022) or regulatory processes such as those adopted by China's STAR market. Among the four recognition approaches explored in EFRAG (2021), we prefer the threshold for recognition approach and the conditional recognition approach—that is, to move recognition timing forward based on the R&D cycle. Here, we temporarily call this approach the milestone approach. In our view, if IASB were to adopt this approach in the coming years, the following theoretical and technical issues should be carefully elaborated.

5.1. Decision usefulness of financial reporting

The objective of financial reporting is to provide financial information about the reporting entity that is useful to investors, lenders and other creditors (users) in making decisions relating to providing resources to the entity. Those decisions depend on the returns that users expect. Their expectations about returns depend on their assessment of the amount, timing and uncertainty of future net cash inflows to the entity and management's stewardship of the entity's economic resources. To make these assessments, users need information

about the economic resources of the entity, claims against the entity and changes in those resources and claims. They also need information about how efficiently and effectively the entity's managers have discharged their responsibilities to use the entity's economic resources (IASB, 2018, paras 1.2–1.4).

Current recognition criteria for internally generated intangible assets are so stringent that they militate against capitalizing R&D expenditures, resulting in very limited information about how those expenditures have occurred, how R&D projects have progressed and how an entity's earning power has increased or decreased through successful or failed R&D activities. In many cases, firms may benefit from huge R&D investments in the form of substantial increases in revenues and profits. However, under current accounting standards, the costs are expensed in early periods, whereas related revenues are generated and recognized in future periods. Hence, the related costs and benefits are not associated or matched. In our view, when starting a project involving intangible assets, particularly those that are internally generated, IASB should firstly determine whether current standards have the above deficiencies and whether there is a need to improve the related standards to meet users' needs. We envisage that accounting principles based on milestones of R&D projects have the potential to remedy those deficiencies, thus providing useful financial information for users to make economic decisions.

5.2. Definition of assets and recognition criteria

One key reason for the strict capitalization criteria for internally generated intangible assets is that the current IAS 38 is based on the previous versions of *Conceptual Framework* (IASC, 1989; IASB, 2010), especially the sections on the definition of assets and on recognition.

(1) Definition of assets. The revised *Conceptual Framework* defines an asset as a right that has the potential to produce economic benefits (i.e., an economic resource) controlled by the entity (IASB, 2018, para. 4.4). For that potential to exist, it does not need to be certain, or even likely, that the right will produce economic benefits. It is only necessary that in at least one circumstance, the right will produce economic benefits (IASB, 2018, para. 4.14). In other words, a right can meet the definition of an asset even if the probability that it will produce economic benefits is low.

(2) Recognition criteria. The revised *Conceptual Framework* removes the two recognition criteria in the previous version. Previously, an item that meets the definition of an element would be recognized if (a) it was probable that any future economic benefit associated with the item would flow to or from the entity and (b) the item had a cost or value that could be measured with reliability (IASB, 2010, para. 4.38). According to the revised *Conceptual Framework*, an asset or liability is recognized only if recognition of that asset or liability and any resulting income, expenses or changes in equity provides users of financial statements with useful information. To do so would (a) provide relevant information about the asset or liability and any resulting income, expenses or changes in equity and (b) give a faithful representation of the asset or liability and any resulting income, expenses or changes in equity (IASB, 2018, 5.7).

Based on the above discussion, we feel strongly that the *Conceptual Framework* recently revised by IASB (2018) provides the Board with a foundation to explore the possibility of revising the definition of intangible assets and loosening their recognition criteria.

(3) Identifiability. To distinguish it from goodwill, IAS 38 defines an intangible asset as an *identifiable* nonmonetary asset without physical substance (IASB, 2021b, para. 8). In our view, identifiability criteria should remain. Firstly, the revised *Conceptual Framework* defines an asset as a present economic resource controlled by the entity as a result of past events (IASB, 2018, para. 4.2). Identifiability is essential to assess whether an entity controls an intangible asset. Secondly, the revised *Conceptual Framework* further defines an economic resource as a right that has the potential to produce economic benefits (IASB, 2018, para. 4.2). Identifiability is also essential to assess whether an entity has such a right. Thirdly, identifiability is necessary to associate expenditures with a particular internal project regardless of whether these expenditures should be expensed or capitalized.

(4) Expected future economic benefits. Under current IAS 38, an intangible asset shall be recognized if and only if (a) it is probable that the expected future economic benefits that are attributable to the asset will flow to the entity and (b) the cost of the asset can be measured reliably (IASB, 2021b, para. 21). Because the revised *Conceptual Framework* has removed these recognition criteria, IASB could consider loosening the recognition

criteria of intangible assets in the same manner. Consequently, IASB should consider removing some of the capitalization criteria of internally generated intangible assets, such as the demonstration of how the intangible asset will generate probable future economic benefits (IASB, 2021b, para. 57).

(5) Separation between the research and development phases. According to current IAS 38, to assess whether an internally generated intangible asset meets the criteria for recognition, an entity classifies the generation of the asset into either the research phase or the development phase (IASB, 2021b, paras. 52–55). All of the expenditures on the research phase of an internal project shall be expensed when they are incurred, whereas some expenditures in the development phase would be qualified for capitalization if very strict criteria are met. The Board applies the ability to generate future economic benefits to distinguish between the research phase and the development phase. If the Board were to decide to remove the ability to generate probable future economic benefits from the definition and recognition criteria of intangible assets, it should reconsider the need to distinguish between the research phase and the development phase of an internal project. Our case study proves that in reality, the R&D cycle and approval mechanism of medical devices and similar industries do not have such a significant distinction. In practice, the concept of the development phase is less important than the specific milestone in the R&D cycle at which the firm begins to capitalize its subsequent expenditures.

5.3. Measurement

In principle, the milestone approach that we propose is similar to the second recognition approach (the threshold for recognition) and third recognition approach (conditional recognition) discussed by EFRAG (2021).

The second approach suggests recognizing an internally generated R&D project as an intangible asset if specified thresholds are met at the start of the project. Unlike current IAS 38, this approach would loosen both the definition and the recognition criteria of intangible assets, similar to the milestone approach in our minds except for identifiability, which we believe is necessary to maintain in the definition of intangible assets, whereas this approach would consider removing it from the definition.

The third approach requires an entity to continuously assess whether the recognition criteria are met. If the criteria are met, all subsequent R&D costs are recognized as intangible assets. EFRAG discusses three variances of this approach. R&D expenditures can be (i) expensed as incurred until the recognition criteria are met, (ii) capitalized and fully impaired until the internal project meets the criteria, at which point the impairment loss is reversed, or (c) recognized as expenses in OCI as incurred until the recognition criteria are met.

(1) Reversal of expensed R&D cost. In our view, the key difference between the second and third approaches and among the three variances of the third approach is related to the reversal of expensed R&D cost before recognition criteria are met. The first variance implies one principle in current IAS 38, that is, to prohibit the reinstatement of an expenditure previously recognized as an expense (IASB, 2020a, paras. 65, 66 and 71). Although the third approach, as proposed by EFRAG (2021), would move ahead with recognition timing compared with the current requirement in IAS 38, and would possibly obtain a result similar to that obtained by the second approach, this variance would capitalize a lower amount of R&D cost than the second and third variances. However, this variance has the advantage of reducing potential room for earnings management through the reversal of expensed R&D cost compared with the second or third variance.

In the second variance, both the expenditures incurred before and the expenses incurred after the recognition criteria are met are capitalized. The reversal of the impairment loss indicates to users when the recognition criteria are met. This variance provides better information on the progress of R&D projects than the other variances, helping users make rational capital allocation decisions and assess how management is discharging their stewardship. One major disadvantage of this variance is that management may use its discretionary power to manage earnings and other financials, especially when there is no strict auditor scrutiny and regulatory enforcement.

The third variance results in final financials similar to those produced by the second variance. In our view, however, this variance is inconsistent with the revised *Conceptual Framework*, which clearly states that in exceptional circumstances, the Board may decide that income or expenses arising from a change in the *current value* of an asset or liability are to be included in OCI (IASB, 2018, para. 7.17) because either the third approach or the milestone approach that we are considering uses a cost rather than a *current value* basis.

Hence, we do not expect IASB to follow this path to improve accounting standards for internally generated intangible assets.

(2) Impairment of assets. Adding a project on intangible assets to the research pipeline would inevitably trigger a debate on whether IAS 36 *Impairment of Assets* should be revised, and if so, how. If IASB decides to amend the definition of intangible assets and their recognition criteria based on the revised *Conceptual Framework*, the new principles would be incompatible with those in IAS 36, which relies heavily on expected future cost and benefits from the related asset or group of assets. Hence, IASB shall explore the need and methods to revise IAS 36 accordingly. If IASB does not intend to do so, the second variance of the third approach might be the appropriate option.

(3) Option to use revaluation model in subsequent measurement. As discussed in Section 3, IAS 38 allows the use of a revaluation model to measure intangible assets. However, Christensen and Nikolaev (2013) find that all of the firms in their research sample use the cost model rather than the revaluation model during their 2005 transition to IFRS. In our opinion, if there is any possibility that IASB would consider revising IAS 38 by following the fair value approach, the Board should firstly conduct a thorough investigation of the reasons that the revaluation model has not been widely adopted. Possible reasons might be that the conditions specified in the standards for using this option are too rigid, preparers find it difficult to obtain reliable current measures or determine whether users do not feel that the resulting information is useful. If users feel that the resulting information is useful, the Board shall consider whether it is better to revise the conditions and principles to apply this option or to introduce fair value measurement for some or even all intangible assets, particularly in subsequent measurements.

5.4. Additional disclosure

Because it was issued long ago, IAS 38 contains disclosure requirements that are more limited than the recently promulgated IFRS. We are in favor of any initiative to enhance the disclosure of intangible assets in the notes to financial statements, such as the timing of R&D capitalization, the nature and progress (both expected and actual) of R&D projects and the approval mechanism of milestones. In our view, the AASB's (2022) proposal provides a very good basis for IASB to consider adding requirements for increased disclosure.

Our case study also shows that comment letters from capital market regulators and responses from firms about intangible assets-related accounting treatment provide an important source of information for users to judge and make decisions. A recent case study of listed firms in China's pharmaceutical industry shows that such a regulatory system also encourages auditors to provide users with more information about the capitalization of R&D costs in the form of key audit matters (He et al., 2022).

Moreover, our proposed milestone approach is cost-based. In many cases, the information obtained from such an approach may not be able to give a clear picture of the expected value of related R&D projects. We support efforts to provide expected value-based information in management discussion and analysis (MD&A) sections and sustainability reports. Such disclosures would be useful for evaluating the value of R&D projects and their relationship to an entity's value if they meet the qualitative requirements in the *Conceptual Framework*.

5.5. Qualitative characteristics of useful information

Based on the revised *Conceptual Framework for Financial Reporting*, faithful representation has replaced reliability to become a fundamental qualitative characteristic. Useful financial information must be relevant and faithfully represent what it purports to represent. In addition, decision usefulness is enhanced if information is comparable, verifiable, timely and understandable (IASB, 2018, para. 2.4).

(1) Relevance and faithful representation and degree of uncertainty. Current financial reporting of internally generated intangible assets relies heavily on limited disclosures in the footnotes to financial statements as required by accounting standards, plus additional information required by regulators. Our proposed milestone approach is generated from the perspective of relevance, specifically, improving earnings relevance by solving the mismatch between R&D-related revenues and expenses. The advantage of the milestone approach is appar-

ent in the sense that it can improve the relevance of financial information and enhance comparability both from period to period for the same entity and in a single period across different entities.

The revised *Conceptual Framework* has replaced reliability with faithful representation as one of the fundamental qualitative characteristics. Although deciding the capitalization timing of internal R&D projects requires the use of judgment and estimation, measurement uncertainty is allowed when providing a faithful representation. The possibility of using discretion to improve the appearance of financial statements is insufficient to prevent reporting entities from recognizing significantly relevant information. Our proposal is consistent with IASB's move toward a more relevant, and thus more useful financial reporting system that allows accounting for uncertainty.

The milestone approach has the potential to improve the relevance and comparability of financial information without sacrificing faithful representation. Although the R&D cycle varies across industries, products in the same industry should go through the sequential stages of R&D with high similarity. As is evident from this case analysis, R&D projects in the medical device industry are subject to the same R&D cycle, with little discretion. Every medical device product should go through project approval, design validation and verification, animal experiments, clinical trials and product approval to go to market. Each step toward the final stage of product approval indicates that the project has made a significant advance in technological feasibility. In other words, the later the stage of the project, the lower the uncertainty of its ability to generate economic benefits for the entity. Moreover, concerns about earnings management can be largely alleviated due to rigid R&D cycles and milestone concepts inherent to the industry. Regulatory approval mechanisms and authorized third-party organizations are deeply involved through the cycle, and both of them enhance the difficulty for management to manipulate the progress of R&D and equip the stages of R&D projects with more credibility.

(2) Comparability. As our case analysis shows, most IPO firms in the STAR market capitalize R&D investment until they enter the last stages of the R&D cycle, such as ethics approval or clinical trials. However, listed medical device firms on the ChiNext market adopt the accounting policies of R&D capitalization, albeit with large variations. Aggressive firms capitalize R&D expenditures during the project approval stage, whereas their conservative counterparts expense all R&D expenditures until the clinical trials.

In our view, medical device firms should be required to capitalize R&D expenditures earlier, perhaps from the design validation and verification or animal experiment stages. By doing so, the mismatch between revenues and expenses would be largely mitigated, and the comparability of financial information would be significantly enhanced. Ultimately, financial statements would be better used as input to predict the company's future operating outcomes, thus improving the statements' relevance.

We stress the importance of the comparability of financial information coming from any potentially revised financial reporting standards for intangible assets. However, this does not mean that we advocate bright-line rules-based standards because, as stipulated in IASB's revised *Conceptual Framework*, for information to be comparable, like things must look alike and different things must look different. Comparability of financial information is not enhanced by making unlike things look alike any more than it is enhanced by making like things look different (IASB, 2018, para. 2.27). To enhance comparability, standard-setters, regulators and practitioners should work together to establish more industry-specific guidance on the timing of R&D capitalization. Concerning the medical device industry, both the stage that can be justified as the time for capitalization and legitimate external and internal evidence for the R&D outcome shall be specified.

6. Conclusion

This study focuses on the financial reporting standards for internally generated intangible assets. With the rapid development of the knowledge-based economy, IAS 38 has led to a large amount of unrecognized value in technology-oriented firms. All of the stakeholders of IFRS and financial information have raised awareness of this issue, giving rise to heated discussions. Recently, IASB decided to add a project on intangible assets to the research pipeline in its five-year work plan (IASB, 2022b). In this study, we summarize the historical development and current requirements of financial reporting standards for intangible assets. We also compare different approaches to improving these standards, including the recognition approach, the fair value approach and the disclosure approach. This paper focuses on the recognition approach, based on which we further

develop our case study. We provide a general picture of the R&D capitalization policies of medical device firms in China's STAR and ChiNext markets, both of which were established to channel capital to high-tech and innovative firms. We further investigate how medical device firms capitalize their R&D investment in their IPO applications, and more specifically, the stage of the R&D cycle at which they capitalize all subsequent expenditures. We conclude that the current recognition criteria for internally generated intangible assets are so stringent that they disincentivize the capitalization of R&D investment. In addition, there is a large variation of capitalization timing within the medical device industry varying from project approval to the clinical trial stage of the R&D cycle, partly due to different IPO systems in the STAR market and the ChiNext market. Finally, we propose the milestone approach to improving financial reporting standards for intangible assets, with discussions of the key theoretical and technical issues that IASB should consider. We suggest that the capitalization criteria on intangibles be determined on the basis of the R&D cycle and that the timing of capitalization be moved forward.

This study has several limitations. Firstly, our conclusion and the proposed milestone approach may have limited generalizability to all industries. We develop our proposal of the milestone approach based on a case analysis of the medical device industry. Although the medical device industry has a rigid and uniform approval system based on the R&D cycle, we cannot conclude that there is the same or similar system in every high-tech sector. Thus, the milestone approach might not apply to some other industries. Concerning those industries without a clear approval mechanism based on the R&D cycle, future case analyses are needed to investigate the feasibility of the milestone approach. Secondly, our case study exclusively focuses on firms' accounting policies on R&D capitalization set forth in their IPO applications. As mentioned in Section 4, China has long had a strict IPO system that pressures IPO firms to present "impeccable" financial statements. To increase the probability of receiving an IPO approval, firms may tend to conservatively expense all of their R&D investments before going public. However, relatively speaking, delisting is a rare event in the Chinese capital market compared with more developed markets. Thus, after going public, firms' accounting strategies for intangibles probably differ from their accounting strategies for IPO purposes. Future research could further focus on listed firms' accounting policies and estimates of their internally generated intangible assets, as presented in their annual financial statements.

Declaration of Competing Interest

None.

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Spillover effects of VAT Self-enforcement properties: Evidence based on the replacement of business tax with VAT reform

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ABSTRACT

In accordance with the purchasing tax-deduction method and the receipt-based value added tax (VAT) system, the same transaction can be recorded by two firms, which creates self-enforcement properties, thereby restraining tax avoidance. Using the Replacement of Business Tax with VAT reform in China, this paper adopts a difference-in-differences design to investigate the spillover effects of VAT self-enforcement properties on corporate income tax avoidance by manually collating information about suppliers/clients of listed firms. As the listed firms' suppliers/clients switch from paying business tax to paying VAT, there is a striking decline in their corporate income tax avoidance behavior. This effect is pronounced in firms with closer upstream and downstream correlations, higher information complexity and stronger incentives for tax avoidance.

1. Introduction

In 2021, the value added tax (VAT) accounted for 37 % of the total tax revenue in China, maintaining its position as the largest source of tax revenue. The VAT also plays a vital role in the tax system in other countries. Vegh and Vuletin (2015) find that the VAT accounts for 31 % of all tax revenues on average, based on data from 92 countries. In addition, the VAT is widely adopted, indicating its importance. By 2015, over 160 countries worldwide had levied a VAT (KPMG, 2015). The popularity of VAT is due not only to its characteristics of tax neutrality and avoiding double taxation but also, and more importantly, to its role as an effective means of tax administration (Bird and Gendron, 2007).

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In the middle of the VAT credited chain, the purchases of firms are deductible as an input tax, which lessens firms' incentives to underreport or not report their purchases. As one firm's purchases are another firm's sales, the buyer's tax avoidance by underreporting or not reporting purchases can make it difficult for the seller to underreport or not report sales, as the same transaction in inter-business trade is recorded on both sides of the transaction in the form of input and output VAT. As such, one firm becomes the third-party information provider for the other, allowing the tax authority to obtain complete transaction information by cross-checking and making it difficult for firms to conceal their transaction records. Thus, the VAT naturally bears self-enforcement properties. Given the importance of the VAT and its nonnegligible role in the tax governance system, it is of great theoretical value and practical significance to explore its specific impact on tax compliance.

However, most published studies on the self-enforcement mechanism of the VAT remain at the theoretical level (Burgess and Stern, 1993; Agha and Haughton, 1996; Kopczuk and Slemrod, 2006; Bird and Gendron, 2007), with few relevant empirical studies and a mere handful of studies on the spillover effect of the VAT's self-enforcing properties. This may stem from the fact that identification of the economic consequences of the VAT's self-enforcement effect requires not only access to information about firms in the supply chain but also an exogenous shock involving a change of this effect, which is difficult to achieve in reality. Therefore, empirical studies either indirectly prove that the VAT has improved the efficiency of the overall tax system in terms of government revenues (Keen and Lockwood, 2010) or verify the deterrent effect of VAT receipts by conducting field experiments with random intervention (Pomeranz, 2015). In this paper, the spillover effects of the VAT self-enforcement mechanism are explored through the exogenous shock brought by a tax reform in China to expand the relevant research field.

Specifically, China launched a pilot program, Replacement of Business Tax with the VAT (VAT reform), in the transportation and modern service industries in Shanghai in 2012 and then gradually extended it to other industries and regions. On May 1, 2016, the VAT reform was rolled out to all industries nationwide; since then, the business tax has been completely abolished. The VAT reform differently affected those firms that have always paid the VAT themselves and their clients/suppliers who paid business tax before the VAT reform. As their clients/suppliers became VAT payers, the environment of tax enforcement that they encountered changed considerably because of the VAT's self-enforcement properties. Specifically, since the VAT reform, the clients of the treated firms have an incentive to ask for VAT input receipts from the firms, while the firms are also more likely to request VAT input receipts from their suppliers. The request for VAT receipts enables the tax authorities to obtain more complete transaction records of the treated firms through third-party information, thereby deterring their tax avoidance behavior (Kleven et al., 2016).

The above information indicates that the VAT reform provides an opportunity to investigate the economic consequences of the self-enforcing properties of the VAT. Specifically, we may examine the spillover effects of the VAT self-enforcement mechanism on restraining corporate income tax avoidance behaviors. Although there are sparse studies on the impact of the VAT's self-enforcement properties on firms' VAT evasion, no study has examined their spillover effects. The empirical results of this paper show a considerable decline in the income tax avoidance behavior of the treated firms after the VAT reform, which is reflected in a noticeable increase in their effective tax rate (ETR). The findings remain robust after a parallel trend hypothesis test, the replacement of income tax avoidance measures, a placebo test, the consideration of change in suppliers/clients and other checks. Furthermore, the above findings are found to be more significant in sample firms with closer upstream and downstream correlation, higher information complexity and stronger tax avoidance incentives than in other firms.[1]

On the whole, this paper corroborates the spillover effects of the VAT's self-enforcement properties on corporate income tax, which contributes to the literature in the following aspects. (1) Studies mainly explore the VAT's supervision effect from a theoretical perspective, with little relevant empirical evidence, and even less attention is paid to this topic in the Chinese literature. In the first academic attempt to fill this gap, this paper

[1] We did not directly investigate the inhibitory effect of the VAT's self-enforcement properties on firms' VAT avoidance behavior, because the suppliers/clients of the treatment group changed from business tax payers to VAT payers, which would directly affect the VAT burden of the treated firms. Therefore, it is difficult to judge whether the change in VAT burden of the treatment group is due to the VAT reform itself or the VAT's self-enforcement properties.

verifies that the VAT is an efficient form of taxation and that its self-enforcing properties have a spillover effect. In terms of research methods, we manually collect relevant information about the suppliers/clients of listed firms and adopt a difference-in-differences model based on quasi-natural events to make the conclusions more reliable. The conclusions of this paper effectively enrich the relevant literature on the VAT supervision effect and also fill in gaps in this important research field in China. (2) We also complement the literature framework on the relationship between third-party information and corporate tax avoidance. A large number of studies propose that third-party information has a deterrent effect on corporate tax avoidance (Tian et al., 2021; Kleven et al., 2011, 2016; Carrillo et al., 2017; Naritomi, 2019). However, to the best of our knowledge, these studies are mainly conducted from the perspective of consumers. Specifically, Tian et al. (2021) verify that the introduction of lottery receipts significantly weakens corporate business tax avoidance, and Naritomi (2019) demonstrates that giving subsidies to clients can encourage them to supervise firms to truthfully provide transaction information and significantly improve the efficiency of VAT administration. The present study is conducted from the perspective of firms' trading partners, namely their clients and suppliers. Thus, it complements prior studies well and makes the research framework in this field more complete. (3) We also broaden the academic literature concerning the VAT reform. Studies consider the impact of this tax reform on the tax burden (Fan and Peng, 2017), investment (Yuan et al., 2015; Li and Zhang, 2015) and division of labor (Chen and Wang, 2016; Fan and Peng, 2017) of the reformed enterprises. We examine the spillover effects of the VAT reform on the income tax avoidance behavior of treated firms' clients and suppliers from a novel perspective, which provides important information for evaluating the VAT transformation.

2. Literature review, theoretical analysis and research hypotheses

2.1. Literature review

2.1.1. Tax enforcement and corporate tax avoidance

Tax enforcement is considered to be a key factor affecting corporate tax avoidance. Studies explore the impact of tax enforcement on corporate tax avoidance mainly from two perspectives: the formal levying behavior of tax authorities and the supervision of third-party reported information.

With respect to formal tax enforcement by tax authorities, corporate tax avoidance is more severe in regions in which tax enforcement is less intense, because tax avoidance is easier to hide and the marginal cost of corporate tax avoidance is lower (Dubin et al., 1990; Slemrod et al., 2001). However, empirically, the precise identification of tax enforcement intensity is challenging. Desai et al. (2007) use the exogenous event of Putin's rise to power and the coinciding increase in tax enforcement intensity in Russia and find that increased tax enforcement alleviates corporate tax avoidance. Fan and Tian (2013) have similar findings by studying China's 2002 income tax sharing reform. Similarly, Chen (2016) takes the 2005 abolition of agricultural tax as a quasi-natural experiment to identify changes in tax administration intensity.

While tax authorities play a vital role in tax enforcement, the literature proves that tax administration remains effective, even with weak government enforcement, as long as third-party information is available. Specifically, Kleven et al. (2016) indicate that even in the most developed economies, the level of tax evasion is extremely high among family-owned small businesses without third-party information sharing. This can be attributed to the fact that third-party information enables the government to verify taxpayer reports against other sources, thus alleviating the information asymmetry between government departments and taxpayers and fully reflecting taxpayers' taxable income (Kleven et al., 2011). Other studies focus mainly on the impact of employer wage reports in formal sectors on individual income tax (Kleven et al., 2011), the impact of other trading partner information on corporate taxable income (Kopczuk and Slemrod, 2006; Pomeranz, 2015; Carrillo et al., 2017) and the impact of clients' demand for receipts on corporate VAT and business tax (Arbex and Mattos, 2015; Naritomi, 2019; Tian et al., 2021) to explore the role of third-party tax information in improving the efficiency of the tax system.

In this paper, we focus on third-party information provided by VAT receipts to examine its impact on income tax avoidance by upstream and downstream firms in the transaction chain, expanding the relevant literature on the importance of third-party information in tax enforcement. In particular, first, we expand the

scope in traditional studies of taxpayers "radiated" by third-party, tax-related information from the taxpayers themselves to their upstream and downstream partners. Second, we extend the scope of corporate VAT avoidance itself to corporate income tax avoidance and prove that VAT receipts, as a type of third-party information in tax administration, have a double spillover effect.

2.1.2. Supervision effect of VAT

The VAT is considered to be one of the most effective tax policies due to its self-enforcement mechanism; therefore, it has been adopted by most countries worldwide over a short period (Bird and Gendron, 2007). Some scholars have called the VAT the "best tax" because it is levied throughout a product's life cycle, and firms have incentives to ask their suppliers for receipts to deduct input costs at all stages, except for the final clients at the retail stage (Agha and Haughton, 1996). The VAT receipt generated in the credited chain and the book records of the counterparties make tax avoidance more difficult (Tait, 1972; Burgess and Stern, 1993). However, most studies on VAT self-enforcement mechanisms remain at the theoretical level (Kopczuk and Slemrod, 2006). Keen and Lockwood (2010), using data from 143 countries over 25 years, find that most countries experienced a significant increase in their revenue-to-GDP ratio after the adoption of the VAT, which confirms that the VAT is an effective instrument of tax administration from a macro perspective. Pomeranz (2015) is the first to empirically verify the deterrent effect of the VAT receipts as third-party vouchers on corporate tax compliance, based on a field experiment approach. Naritomi (2019), taking a tax policy implemented by the government of São Paulo, Brazil as exogenous, finds that sales recorded on the books of firms increase significantly at the last stage of VAT collection, when clients can receive lottery rewards for claiming VAT receipts. This demonstrates that third-party information can deter firms from tax avoidance.

However, studies do not examine the spillover effect of the VAT's self-enforcement properties. In fact, the problem of tax evasion and avoidance is more serious in corporate income tax than in the VAT. Therefore, it is of great practical importance to explore the spillover effect of the VAT's self-enforcement properties on corporate income tax. Furthermore, the paucity of literature on Chinese firms brings into doubt whether and to what extent the VAT's self-enforcement mechanism works in China. In fact, as taxation varies considerably across countries, it is difficult to directly transfer the findings based on one country to another. An understanding of the VAT's self-enforcement properties can be comprehensive and profound only when a large number of types of countries are examined. Therefore, this paper based on the VAT reform is conducted in China, the largest developing country, to investigate the spillover effect of the VAT's self-enforcing properties on corporate income tax compliance behavior, which is a meaningful supplement to the literature.

2.2. Theoretical analysis and research hypothesis

To investigate the spillover effect of the VAT's self-enforcing properties, we take the VAT reform as an entry point and examine changes in the income tax avoidance behavior of firms that always paid the VAT themselves but whose clients or suppliers paid business tax before this policy (treated firms) from before to after the VAT reform. Theoretically, the treated firms gain third-party tax information when their upstream and downstream partners change from business tax payers to VAT payers; thus, their income tax avoidance behavior is restrained. This is because, in theory, the VAT, as a turnover tax, calculates both output tax from selling goods and input tax from purchasing goods. The difference between the two is the actual VAT tax burden that firms must pay. Firms thus have an incentive to declare input tax deduction truthfully to reduce their actual net tax burden. In practice, all VAT deduction vouchers are based on the VAT receipts printed by the tax authorities. Downstream firms take the initiative to obtain VAT receipts from their upstream firms to deduct input costs. Moreover, China's tax enforcement system is based on such receipts, which were originally meant to record transactions between firms and have become an important medium for tax enforcement, as well as a primary basis for tax audits. Therefore, VAT receipts, as important third-party information, can be used to supervise firms' transactions and amounts after the treatment group's clients or suppliers have been transformed from business tax payers to VAT payers.

In addition to VAT receipts, the more authentic book records of one side of a transaction also provide more reliable tax information for the other side after the VAT reform, thus allowing tax authorities to cross-check transaction information during audits. After the introduction of the VAT, firms have less incen-

tive to underreport or to not report their purchases due to the credited mechanism of VAT input tax. Moreover, the purchases of a downstream firm represent the sales of its upstream firm (supplier); similarly, the sales of an upstream firm are the purchases of its downstream firm (client). In this way, a transaction is recorded on the books of both sides, one as a purchase and one as a sale. In this regard, there are only two ways to underreport or not report transaction records. In the first scenario, the firms in the VAT-credited chain do not collude, and the books of the upstream and downstream firms are inconsistent. However, this increases the risk of tax audits and the marginal cost of tax avoidance. In the second scenario, the firms in the VAT-credited chain do collude, and the transaction is hidden or underreported on both books. However, it is difficult for them to collude because firms tend to increase their input tax costs or decrease their output tax costs to minimize their tax burden. Increasing the input tax results in an increase in the output tax of the upstream firms, increasing their tax burden. Similarly, a reduction in the output tax reduces the input cost of the downstream firms, which increases their tax burden. The interests of both sides are not aligned, leading to the failure of collusion (Pomeranz, 2015).

Therefore, according to the analysis above, the VAT's self-enforcement properties make it more likely that the books of firms on both sides of a transaction remain authentic and consistent after (vs before) the VAT reform, as the interests of upstream and downstream partners are mutually restricted. The more authentic and accurate transaction records of the third-party reported information make it difficult for firms to underreport or not report the transaction records to the government. Transaction records related to VAT receipts mainly involve sales of firms, procurement of raw materials, services and fixed assets. Such information is a crucial basis for calculating the taxable income of firms, rendering it more difficult for them to avoid income tax. On this basis, the following research hypothesis is proposed:

Firms that have always paid VAT themselves but whose clients or suppliers paid business tax before the VAT reform significantly reduce their corporate income tax avoidance behaviors as their clients or suppliers are transformed into VAT payers.

It should be stressed that we test changes in the corporate income tax burden rather than in the VAT for the treated firms for the following reasons. (1) The change of treated firms' clients or suppliers from business tax payers to VAT payers directly affects the VAT burden of the treatment group. Therefore, it is difficult to distinguish whether changes in the VAT are due to the VAT reform itself or to the VAT's self-enforcement properties. In contrast, the VAT reform has no direct effect on the treated firms' income tax burden; thus, their improved tax compliance can be attributed to the VAT's self-enforcement mechanism. (2) Examining the impact of the VAT reform on income tax evasion expands the research scope from being limited to the VAT to including income tax. The test of spillover effects gives us a deeper understanding of the interactions among firms in the supply chain and the correlations between different types of taxes.

3. Research design

3.1. Sample construction and data sources

In this paper, we investigate the spillover effects of the VAT's self-enforcing properties by examining the changes in income tax avoidance behavior of treated firms from before to after the VAT reform. As mentioned above, treated firms have consistently paid VAT themselves; however, their clients or suppliers paid business tax before the VAT reform. Therefore, we first filter the treated firms for this paper. The procedure for obtaining the treatment group is as follows. First, we identify listed firms that have been VAT payers throughout the sample period. Second, we narrow this group to firms with at least one major client or supplier that was a business tax payer before the VAT reform. To make the relevant judgments, we obtain the names of the top five suppliers and clients of Chinese A-share listed firms from the Chinese Research Data Services (CNRDS) database. However, suppliers and clients include both listed and unlisted firms, requiring further

discussion. If the top five suppliers and clients are listed firms, we can directly obtain the necessary data by referring to their disclosed information. If not, we search the Global Database of the Wind Information Financial Terminals (Wind) database[2] for information on each of these suppliers and clients, mainly by region and industry, to determine the necessary data, namely whether they were business tax payers before the VAT reform and when they were piloted. Through the above procedure, we obtain the sample firms of this paper. Finally, we use the data of these firms from 2008 to 2020 as the sample for this paper. Excluding observations that are missing empirical variables, we ultimately obtain 3,307 observations.

For the sample selection in this paper, it must be highlighted that the sample is limited to firms that have always paid VAT themselves but have at least one client or supplier that paid business tax before the VAT reform. This means that the sample firms are all eventually be affected by the reform, but the timing of the effect varies depending on when their clients or suppliers became VAT payers. It also means that we do not include firms whose clients or suppliers also paid VAT before and after the reform in the control group. In accordance with the requirements of information disclosure, listed firms need only disclose data on their top five clients and suppliers. Even if both a listed firm itself and its major clients or suppliers have always been VAT payers, this does not necessarily mean that the firm's other clients and suppliers have always paid VAT. Therefore, we cannot obtain a relatively clean control group (i.e., never-treated group) based on the current data. However, we can use a staggered difference-in-differences (DID) model to identify the spillover effects of the VAT's self-enforcement properties because of the staggered implementation of the reform. This empirical model does not require an absolutely clean control group in the sample, as the treatment groups are disposed of at different points in time, such that the treatment group not yet treated can serve as a control group for other treatment groups that have been treated. The classic literature on the use of DID models (Bertrand et al., 2002; Bertrand and Mullainathan, 2003) does so.

Recent studies in statistics, however, find that the estimation of the traditional two-way fixed effects (TWFE) model may have bias in the staggered DID model (Baker et al., 2022). Goodman-Bacon (2021) holds that when treatment groups are treated at different times, the DID results estimated by TWFE are actually weighted averages of the treatment effects across periods. Nevertheless, when treatment groups treated at different times have different treatment effects, the biased weight assignment may lead to bias in the final estimation results. To solve this problem, we also use the SADID method for estimation (Sun and Abraham, 2021). This method effectively addresses the bias caused by the staggered time with heterogeneous treatment in the TWFE DID model (Sun and Abraham, 2021; Baker et al., 2022).

All of the data in this paper are obtained from the CSMAR database, except for the statutory corporate income tax rate and income tax payable data, which are from the WIND database. The sample starts in 2008, when the new Enterprise Income Tax Law was implemented in China, so that the impact of changes in the tax environment can be removed from the sample. Furthermore, the VAT reform pilot started in 2012, so our starting date of 2008 ensures that we capture observations of the earliest affected group before the reform's effects.

3.2. Empirical model and variable definitions

The VAT reform is progressively promoted by region and by industry; therefore, the following staggered DID model is used:

$$ETR_{it} = \beta_0 + \beta_1 Reform_{it} + Control + \mu_i + \eta_t + \varepsilon_{it} \quad (1)$$

where the explanatory variable *ETR* measures the degree of corporate income tax avoidance. Specifically, the effective tax rate (*ETR*) indicates the current income tax expense divided by the pre-tax profit. It is generally believed that the higher the *ETR*, the lower the degree of corporate income tax avoidance.[3] *Reform* is the core

[2] It should be noted that the CNRDS database also discloses the industry of non-listed supplier/client firms; however, according to their business content, we find that the industry judgment of the CNRDS deviates to some extent. To improve accuracy, we query the industry of unlisted supplier/client firms in the WIND database and supplement the industry of firms not found in the WIND database with the CNRDS disclosure.

[3] Consistent with the literature, we winsorize the value of *ETR* to the interval of [0,1].

explanatory variable in this paper. *Reform* takes the value of 1 for the year of the VAT's implementation with respect to the observed firms and all following years, and 0 otherwise. For example, before 2012, the reform had not yet been implemented. In this case, *Reform* takes the value of 0 for all of the sample firms. In 2012, the VAT reform was first piloted in certain industries in Shanghai. At this point, if the customers or suppliers of the treated firm are subject to the reform, the *Reform* of this firm for 2012 and the following years all take the value of 1. It is anticipated that the regression coefficient for *Reform* is significantly positive.

Referring to the literature (Tang et al., 2017; Wu, 2009), we include the following control variables in the model that may affect corporate tax avoidance: *SIZE*, the natural logarithm of total assets at the end of the year; *LEV*, the total debt divided by total assets at the end of the year; *ROA*, the profit before tax divided by total assets at the end of the year; *INTANG*, the net intangible assets divided by total assets at the end of the year; *PPE*, the net fixed assets divided by total assets at the end of the year; *INVENT*, the net inventory divided by total assets; *RATE*, the statutory income tax rate applicable to the firm for the period; *CASH*, the cash and cash equivalents divided by total assets at the end of the year; *AGE*, the natural logarithm of the enterprise's age; *BOARD*, the natural logarithm of the number of board members; and *LOSS*, the loss position in the previous period, which equals 1 if the profit is less than zero in the previous year, and 0 otherwise. In addition, we add time fixed effects, μ_i, and firm fixed effects, η_t, to the model in which ε_{it} is the residual term. To obtain more realistic estimation results, we have adjusted the clustering of standard errors at the firm level.

4. Empirical results and analysis

4.1. Descriptive statistics

Table 1 presents the descriptive statistics for the main variables in this paper, and we winsorize all continuous variables at the top and bottom 1 % to prevent the influence of outliers. The mean value of *ETR* is 0.205, indicating that the average effective income tax rate of the sample firms is 20.5 %. The mean value of *Reform* is 0.54, meaning that 54 % of the sample firms have been affected by the reform. The results of the remaining variables are consistent with the actual situation of the firm.

4.2. Multiple regression results of the spillover effects of the VAT's self-enforcement properties

Table 2 presents the multiple regression results of Model (1); the first two columns are the results of the traditional DID regression method, and the last two columns are the results of the regression adopting the SADID method. We only control for firm and year fixed effects in columns (1) and (3). The regression coefficients of *Reform* are both significant and positive at the 5 % confidence level. We add other control variables in columns (2) and (4) and find that the regression coefficients of *Reform* are significant and positive at the 5 %

Table 1
Descriptive statistics.

Variable	Observations	Mean	Standard deviation	25 % quantile	Median	75 % quantile
ETR	3,307	0.205	0.126	0.104	0.175	0.262
Reform	3,307	0.541	0.498	0	1	1
SIZE	3,307	22.010	1.236	21.090	21.890	22.800
LEV	3,307	0.462	0.218	0.286	0.463	0.630
ROA	3,307	0.031	0.063	0.011	0.030	0.057
INVENT	3,307	0.157	0.154	0.056	0.116	0.195
INTANG	3,307	0.049	0.053	0.017	0.035	0.062
PPE	3,307	0.245	0.181	0.105	0.204	0.357
RATE	3,307	0.197	0.051	0.150	0.150	0.250
CASH	3,307	0.142	0.182	0.031	0.079	0.179
BOARD	3,307	2.236	0.243	2.079	2.197	2.398
AGE	3,307	2.247	0.796	1.609	2.485	2.890
LOSS	3,307	0.107	0.310	0	0	0

Table 2
Multiple regression results for spillover effects of VAT's self-enforcement properties on corporate income tax.

Variable	(1)	(2)	(3)	(4)
	ETR	*ETR*	*ETR*	*ETR*
Reform	0.039**	0.039**	0.024**	0.022***
	(2.36)	(2.43)	(2.43)	(2.66)
SIZE		0.027*		0.034
		(1.76)		(1.30)
LEV		−0.059		−0.203**
		(-1.08)		(-2.46)
ROA		0.462***		0.344*
		(4.21)		(1.86)
PPE		−0.023		0.038
		(-0.34)		(0.24)
INVENT		−0.023		0.043
		(-0.34)		(0.30)
INTANG		0.058		0.873***
		(0.67)		(2.78)
CASH		0.261*		0.043
		(1.77)		(0.71)
BOARD		−0.021		0.014
		(-0.73)		(0.32)
AGE		0.005		0.016
		(0.24)		(0.46)
RATE		0.619		0.148
		(1.60)		(0.83)
LOSS		0.032*		0.023
		(1.67)		(0.66)
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Obs.	3,307	3,307	2,839	2,839
Adj-R^2	0.155	0.178	0.190	0.207

Notes: *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively; *T*-statistics, reported in parentheses, are computed based on standard errors adjusted for firm-level clustering. The reduced sample size in columns (3)–(4) is due to the fact that SADID requires a never-treated group. In our study, the implementation of the reform was gradually extended from the pilot cities to the whole country; therefore, we do not have access to the never-treated group. For this reason, we select the last group of companies whose suppliers or customers were affected by the reform and set them as the never-treated group after excluding their post-reform samples. Therefore, the sample size of the SADID regression is reduced.

and 1 % confidence levels, respectively. In summary, the regression results in Table 2 confirm our research hypothesis that the firms that have always paid VAT show a significant decline in income tax avoidance behavior as their clients or suppliers change from business tax payers to VAT payers. The regression coefficient of *Reform* in column (2) is 0.039, which indicates an average increase of 3.9 % in the effective income tax rate of the treated firms, corresponding to 19 % of the mean effective income tax rate. However, the regression coefficient of *Reform* in column (4) falls to 0.022, which is equivalent to 10.7 % of the mean effective income tax rate. Thus, the degree of impact of the VAT's self-enforcement properties on curbing corporate income tax avoidance is greater; however, the traditional method of TWFE-staggered DID model regression may overestimate the degree of impact of the reform on corporate tax avoidance.

4.3. Robustness test

To ensure the reliability of the conclusions in this paper, we perform the following robustness tests and present the results in Tables 3 and 4.

Table 3
Robustness test.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	ETR	*ETR1*	*ETR2*	*ETR*	*ETR*	*ETR*	*ETR*
Pre^7	−0.018						
	(-0.24)						
Pre^6	−0.042						
	(-0.51)						
Pre^5	−0.004						
	(-0.05)						
Pre^4	0.046						
	(0.47)						
Pre^3	0.097						
	(0.87))						
Pre^2	0.134						
	(1.07)						
Pre^1	0.178						
	(1.27)						
Current	0.250						
	(1.60)						
$After^1$	0.283*						
	(1.66)						
$After^2$	0.317*						
	(1.70)						
$After^3$	0.351*						
	(1.73)						
$After^4$	0.384*						
	(1.76)						
$After^5$	0.432*						
	(1.85)						
$After^6$	0.436*						
	(1.75)						
$After^7$	0.504*						
	(1.91)						
$After^8$	0.610**						
	(2.12)						
Reform		0.029**	0.036*	−0.015	−0.014	−0.007	0.005
		(2.00)	(1.78)	(-0.72)	(-0.66)	(-0.36)	(0.30)
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	3,307	3,307	3,145	3,307	3,307	3,307	3,307
Adj-R2	0.180	0.208	0.096	0.176	0.176	0.175	0.175

Notes: *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. *T*-statistics, reported in parentheses, are computed based on standard errors adjusted for firm-level clustering.

4.3.1. Parallel trend hypothesis test

An important premise of the DID model is that it satisfies the parallel trend hypothesis, which aims to verify that the treatment and control groups have the same time trend before the policy shock. In this paper, we test the parallel trend hypothesis using the following model:

$$\begin{aligned} ETR_{it} = {} & \beta_0 + \beta_1 Pre^1_{it} + \beta_2 Pre^2_{it} + \beta_3 Pre^3_{it} + \beta_4 Pre^4_{it} + \beta_5 Pre^5_{it} + \beta_6 Pre^6_{it} + \beta_7 Pre^7_{it} + \beta_8 Current_{it} + \\ & \beta_9 After^1_{it} + \beta_{10} After^2_{it} + \beta_{11} After^3_{it} + \beta_{12} After^{4+}_{it} + \beta_{13} After^{5+}_{it} + \beta_{14} After^{6+}_{it} + \\ & \beta_{15} After^{7+} + \beta_{16} After^{8+} \text{Control} \ + \mu_i + \eta_t + \varepsilon_{it} \end{aligned} \tag{2}$$

where we set a series of dummy variables, using the year in which the clients or suppliers of the treated firms change from paying business tax to paying VAT as the base year. Specifically, if the observations of clients or suppliers of the treatment group are in the first year before the VAT reform, $Pre^1{}_{it}$ is assigned the value of 1,

Table 4
Consideration of the impact of the changes in customers and suppliers.

Variable	(1)	(2)	(3)
	ETR	*ETR*	*ETR*
Reform	0.030	0.010	0.055***
	(1.22)	(0.53)	(2.87)
High_Stable	−0.038*		
	(-1.75)		
*High_Stable*Reform*	0.048*		
	(1.67)		
Low_Variance		−0.012	
		(-0.71)	
*Low_Variance *Reform*		0.043**	
		(2.06)	
Control	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Obs.	2,043	3,307	1,456
Adj-R2	0.225	0.180	0.254

Notes: *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. *T*-statistics, reported in parentheses, are computed based on standard errors adjusted for firm-level clustering.

and 0 otherwise; if they are in the first two years before the reform, Pre^2 equals 1, and 0 otherwise. Similarly, Pre^3, Pre^4, Pre^5, Pre^6 and Pre^7 are constructed to distinguish whether the clients or suppliers of the treated firms are in the first three, four, five, six and seven years before the VAT reform, respectively. If the clients or suppliers of the treated firms are in the current year, the next year, the next two years, the next three years, the next four years, the next five years, the next six years, the next seven years or the next eight years, then *Current*, $After^1$, $After^2$, $After^3$, $After^4$, $After^5$, $After^6$, $After^7$ and $After^8$ are assigned a value of 1, respectively, and 0 otherwise. We select the first year of the sample as the control year and compare the seven years before the implementation of the reform to the last year of the sample with the control year by setting Pre^7–$After^8$. The regression results for Model (2) are presented in column (1) of Table 3. The results show that the variables *Pre1–Pre7* before the implementation of the reform are statistically insignificant, and the coefficients show a gradual trend toward being significantly positive from *Current*. Specifically, the coefficient of *Current* is positive; it is not significant but has a large *t value*. Starting from *After1*, the coefficient becomes significantly positive. This indicates that before the implementation of the policy, the degree of tax avoidance between the treated firms and the untreated firms does not show obvious differences, while after the VAT reform, there is a significant difference in income tax compliance behavior between the two groups. In addition, we find that the self-supervision effect of VAT gradually strengthens over time, as evidenced by the increasing coefficients of the relevant dummy variables after the implementation of the policy.

4.3.2. Replacing measures of corporate income tax avoidance

We then use two other indicators of actual income tax rates commonly used in the literature to measure the degree of corporate income tax avoidance. First, drawing on the literature (Wu, 2009), *ETR1* = total income tax expense/pre-tax profit. *ETR1* is also a widely used indicator of corporate tax avoidance (Hanlon and Heitzman, 2010). Second, *ETR2* = (current income tax expense + income tax payable at the beginning of the period – income tax payable at the end of the period)/pre-tax profit. The numerator of this indicator estimates the actual cash flow of income tax paid by the firm during the year, which is a measurement of the actual income tax rate of the firm on the accrual basis (Dyreng et al., 2008). The results in columns (2)–(3) of Table 3 show that the regression coefficient on *Reform* remains significantly positive when we change the explanatory variables to *ETR1* and *ETR2*. In summary, the different measurements of the explanatory variables do not change the conclusions of this paper.

4.3.3. Placebo test

We also conduct a placebo test to rule out the possibility that our findings are based on coincidence and are not a result of the VAT reform. Specifically, we artificially replace the first piloted year with 2008, 2009, 2010 and 2011, and base the subsequent years of the reform on the first piloted year. We then reassign the *Reform* variable. The results in columns (4)–(7) of Table 3 show that the regression coefficients on the *Reform* variables are no longer significant when we artificially change the implementation time of the VAT reform. The results of this placebo test suggest that our original findings are indeed caused by the VAT reform rather than the effect of time trends or accidental factors.

4.3.4. Consideration of the impact of changes in clients and suppliers

In the research design of this paper, we can only observe the information of the top five clients and suppliers of listed firms, which means that the empirical results potentially have selectivity bias due to changes in clients and suppliers. Furthermore, if a firm's clients and suppliers change frequently, the effect of VAT self-enforcing may be weakened because of the discontinuity of information matching. For this reason, we consider the impact of the changes in clients and suppliers in this section. Specifically, we conduct an additional test as follows. First, we examine whether our conclusions are more pronounced in samples with greater (vs lesser) stability of key clients and suppliers. For this purpose, we construct two variables: *High_Stable* and *Low_Variance*. Referring to the literature (Wang et al., 2015), we use the repeated number of the top five clients or suppliers within three years to measure the stability of clients or suppliers. If the repeated number of the top five clients or suppliers of a firm within three years is greater than the sample median,[4] *High_Stable* takes the value of 1, and 0 otherwise. In addition, we measure the stability of the clients or suppliers by the mean standard deviation of the concentration over the sample period of the top five customers or suppliers. When the VAT reform affects the clients of the treatment group, the mean standard deviation of the proportion of sales from the five major clients to the total annual sales of a firm during the sample period is used to measure customer stability. We define the concentration of the treated firms' suppliers in the same way; *Low_Variance* takes a value of 1 when the standard deviation of clients' or suppliers' concentrations is below the sample median, and 0 otherwise. Thus, a *High_Stable* or *Low_Variance* equaling 1 indicates that the firms' clients or suppliers are stable. We cross-multiply each of these two variables with *Reform* and put them into the model. The regression results are presented in columns (1) and (2) of Table 4 and suggest that our conclusion mainly applies to the sample clients or suppliers with high stability.

Second, we limit the sample period from three years before to three years after the policy implementation to exclude the influence of changes in clients or suppliers on the findings. For instance, if a treated firm is affected in 2012, we retain the sample from 2009 to 2015. Theoretically, a firm's clients and suppliers are unlikely to change significantly in the short term; therefore, this limitation on the sample should eliminate the potential bias caused by frequent changes in clients and suppliers to a large extent. The results, presented in column (3) of Table 4, indicate that after reducing the sample, the results are still significantly positive at the 1 % confidence level, and the regression coefficient on *Reform* increases from 0.039 to 0.055. In summary, the conclusions remain robust after considering the impact of changes in clients and suppliers.

5. Additional tests

In this section, we further investigate how the spillover effects of the VAT's self-enforcement properties vary across firms. These additional cross-sectional tests are intended to further support the theoretical logic of this paper and to deepen our understanding of the spillover effects of the VAT's self-supervision mechanism. Specifically, we delve into the mechanism from three aspects: the closeness of the correlation between upstream and downstream firms, their information complexity and the degree of their tax avoidance incentives.

[4] The median repeated number of the top five clients and suppliers within three years is 2.

5.1. Impact of correlation between upstream and downstream firms

A simple logical extension of the theoretical analysis in this paper is that firms with a closer correlation to their upstream and downstream firms are more affected, i.e., their effective income tax rate increases more than that of firms that are less closely connected with their upstream and downstream firms in the supply chain. Specifically, given a closer correlation between the treated firms and their clients or suppliers, more third-party information is generated by their clients or suppliers after the VAT reform. This makes it more difficult for the treatment group to avoid tax, as the tax authorities have more complete and authentic transaction information about them than about other firms.

In line with the literature, two indicators are used in this study to measure the correlation between the firms and their clients and suppliers. First, we use the purchases and sales ratio of the major clients and suppliers. It is widely accepted that the higher the proportion of sales (purchases) to major clients (suppliers), the more dependent a firm is on a small number of clients and suppliers and, therefore, the closer its relationship with them. Based on Fang and Zhang (2016), we use the sum of the sales (purchase) proportions of the top five clients (suppliers) to construct the relevant indicator.[5] Accordingly, we first construct indicator *Five*, which stands for the sales proportion of the top five clients of the treated firms when the clients are affected by the VAT reform. Similarly, *Five* also represents the purchase proportion of the top five suppliers of the treated firms when the suppliers are affected by the VAT reform. Then, we construct a dummy variable, *High_Five*, according to the median of the year. *High_Five* equals 1 if a firm is regarded as having a stronger correlation with its upstream and downstream firms, and 0 otherwise. We cross-multiply this variable with *Reform* and put it into the model. The corresponding regression results are presented in column (1) of Table 5, which shows that the coefficient on *High_Five*Reform* is statistically significant. This result further confirms our expectation, namely that the extent to which a firm's income tax liability is affected by the VAT's self-supervision effect is greater when it is more closely related to its upstream and downstream partners in the supply chain.

The second indicator we use to measure the correlation between the firms and their clients and suppliers is the degree of enterprise integration. The degree of enterprise integration is also often used to measure the correlation of a firm to its upstream and downstream partners (e.g., Buzzell, 1983; Fan and Peng, 2017). It is generally accepted that a firm's higher degree of enterprise integration results in a smaller proportion of raw materials it must purchase in the production of its products and greater distance between the upstream and downstream firms. We adopted a modified value added to sales (VAS) to measure the degree of enterprise integration. In particular, modified VAS = value added – net profit after tax + net profit/revenue – net profit after tax + net profit and further = value added – net profit after tax + net assets × average ROE/revenue – net profit after tax + net assets × average ROE, where value added = sales – purchases; purchases = [(cash payment for goods purchased and services accepted + advance payment on the opening balance – advance payment on the closing balance + accounts payable on the closing balance – accounts payable on the opening balance + note payable on the closing balance – note payable on the opening balance)/(1 + VAT rate on purchased goods) + opening balance of inventory – ending balance of inventory]. We then construct a dummy variable, *Low_VAS*, using the median of the sample year. When a firm is less integrated, and thus its correlation with upstream and downstream firms is stronger, *Low_VAS* equals 1, and 0 otherwise. We cross-multiply the variable with *Reform* and put it into the model and present the corresponding regression results

[5] It is important to point out that it is more accurate to measure the correlation between firms and their clients and suppliers by directly using the ratio of sales (purchases) of the clients (suppliers) affected by the VAT reform to the firms' total sales (purchases). However, the sum of the sales (purchases) of the top five clients (suppliers) is a mandatory disclosure for listed firms, while the sales (purchase) of individual clients (suppliers) is a voluntary disclosure. Therefore, we do not have access to the relevant data of some listed firms. However, the method in this paper does not lead to large errors, because the sales (purchases) ratio of the top five clients (suppliers) is bound to be highly correlated with the sales (purchases) ratio of each individual client (supplier) in the top five. Furthermore, we transform the dummy variables in our empirical analysis, which can further reduce the measurement error of the variables. In addition, for those samples that disclosed the proportion of sales (purchases) of individual clients (suppliers), we find that the proportion of purchases of suppliers affected by the VAT reform is 20% of the total purchases of the experimental firms, while the proportion of clients' income affected by the VAT reform is 16% of the total income of the experimental firms. This suggests that the suppliers and clients affected by the VAT have a significant impact on the experimental firms.

Table 5
Impact of correlation between upstream or downstream firms.

Variable	(1) *ETR*	(2) *ETR*
Reform	0.024	0.050**
	(1.43)	(2.47)
High_Five	−0.026	
	(-1.34)	
*High_Five*Reform*	0.039*	
	(1.72)	
Low_VAS		−0.004
		(-0.31)
*Low_VAS*Reform*		0.036**
		(2.01)
Control	Yes	Yes
Firm FE	Yes	Yes
Year FE	Yes	Yes
Obs.	3,276	2,792
Adj-R^2	0.186	0.202

Notes: *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. *T*-statistics reported in parentheses are computed based on standard errors adjusted for firm-level clustering.

in column (2) of Table 5. The regression coefficient on *Low_VAS*Reform* is significantly positive at the 5 % confidence level.

5.2. Impact of firm information complexity

The higher the information complexity of a firm is, the greater the information asymmetry between it and the government may be, and the more incremental information can be provided by the emergence of third-party information. Therefore, in theory, the VAT's self-enforcement properties have a greater impact on firms with higher information complexity than on those with lower information complexity. To test this assumption, we measure the information complexity of firms in two dimensions: business group complexity and disclosure quality. Specifically, we use the number of subsidiaries of a listed firm along with the regional dispersion of subsidiaries to measure the information complexity of the listed firms. In general, as the number of subsidiaries increases, intragroup-related transactions and profit transfers are likely to increase in prevalence, which increases firm information complexity. Furthermore, the greater the regional dispersion of a firm's subsidiaries, the more the tax authorities must understand the whole group through cross-regional cooperation, which can make it more difficult for the tax authorities to understand the firm, given the higher level of information complexity.

From these three measures, we construct the following variables: *High_Subsidiary_Number*, *High_Subsidiary_Disperse* and *Low_Score*. *High_Subsidiary_Number* takes a value of 1 when the number of subsidiaries of a listed firm is greater than the median of the sample year, and 0 otherwise. *High_Subsidiary_Disperse* takes a value of 1 when the regional dispersion of a listed firm's subsidiaries is greater than the annual median, and 0 otherwise; the regional dispersion of a firm's subsidiaries is equal to the number of provinces in which the subsidiaries are distributed. For example, when a listed firm has 10 subsidiaries, which are dispersed across five provinces, the value of the regional dispersion of subsidiaries is 5. *Low_Score* takes the value of 1 when a firm's information disclosure index is low, and 0 otherwise. For this, we use the disclosure index provided by the Shenzhen Stock Exchange (SZSE).[6] Each year, the SZSE scores the quality of information disclosed by listed firms according to four levels: A, B, C and D. It is generally accepted that the quality of information disclosed by a firm is high if it has an A score; otherwise, the quality is relatively low. In summary, the information com-

[6] This limits the sample in this section to firms listed on the SZSE.

plexity of a firm is high when *High_Subsidiary_Number*, *High_Subsidiary_Disperse* and *Low_Score* are each equal to 1.

We cross-multiply each of the above dummy variables with *Reform* and put them into the model with the regression results in Table 6. The regression coefficients for *High_Subsidiary_Number*Reform*, *High_Subsidiary_Disperse*Reform* and *Low_Score*Reform* are all significant and positive, in line with our expectation. These results demonstrate that the spillover effect of the VAT's self-enforcing properties is greater for firms with high information complexity than for other firms.

5.3. Impact of corporate tax avoidance incentives

For firms with stronger tax avoidance incentives, additional third-party information has a greater deterrent effect on their tax avoidance behavior. Therefore, it is assumed that the spillover effects of the VAT's self-enforcement mechanism is more pronounced for firms with stronger tax avoidance incentives. We measure the tax avoidance incentives of firms by the degree of their financing constraints. In general, firms with more severe financing constraints have stronger incentives to save cash flow expenditures by avoiding taxes (Law and Mills, 2015; Edwards et al., 2016). We use a firm's level of dividend payments (Louis and Urcan, 2015) and the degree of financial development in the firm's location (Fan et al., 2011) to empirically measure the degree of its financing constraints.

First, we take cash dividends divided by net profit as a measure of the dividend payout ratio (Louis and Urcan, 2015). Firms that pay fewer dividends are more internally capital constrained and face a greater degree of financing constraints (Fazzari et al., 1988; Almeida et al., 2004). On this basis, we construct the dummy variable, *Low_Dividend*, which takes a value of 1 when a firm's dividend payout ratio is less than the median of the sample year, and 0 otherwise. Second, following Liu and Ye (2014), we use the degree of financial marketization in the location of the firms to measure their financial development. In particular, the data on financial marketisation are derived from Marketization Index of China's Provinces (2018) (Wang et al., 2019). However, the index is updated only until 2016. Referring to the literature (Yu et al., 2010), we forecast the financial marketization index from 2017 to 2020 with the average growth rate of regional index growth over

Table 6
Impact of firm information complexity.

Variable	(1) *ETR*	(2) *ETR*	(3) *ETR*
Reform	0.016	0.015	0.096***
	(0.80)	(0.70)	(2.72)
High_Subsidiary_Number	−0.015		
	(-0.71)		
*High_Subsidiary_Number*Reform*	0.036*		
	(1.69)		
High_Subsidiary_Disperse		−0.013	
		(-0.86)	
*High_Subsidiary_Disperse*Reform*		0.039*	
		(1.87)	
Low_Score			−0.057**
			(-2.36)
*Low_Score*Reform*			0.067**
			(2.10)
Control	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Obs.	3,169	3,149	2,409
Adj-R^2	0.186	0.180	0.170

Notes: *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. *T*-statistics, reported in parentheses, are computed based on standard errors adjusted for firm-level clustering.

Table 7
Impact of firm tax avoidance incentives.

Variable	(1) *ETR*	(2) *ETR*
Reform	0.039**	0.192
	(2.41)	(1.09)
Low_Dividend	−0.052***	
	(-4.42)	
*Low_Dividend*Reform*	0.009**	
	(2.48)	
Low_Index		−0.013
		(-0.71)
*Low_Index*Reform*		0.042*
		(1.92)
Control	Yes	Yes
Firm FE	Yes	Yes
Year FE	Yes	Yes
Obs.	3,307	3,307
Adj-R^2	0.192	0.180

Notes: *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. *T*-statistics, reported in parentheses, are computed based on standard errors adjusted for firm-level clustering.

the past years. On this basis, we construct a dummy variable, *Low_Index*, which takes a value of 1 when the firm's financial marketization index is less than the median, and 0 otherwise. Therefore, a firm has a strong tax avoidance incentive when both *Low_Dividend* and *Low_Index* are equal to 1. Next, we cross-multiply each of these two variables with *Reform* individually and put them into the model and present the corresponding regression results in Table 7. The regression coefficients of *Low_Dividend*Reform* and *Low_Index*Reform* are both significant and positive, in line with our expectations. In other words, the spillover effects of the VAT's self-enforcement property are more pronounced in firms with stronger tax avoidance incentives than in other firms.

6. Conclusion

The VAT plays an incredibly important role in tax systems, both in theory and in practice. The VAT effectively avoids double taxation, and its self-enforcement mechanism in tax administration is a vital reason for its wide adoption by countries worldwide. Moreover, the VAT has always been the largest contributor to China's annual tax revenue; therefore, studying the VAT has important implications for improving China's tax system. Our setting is unique in exploring the spillover effects of the VAT's self-enforcement properties on corporate income tax evasion. Our results show that the degree of income tax avoidance of those firms that pay VAT decreases significantly as their clients or suppliers change from being business tax payers to being VAT payers under the Replacement of Business Tax with VAT reform. Such a decline is pronounced for firms that are more closely related to their upstream and downstream firms, have higher information complexity and have stronger tax avoidance incentives than for other firms. This conclusion effectively confirms the important role of the VAT in restraining corporate tax avoidance. Moreover, this deterrence is not limited to the VAT itself but spills over into corporate income tax.

The findings of this paper augment research on the factors affecting corporate tax avoidance and enrich the policy evaluation of the Replacement Business Tax with VAT reform. This paper also has important practical significance and serves as a tool for policy enlightenment. First, the study finds that the adoption of the VAT generates third-party tax information and leaves a more accurate written record, thus providing tax authorities with more information and improving tax enforcement. The findings have reference value for the government in choosing tax tools and provide information relevant to effective tax policy-making in the future. Second, our findings on the spillover effect of the VAT suggest that the introduction of a VAT policy may

have a multiplier effect on other firms through a focal firm's transaction network and, furthermore, that this effect is not limited to the VAT. Therefore, policy-makers should take this spillover effect into account when assessing the potential impact of policies.

This paper only examines the spillover effect of the VAT's self-enforcement properties in curbing income tax avoidance. However, such properties may also have spillover effects in other areas, for example, in inhibiting the manipulation of financial statements to improve the quality of accounting information and the accuracy of investors and intermediaries by using the financial information of suppliers or clients to predict corporate performance. These are areas ripe for further exploration and study in the future.

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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Does the reputation mechanism apply to independent directors in emerging markets? Evidence from China

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ABSTRACT

We examine whether reputable independent directors improve firm performance and governance quality in emerging markets, using data from China. Firms with such directors, measured as the number of directorships in other listed firms, have higher profitability, operating efficiency and productivity. They suffer from fewer agency problems, pay more cash dividends and have lower likelihoods of receiving modified audit opinions and participating in financial disclosure-related irregularities than their counterparts. In China's unique institutional context, the reputation mechanism for independent directors applies to firms in regions with weak marketization environments, non-state-owned enterprises and firms without political connections; it also applies when external governance is weak. Overall, reputable independent directors appear to occupy valuable advising and monitoring roles and compensate for weak institutions and governance in China.

1. Introduction

In the past two decades, many emerging markets have followed developed markets to mandate that public firms employ independent directors as an important component of corporate governance. However, given the prevalence of dominant shareholders and the lack of competent and qualified independent directors in emerging markets, it is unclear whether independent directors occupy effective roles in advising and monitoring managers (Jiang and Kim, 2015). A few studies recognize that not all independent directors are equal and that

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the extent to which independent directors can monitor and advise manages largely depends on the directors' characteristics and skills.[1] For example, Giannetti et al. (2015) find that independent directors with foreign experience improve firm performance in China, particularly by increasing the internationalization of firm operations. Jiang et al. (2016) document that independent directors of a younger age or with a good reputation are more likely to cast dissenting votes in board meetings, and thus perform a better monitoring role than directors of an older age or with a poor reputation. We extend this research by examining whether independent directors with good reputations can effectively advise and monitor managers, and thus contribute to firm performance and governance quality in China.

Reputation is often presented as a strong incentive for independent directors to fulfil their duties. Fama and Jensen (1983) propose that outside directors have the incentives to develop their reputations as experts in decision control. A number of studies show that directors in the U.S. are rewarded with more career opportunities after they establish good reputations by terminating underperforming chief executive officers (CEOs) (Farrell and Whidbee, 2000), obtaining high takeover premiums (Harford, 2003) or reporting improved operating performance (Yermack, 2004). In contrast, directors are more likely to lose their directorships if they are involved in shareholder lawsuits (Fich and Shivdasani, 2006), option backdating (Ertimur et al., 2012) or proxy contest nominations (Fos and Tsoutsoura, 2014). Therefore, career concerns are strong motivators for independent directors to build reputations as effective monitors of and valuable advisors to senior management. Recent studies confirm that U.S. firms with a high proportion of independent directors with relatively good reputation incentives are associated with high earnings quality, good information environments (Masulis and Mobbs, 2016; Sila et al., 2017; Bryan and Mason, 2020) and good performance (Masulis and Mobbs, 2014, 2017).

However, it is unclear *ex ante* whether reputable independent directors perform their duties in emerging markets as effectively as in the U.S. Unlike U.S. firms with widely dispersed ownership, firms in emerging markets such as China usually have a dominant shareholder who handpicks independent directors (Jiang and Kim, 2015; Ma and Khanna, 2016; He and Luo, 2018). Given the weak investor protections in emerging markets, dominant shareholders are likely to abuse the private benefits of control and expropriate minority investors by tunneling, performing related-party transactions and conceding loan guarantees to controlling shareholders (Berkman et al., 2009; Jiang et al., 2010; Peng et al., 2011). It is therefore debatable whether dominant shareholders have strong incentives to value and hire reputable independent directors who can discipline and restrict tunneling by dominant shareholders. Indeed, it is often assumed that independent directors are hired as "rubber stamps" to meet regulatory requirements.[2] Furthermore, it is possible that independent directors may themselves collude with dominant shareholders to secure directorships and related benefits. Such directors may crowd out reputable directors, further constraining the roles played by reputable directors in emerging markets.

Many studies document the positive relationship between director quality and the number of directorships held by a given director (e.g., Kaplan and Reishus, 1990; Gilson, 1990; Brickley et al., 1999; Ferris et al., 2003). Therefore, we measure an independent director's reputation as the number of directorships held by the director in other listed firms. We use firm-level average directorships to measure the average reputation of all of the independent directors in a firm. Using a sample of 20,448 firm-year observations of listed Chinese firms from 2004 to 2017, we document a positive association between director reputation in year t-1 and firms' operating performance in year t, measured by the return on equity (ROE), assets turnover ratio and total factor productivity. This association remains robust after we control for several firm and board characteristics and industry- and firm-fixed effects. Furthermore, we find that independent directors' reputations are negatively related to agency costs between shareholders and managers and between majority and minority shareholders, but positively related to focal firms' cash dividend payouts. This suggests that reputable independent directors are more likely to play effective governance roles in safeguarding shareholders, particularly minority ones, from expropriation by corporate insiders such as managers and large shareholders. Finally, we show that firms hir-

[1] See Adams et al. (2010) for a survey of the literature on the boards of directors. Jiang and Kim (2015) provide an overview of research on boards of directors in China.

[2] For example, Jiang and Kim (2015) report that the majority of Chinese public firms have the minimum number of independent directors required to meet regulatory requirements. These requirements state that at least one third of the directors must be independent, suggesting that firms in China do not have much incentive to hire independent directors.

ing reputable independent directors in year *t*-1 are less likely to receive modified audit opinions and to practice financial disclosure-related irregularities in year *t*. This finding indicates that reputable independent directors can improve the financial reporting quality of Chinese firms.

Although we show that reputable independent directors are valuable for shareholders, several constraints prevent all existing firms from hiring reputable directors to improve their operating performance and governance quality. These constraints include the limited pool of directors, the limited amount of time and energy that reputable directors have and dominant shareholders' incentives to avoid monitoring by reputable directors. The decision to hire a reputable independent director likely arises from balancing the benefits and costs of having reputable directors. In further analysis, we explore the possible motivations for firms to hire reputable independent directors. We find that the likelihood of hiring a reputable director is positively related to state-owned enterprises (SOEs) and firm size, which is consistent with the argument made by Masulis and Mobbs (2014) that large firms bring independent directors more visibility and prestige. We conjecture that firms in highly competitive environments are more likely than firms in other environments to hire reputable directors to access their skills and expertise. We show that firms facing high product market competition or that are located in regions with high levels of marketization are more likely to hire reputable directors than firms facing low market competition or that are located in regions with low levels of marketization. We also find that firms with large boards of directors have more opportunities to hire reputable independent directors than firms with small boards.

Although we mindfully examine the association between firm performance in year *t* and independent directors' reputations in year *t*-1, our results may be subject to endogeneity concerns. We address these concerns in two ways. First, we use the two-stage Heckman procedure to address the self-selection issue arising from firms' decision to hire independent directors, as firms with and without reputable directors may be fundamentally different. Second, we use two instrumental variables, i.e., the sum of the number of key universities belonging to the 985 Project and the number of universities with accounting as a national key discipline, and the air pollution index in local provinces. Both instrumental variables capture the supplies of external qualified independent directors, and are thus related to the probability of a firm hiring reputable directors. Neither instrumental variable is directly related to firm performance and governance quality. The results from these tests confirm that, after addressing endogeneity concerns, reputable independent directors remain positively associated with firm performance, governance quality and financial reporting quality. In addition, we conduct a robustness check on the measure of independent directors' reputations. Following other studies (e.g., Masulis and Mobbs, 2014; Sila et al., 2017; Bryan and Mason, 2020), we measure independent directors' reputations based on both multiple directorships and service in large firms and find similar results for both.

On 19 October 2013, the Chinese government issued a regulatory policy prohibiting retired governance officials from serving as independent directors of listed firms, resulting in a large turnover of government official directors (Liu et al., 2018; Shi et al., 2018). Further analysis reveals that the positive effect of reputable independent directors on firm performance and governance quality is valid only for the period preceding the policy implementation. As government officials care deeply about their reputations and are likely to hold multiple directorships (i.e., reputable directors in this study) in China (Liu et al., 2018; Shi et al., 2018), these results are consistent with other studies on the reputation concerns of independent directors. In the context of China's unique institutions, our cross-sectional analyses reveal that the positive effect of reputable independent directors on firm performance is more pronounced for firms in regions with low marketization environments, for non-SOEs (*vs* SOEs), and for firms without political connections (*vs* with political connections) than for their counterparts. This suggests that the reputation mechanism holds better when formal or informal institutions are relatively weak. We further find that the positive effect of reputable independent directors is stronger when product market competition, analyst coverage and institutional ownership are low than when they are high, highlighting a substitution effect between internal and external governance. As legal protections for investors and external governance are weak and underdeveloped in China and other emerging markets, these results have meaningful implications for policymakers and shareholders who aspire to improve firms' governance quality and for investors who want to invest in firms with good governance.

Our study contributes to the literature in two ways. First, we show that independent directors' reputations are positively related to firm performance, governance quality and financial reporting quality in a market with weak investor protection. This indicates that reputable independent directors can play effective advising and

monitoring roles. Our evidence is consistent with studies from the U.S., which show that reputation concerns motivate independent directors to fulfil their duties (e.g., Fama and Jensen, 1983; Masulis and Mobbs, 2014, 2016, 2017; Sila et al., 2017; Bryan and Mason, 2020). Our results are also consistent with the findings of Jiang et al. (2016), who show that independent directors with strong reputations are more likely to cast dissenting votes in board meetings than directors with poor reputations; dissenting directors are also rewarded with more directorships in the future. Together with Jiang et al. (2016), we show that, despite dominant shareholders' expropriation incentives, reputation can motivate independent directors to fulfil governance roles and contribute to firm performance in markets with weak investor protection.

Second, we add to the growing literature on firm performance and the various features of directors and boards in China. Acknowledging that the contribution of directors to firm performance largely depends on their characteristics and skills, studies show that firm performance is positively related to the presence of female (Liu et al., 2014), foreign (Giannetti et al., 2015) and independent directors (Firth et al., 2007; Conyon and He, 2011; Liang et al., 2013; Liu et al., 2015). Our results suggest that reputable independent directors contribute to operating performance, governance quality and financial reporting quality. For investors, our results demonstrate that the reputations of independent directors can effectively signal the governance quality of firms in markets with weak investor protection.

The remainder of the paper proceeds as follows. In Section 2, we review related studies and state our research questions. In Section 3, we describe the data, sample and research design. We report the empirical findings in Section 4 and conclude the study in Section 5.

2. Related studies

2.1. Independent directors in China

Since its two stock exchanges, Shanghai and Shenzhen, were set up in the early 1990 s, China has followed developed markets by introducing boards of directors and other governance structures for listed firms. From 1997 onwards, Chinese listed firms have been encouraged to appoint independent directors to their boards to safeguard minority shareholders' interests. In 2001, the China Securities Regulatory Commission (CSRC) set out the requirements for independent directors, which are that independent directors and their immediate family members cannot work for, own a significant number of shares in or provide consulting services to the firm. These rules were implemented to allow independent directors to work without any conflicts of interest. In 2003, the CSRC required that at least one third of the directors of listed firms be independent; these directors can serve a term of up to 3 years, with a maximum of two consecutive terms in a given firm and a maximum of five concurrent directorships.

The regulation also allows independent directors to be nominated by large shareholders who own a minimum of 1 % of total shares in the firm. In practice, controlling and other major shareholders usually nominate and appoint independent directors. For example, the Shanghai Stock Exchange (2004) reports that 70 % of independent directors are nominated by listed firms' largest shareholders. Given the controlling shareholders' incentives to expropriate from minority shareholders, it has long been debated whether firms have strong incentives to appoint independent directors who can effectively monitor the management and restrict expropriation by controlling shareholders.[3] Indeed, a survey of independent directors in China conducted by Lin et al. (2008) reveals that few independent directors consider themselves empowered to influence corporate decisions. As Chinese firms are replete with agency problems such as tunneling (Jiang et al., 2010), related-party transactions and loan guarantees to controlling shareholders (Berkman et al., 2009; Peng et al., 2011) despite the presence of independent directors, it is likely that independent directors cannot effectively regulate such problems in China (He and Luo, 2018).[4] It is also well known that few Chinese listed firms have more than the minimum number of independent directors (i.e., one third) required by the regulation (Jiang and Kim,

[3] Evidence from the U.S. suggests that when CEOs are involved in selecting directors, they prefer grey directors with conflicts of interest over outside independent directors (Shivdasani and Yermack, 1999). Board monitoring decreases when independent directors are friends of the CEO (Hwang and Kim, 2009) or when several board members are appointed by the current CEO (Coles et al., 2014).

[4] A counter-argument is that tunneling may worsen in the absence of independent directors and boards in China.

2015). This implies that controlling shareholders do not have strong incentives to appoint more independent directors to monitor and constrain their abuse of the private benefits of control.

The literature shows mixed evidence for the relationship between the number of independent directors and firm performance.[5] However, not all independent directors are alike and that their contributions to firm performance may depend on their skills and characteristics (Adams et al., 2010). For example, Giannetti et al. (2015) find that firms that appoint independent directors with foreign experience show improved operating performance and internationalization of firm operations. Jiang et al. (2016) document that independent directors who are young or have good reputations are more likely to perform monitoring roles by casting dissenting votes in board meetings than directors who are old or have poor reputations. Liu et al. (2014) show that female directors are positively associated with firm performance in China. These studies suggest that it is important to account for independent directors' skills and characteristics when examining their monitoring and advising roles.

2.2. Reputations of independent directors

It is argued that reputation concerns motivate independent directors to monitor managers, with good reputations bringing in more future directorships (Fama and Jensen, 1983). Empirical evidence from the U.S. largely supports this argument. Independent directors gain more directorships when they effectively perform their duties and safeguard investors' interests (Farrell and Whidbee, 2000; Harford, 2003; Yermack, 2004) and lose their directorships when they are involved in corporate scandals (Fich and Shivdasani, 2006; Ertimur et al., 2012; Fos and Tsoutsoura, 2014). Reputation concerns also motivate independent directors to allocate considerable efforts to large firms that offer more visibility and prestige (Masulis and Mobbs, 2014). Several recent studies consistently show that independent directors with strong reputation incentives raise CEO pay–performance sensitivity and improve corporate information transparency particularly earnings quality in the U.S. (Masulis and Mobbs, 2016, 2017; Sila et al., 2017; Bryan and Mason, 2020).

However, there is limited evidence on independent directors' reputation concerns in markets with weak investor protections. Given the dominance of controlling shareholders in corporate decision-making, the extent to which independent directors effectively play monitoring roles is unclear. One exception is shown by Jiang et al. (2016), who examine directors' voting outcomes in the board meetings of Chinese listed firms. They document that reputable independent directors are more likely to cast dissenting votes than directors with poor reputations; dissenting directors are also more likely to gain future directorships than assenting directors. Their evidence suggests that career and reputation concerns can motivate independent directors of Chinese firms to dissent and thus play a monitoring role.

Our study aims to extend this stream of research and provide evidence for the role of reputable independent directors in markets with weak investor protections. Based on the research, we argue that reputable directors contribute to firm performance in several ways. First, reputation concerns motivate reputable directors to effectively monitor managers' performance, discipline underperforming managers and restrict expropriation from minority shareholders by controlling shareholders. These governance roles reduce agency problems and improve operating performance. Second, reputable directors usually have specialized skills, knowledge and social connections, which can help firms operate efficiently (Giannetti et al., 2015), obtain government support or bank loans and gain business opportunities with other firms; collectively, this can improve operating performance. Third, as corporate insiders tend to provide opaque financial reports to camouflage their opportunistic behaviors, reputable independent directors can improve focal firms' financial reporting quality and signal a high governance quality to outside investors.

Thus, if reputable independent directors effectively perform monitoring and advising roles in Chinese firms, we expect to observe a positive association between these directors and firm performance. Specifically, we predict that reputable independent directors are positively associated with firms' operating performance, cash dividends available to outside investors and financial reporting quality, but are negatively associated with firms'

[5] Jiang and Kim (2015) summarize the mixed findings on the relation between independent directors and firm performance in China. Adams et al. (2010) discuss mixed evidence in the U.S. and other countries.

agency costs resulting from conflicts of interest between shareholders and managers and between majority and minority shareholders.

3. Research design, data and sample

3.1. Measures of independent directors' reputations

Following the literature, we measure the reputations of independent directors as the number of directorships held by an independent director; we assume that more directorships indicate better reputations for the directors, as shown by Jiang et al. (2016). Many studies document that the quality of directors is positively related to the number of directorships they hold (e.g., Kaplan and Reishus, 1990; Gilson, 1990; Brickley et al., 1999; Ferris et al., 2003). Research also shows that independent directors gain more directorships after establishing good reputations by disciplining underperforming managers or improving firm value (Farrell and Whidbee, 2000; Yermack, 2004). At the firm-year level, we calculate the average directorships (*SEATS*) of all of the independent directors in a firm and use it to capture the average reputations of the independent directors of a given firm in a year.

3.2. Measures of firm performance

We use three measures to capture firm performance. The first is ROE (*ROE*), computed as net income divided by shareholders' equity. *ROE* measures firm profitability or the profits produced by firm operations by using shareholders' capital. The second is the total assets turnover ratio (*TURN*), computed as total revenue divided by total assets. *TURN* measures a firm's operating efficiency in using its assets to generate revenue. The third is total factor productivity (*TFP*). We compute a firm's *TFP* as the residuals from the regressions of revenue on the number of employees, total assets and total expenses for materials and other inputs. Following Giannetti et al. (2015), we estimate the regression by industry and year. *TFP* captures a firm's deviation from the industry's factor productivity for a given year.

We also use three measures to capture the effectiveness of independent directors' monitoring roles. The first is the ratio of administrative expenses divided by revenue (*ACOST1*), which is used to capture the agency costs resulting from conflicts of interest between shareholders and managers (He and Luo, 2018). Studies suggest that the excessive consumption of corporate insiders' perquisites, or perks, is directly reflected in the increase of administrative expenses (Ang et al., 2000; Singh and Davidson, 2003). The second is the ratio of other receivables divided by total assets (*ACOST2*), which is used to capture the agency costs resulting from conflicts of interest between majority and minority shareholders. In China, large shareholders expropriate the interests of minority shareholders, usually in the form of related party transactions (Jiang and Kim, 2015; Jiang et al., 2010). Such transactions are vaguely reflected in the balance sheet as other receivables to bypass regulations. Therefore, *ACOST2* is a direct measure of expropriation by controlling shareholders and is used in several studies (e.g., He and Luo, 2018; Qian and Yeung, 2015). The third is cash dividends (*DIV*), computed as cash dividends divided by total assets. As La Porta et al. (2000) shows, agency problems such as expropriation from minority shareholders by controlling shareholders prevent firms from paying cash dividends. If independent directors can constrain agency problems, then firms will have more cash dividends available to outside shareholders.

To provide corroborating evidence, we also consider the quality of financial reporting. Publicly listed firms and their insiders have a basic responsibility to provide high-quality financial reports to outside stakeholders. However, corporate insiders tend to reduce information transparency by providing opaque financial reports that camouflage agency problems. Therefore, if reputable independent directors indeed effectively play monitoring roles, then they ought to increase the quality of financial reporting. We use two measures to measure the quality of financial reports. The first is the probability of receiving a modified audit opinion (*MAO*). If a firm provides a low-quality financial report with some material errors, then external auditors are more likely to issue a modified audit opinion. The second is the probability of practicing financial disclosure-related irregularities (*IRREGULARITIY*), which violate corporate disclosure rules and can be identified and penalized by regulators. These irregularities include misstatements of accounting numbers, delayed disclosures, failures to

disclose material information and inappropriate accounting statements. We predict that firms with reputable independent directors will have lower probabilities of receiving modified audit opinions and engaging in financial disclosure-related irregularities than their counterparts.

3.3. Regression models

To control for firm characteristics and isolate the effects of reputable independent directors as advisors on and monitors of firm performance, governance quality and financial reporting quality, we estimate the following regression models using firm-year observations:

$$DEP_{i,t} = \alpha + \beta REPU_{i,t-1} + Controls_{i,t-1} + \varepsilon_{i,t} \quad (1)$$

where *DEP* is the measure of firm *i*'s performance, monitoring effectiveness and financial reporting quality in year *t* and includes *ROE*, *TURN*, *TFP*, *ACOST1*, *ACOST2*, *DIV*, *MAO* and *IRREGULARITY*. *REPU* is firm *i*'s independent directors' average reputation in year *t*-1, measured by *SEATS*. We measure the dependent variables in year *t* and the explanatory variables in year *t*-1 to partially address endogeneity issues. If reputable independent directors indeed effectively play advising and/or monitoring roles, then the coefficient β should be significantly positive when taking *ROE*, *TURN*, *TFP* or *DIV* as the dependent variable, but significantly negative when taking *ACOST1*, *ACOST2*, *MAO* or *IRREGULARITY* as the dependent variable. In particular, as *MAO* and *IRREGULARITY* are dummy variables, we employ the logit regression model to estimate Equation (1) when taking them as the dependent variables.

Following the literature, we include several control variables in the multivariate regressions. We control for firm size (*SIZE*), firm age (*AGE*), sales growth rates (*GROWTH*), leverage ratio (*LEVE*), free cash flows (*FCF*) and stock return volatility (*VOL*). We control for firms' ownership structures using three variables: *SOE*, which indicates whether it is an SOE; *TOP1*, which indicates the percentage of shares owned by the largest shareholder; and *MO*, which indicates the percentage of shares owned by managers. We control for board characteristics, namely, board size (*BOARDSIZE*), the percentage of directors who are independent (*INDEPENDENCE*), CEO and chair duality (*DUAL*) and directors' share ownership (*BO*). Finally, we include year- and industry-fixed effects to control for specific factors affecting firm performance in a specific year or industry. Please see the Appendix for the detailed definitions of the variables.

3.4. Sample and data

The initial sample includes all public firms listed on the two Chinese stock markets, Shanghai and Shenzhen, from 2004 to 2017. Our sample period starts from 2004 because in 2003, the rules requiring Chinese listed firms to have boards of prescribed sizes, at least one third of which constitute independent directors, were introduced. We acquire the firms' accounting and governance data from the China Stock Market and Accounting Research (CSMAR) database. These data are widely used in other studies that examine the Chinese markets. In addition, we obtain data on marketization development across regions in China from the National Economic Research Institute's marketization index (Wang et al., 2018).

From the initial sample of 30,546 firm-year observations, we exclude financial firms and firm-years with missing data to calculate the variables for the multivariate analyses. Our final sample has 20,448 firm-year observations. In Table 1, we report the distribution of firm-year observations over time. The number of firms roughly increases over time due to growth in China's stock market. Firms in manufacturing industries (i.e., industry codes C0–C9) comprise 51.78 % of the firm-year observations. This is consistent with the dominance of the manufacturing industry in Chinese markets. We further break down the manufacturing industry into 10 sub-manufacturing industries based on the second digit industry code.

Table 2 reports the descriptive statistics of the variables used in the multivariate analysis. To mitigate the effects of extreme values, we winsorize all of the continuous variables at the 1st and 99th percentiles. There are substantial variations in the average number of independent directors' directorships across firms. Moving from the first to the third quartile, the average number of directorships held in other firms increases from 0.333 to 1.400. On average, Chinese firms have an *ROE* of 9.4 %, *TURN* of 0.693 and *TFP* of 0.016. The mean and standard deviation of *ACOST1* (*ACOST2*) are 0.093 (0.021) and 0.072 (0.034) respectively, indicating

Table 1
Sample distribution by industry and year. This table reports the distribution of firm-year observations by industry and year.

Industry name	Industry code	Year														**Total by industry**
		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
Agribusiness	A	12	11	15	14	13	16	18	20	25	25	24	24	29	27	273
Mining	B	29	26	33	34	27	32	36	42	54	61	51	40	53	61	579
Food and drink	C0	44	48	48	46	39	48	51	56	69	79	82	79	96	96	881
Textile, clothing and fur	C1	13	15	22	21	24	30	29	31	43	47	50	44	55	59	483
Wood and furniture	C2	2	3	2	4	3	4	5	4	6	11	9	8	12	15	88
Papermaking and printing	C3	13	13	14	13	16	18	19	23	25	30	32	27	32	36	311
Petroleum, chemical and plastic	C4	89	87	91	94	78	88	113	109	149	183	178	168	190	217	1,834
Electronics	C5	2	4	5	5	4	9	11	13	19	21	20	21	28	32	194
Metal and nonmetallic industry	C6	83	85	90	89	84	91	103	102	125	145	142	111	155	173	1,578
Machinery, equipment and instrument	C7	131	120	155	153	140	179	191	220	321	392	407	389	447	516	3,761
Medicine and biological products	C8	53	57	69	68	71	71	78	85	111	128	135	128	152	154	1,360
Other manufacturing industries	C9	4	3	2	4	4	6	5	5	9	10	10	12	12	11	97
Public utilities	D	59	55	65	67	48	59	61	60	76	83	77	74	83	79	946
Construction	E	22	18	21	21	22	29	35	36	39	56	52	51	58	66	526
Transportation	F	44	47	48	52	50	52	55	58	68	69	69	63	69	69	813
Information technology	G	84	81	95	88	98	113	135	166	228	272	283	290	307	345	2,585
Wholesale, retail and trade	H	93	85	94	97	92	93	92	98	113	123	113	108	119	126	1,446
Real estate	J	83	79	85	78	75	90	98	94	107	112	99	93	95	103	1,291
Social service	K	39	29	36	44	40	48	60	62	78	84	80	79	96	102	877
Communication and culture	L	14	9	12	10	9	9	11	17	22	29	30	30	34	40	276
Conglomerate	M	21	20	20	19	16	16	17	19	17	19	18	14	14	19	249
Total by year	Total	934	895	1,022	1,021	953	1,101	1,223	1,320	1,704	1,979	1,961	1,853	2,136	2,346	20,448

Table 2
Descriptive statistics. This table reports the descriptive statistics of the main variables for a sample of Chinese listed firms from 2004 to 2017. The variables are defined in the Appendix.

Variables	N	Mean	S.D.	Min.	P25	Median	P75	Max.
SEATS	20,448	0.953	0.744	0	0.333	0.833	1.400	3.000
ROE	20,448	0.094	0.076	0.002	0.038	0.077	0.127	0.397
TURN	20,448	0.693	0.491	0.077	0.367	0.573	0.861	2.753
TFP	20,448	0.016	0.279	−0.771	−0.145	−0.001	0.160	0.893
ACOST1	20,448	0.093	0.072	0.008	0.046	0.076	0.116	0.435
ACOST2	20,448	0.021	0.034	0.000	0.004	0.010	0.023	0.209
DIV	20,448	0.266	0.311	0	0	0.200	0.372	1.869
MAO	20,448	0.025	0.156	0	0	0	0	1
IRREGULARITY	20,448	0.084	0.278	0	0	0	0	1
SIZE	20,448	21.843	1.232	19.312	20.965	21.69	22.537	25.679
LEVE	20,448	0.453	0.209	0.051	0.293	0.456	0.611	0.941
AGE	20,448	2.218	0.616	0.693	1.792	2.303	2.708	3.178
GROWTH	20,448	0.230	0.551	−0.572	−0.004	0.132	0.310	3.943
FCF	20,448	0.049	0.076	−0.186	0.008	0.048	0.092	0.264
VOL	20,448	0.031	0.010	0.015	0.024	0.029	0.036	0.061
SOE	20,448	0.498	0.500	0	0	0	1	1
TOP1	20,448	0.367	0.155	0.090	0.243	0.347	0.481	0.750
BOARDSIZE	20,448	9.010	1.849	5	8	9	9	15
INDEPENDENCE	20,448	0.365	0.052	0.250	0.333	0.333	0.385	0.571
DUAL	20,448	0.199	0.399	0	0	0	0	1
MO	20,448	0.045	0.114	0	0	0	0.008	0.562
BO	20,448	0.083	0.167	0	0	0	0.043	0.645

S.D.: standard deviation; Min.: minimum; P25: 25th percentile; P75: 75th percentile; Max.: maximum.

large variations in agency costs across firms. In the total sample, 2.5 % of sample firms received modified audit opinions from auditors and 8.4 % of sample firms were identified and penalized by the regulators for financial disclosure-related irregularities. Chinese firms also exhibit high sales growth rates, high stock return volatility and high concentration of ownership, with the largest shareholders holding 36.7 % of shares on average. In contrast, managers and directors do not own many shares in the firms. The average board has nine directors, one third (three) of which are independent. These firm and board characteristics are consistent with those reported by He and Luo (2018) and Jiang et al. (2016).

4. Empirical results

4.1. Directors' reputations and firm performance

Our empirical analyses begin with a Pearson correlation analysis of the main variables. The results are shown in Table 3. *SEATS* is positively related to *ROE*, *TURN*, *TFP* and *DIV* but negatively related to *ACOST1*, *ACOST2*, *MAO* and *IRREGULATION*. These results suggest that firms with more reputable independent directors have better operating performance, pay more cash dividends, suffer from lower agency costs and provide higher quality financial reports than those with fewer such directors. *SEATS* is also positively related to *SIZE*, *LEV*, *AGE*, *FCF* and *VOL* but negatively related to *SOE*, indicating that several specific firm-level characteristics of firms are linked to reputable independent directors. That is, large firms, firms with high leverage, old firms, firms with a high operating cash flow, firms with a high stock return volatility and non-SOE firms have independent directors with better reputations than their counterparts.

We also conduct a univariate test to compare firms with independent directors with good and bad reputations. Specifically, we partition the sample based on *SEATS* into two subsamples: $SEATS \leq 1$ and $SEATS > 1$. We then compare the means and medians of the measures of firm performance for the firms in these two subsamples. Table 4 reports the results of the univariate test. We find that relative to firms with directors with worse reputations ($SEATS \leq 1$), firms with directors with better reputations ($SEATS > 1$) report a higher *ROE*, higher *TURN*, higher *TFP* and more cash dividends, overall indicating better operating

Table 3
Pearson correlation coefficient matrix. This table reports the Pearson pairwise correlation coefficient matrix of the main variables for a sample of Chinese listed firms from 2004 to 2017. ***, ** and * indicate that the correlation coefficients are statistically significant at the 1%, 5% and 10% levels (two-tailed), respectively. The variables are defined in the Appendix.

	1	2	3	4	5	6	7	8	9	10	11	12
1 *SEATS*	1											
2 *ROE*	0.029***	1										
3 *TURN*	0.025***	0.232***	1									
4 *TFP*	0.016**	0.289***	0.297***	1								
5 *ACOST1*	−0.021***	−0.141***	−0.422***	−0.181***	1							
6 *ACOST2*	−0.079***	−0.076***	−0.038***	−0.041***	0.098***	1						
7 *DIV*	0.047***	−0.081***	0.003	−0.001	−0.012*	−0.139***	1					
8 *MAO*	−0.042***	−0.047***	−0.034***	−0.023***	0.138***	0.169***	−0.086***	1				
9 *IRREGULARITY*	−0.029***	−0.048***	−0.014**	−0.018**	0.032***	0.076***	−0.047***	0.087***	1			
10 *SIZE*	0.168***	0.116***	0.034***	−0.006	−0.328***	−0.118***	0.066***	−0.096***	−0.054***	1		
11 *LEVE*	0.017**	0.107***	0.157***	0.002	−0.307***	0.205***	−0.200***	0.115***	0.074***	0.368***	1	
12 *AGE*	0.087***	0.014**	0.023***	0.001	−0.074***	0.088***	−0.144***	0.059***	0.012*	0.300***	0.359***	1
13 *GROWTH*	−0.007	0.176***	0.080***	0.075***	−0.088***	0.001	−0.063***	−0.004	0.007	0.038***	0.071***	−0.011
14 *FCF*	0.013*	0.276***	0.125***	0.197***	−0.041***	−0.117***	0.083***	−0.051***	−0.065***	0.037***	−0.135***	0.004
15 vol	0.017**	0.004	−0.031***	−0.017**	0.097***	−0.040***	−0.084***	0.010	0.029***	−0.128***	−0.022***	−0.034***
16 *SOE*	−0.020***	−0.020***	0.099***	0.044***	−0.174***	0.017**	−0.024***	−0.023***	−0.039***	0.249***	0.240***	0.336***
17 *TOP1*	−0.007	0.081***	0.080***	0.060***	−0.178***	−0.072***	0.111***	−0.062***	−0.057***	0.201***	0.038***	−0.101***
18 *BOARDSIZE*	−0.052***	0.031***	0.041***	0.019***	−0.106***	0.013*	0.041***	0.005	−0.008	0.219***	0.148***	0.057***
19 *INDEPENDENCE*	0.033***	−0.017**	−0.038***	−0.030***	0.046***	−0.048***	−0.017**	−0.012*	−0.004	0.064***	−0.031***	−0.015**
20 *DUAL*	0.022***	−0.012*	−0.054***	−0.036***	0.104***	−0.061***	0.012*	−0.013*	0.021***	−0.109***	−0.144***	−0.175***
21 *MO*	0.029***	−0.003	−0.071***	−0.021***	0.149***	−0.097***	0.074***	−0.031***	−0.013*	−0.173***	−0.283***	−0.421***
22 *BO*	0.030***	−0.010	−0.079***	−0.020***	0.162***	−0.109***	0.091***	−0.043***	−0.005	−0.199***	−0.334***	−0.509***
	13	14	15	16	17	18	19	20	21	22		
13 *GROWTH*	1											
14 *FCF*	0.020***	1										
15 vol	0.055***	−0.043***	1									
16 *SOE*	−0.042***	0.059***	−0.128***	1								
17 *TOP1*	0.037***	0.081***	−0.104***	0.244***	1							
18 *BOARDSIZE*	−0.015**	0.061***	−0.123***	0.281***	0.039***	1						
19 *INDEPENDENCE*	0.012*	−0.041***	0.065***	−0.114***	0.007	−0.390***	1					
20 *DUAL*	0.005	−0.037***	0.081***	−0.271***	−0.080***	−0.176***	0.122***	1				
21 *MO*	0.020***	−0.044***	0.105***	−0.373***	−0.083***	−0.165***	0.125***	0.452***	1			
22 *BO*	0.019***	−0.050***	0.127***	−0.477***	−0.126***	−0.205***	0.125***	0.263***	0.789***	1		

Table 4
Univariate tests. This table reports the results of univariate tests. Firm-year observations are divided into subsamples based on the value of *SEATS* (i.e., < 1 or not). The last two columns compare the mean and median of the two subsamples. The variables are defined in the Appendix. ***, ** and * indicate that the differences are statistically significant at the 1 %, 5 % and 10 % levels (two-tailed), respectively.

Variables	*SEATS* ≤ 1 (*N* = 12,934)			*SEATS* > 1 (*N* = 7,514)			*Diff* in Mean	*Diff* in Median
	Mean	Median	S.D.	Mean	Median	S.D.		
ROE	0.092	0.075	0.076	0.096	0.080	0.076	−0.004***	−0.005***
TURN	0.686	0.566	0.488	0.706	0.583	0.495	−0.020***	−0.017***
TFP	0.012	−0.003	0.280	0.024	0.002	0.276	−0.012***	−0.005**
ACOST1	0.094	0.076	0.074	0.091	0.077	0.068	0.003***	−0.001
ACOST2	0.023	0.010	0.037	0.018	0.009	0.027	0.005***	0.001***
DIV	0.256	0.183	0.311	0.284	0.224	0.312	−0.028***	−0.041***
MAO	0.030	0.000	0.170	0.017	0.000	0.127	0.013***	0.000***
IRREGULARITY	0.090	0.000	0.287	0.074	0.000	0.261	0.016***	0.000***
SIZE	21.71	21.56	1.214	22.07	21.93	1.231	−0.360***	−0.370***
LEVE	0.450	0.453	0.210	0.458	0.463	0.207	−0.008**	−0.010**
AGE	2.185	2.303	0.617	2.276	2.398	0.610	−0.091***	−0.095***
GROWTH	0.232	0.136	0.553	0.229	0.126	0.547	0.003	0.010*
FCF	0.048	0.047	0.076	0.050	0.049	0.075	−0.002**	−0.002**
VOL	0.031	0.029	0.010	0.031	0.029	0.010	0.000**	0.000
SOE	0.506	1.000	0.500	0.484	0.000	0.500	0.022***	1.000***
TOP1	0.368	0.349	0.155	0.365	0.346	0.155	0.003	0.003
BOARDSIZE	9.064	9.000	1.918	8.916	9.000	1.721	0.148***	0.000***
INDEPENDENCE	0.364	0.333	0.052	0.367	0.333	0.052	−0.003***	−0.000***
DUAL	0.192	0.000	0.394	0.210	0.000	0.407	−0.018***	−0.000***
MO	0.042	0.000	0.111	0.049	0.000	0.118	−0.007***	−0.000***
BO	0.080	0.000	0.167	0.089	0.000	0.169	−0.009***	−0.000***

S.D.: Standard deviation.

performance. The latter firms also appear to have lower agency costs and a lower likelihood of receiving modified audit opinions and participating in financial disclosure-related irregularities than the former firms. These results, combined with those shown in Table 3, provide initial evidence that reputable independent directors improve firm performance by reducing agency costs and improving financial reporting quality. We also note that firms with reputable independent directors exhibit unique firm and board characteristics that likely affect the performance measures. Therefore, it is important to control for these confounding factors in the multivariate analyses.

In Table 5, we examine the association between independent directors' reputations and firms' operating performance using multivariate regressions. *SEATS* in year *t*-1 is positively related to the three measures of operating performance in year *t*, namely *ROE*, *TURN* and *TFP*, after controlling for firm and board characteristics. The estimated coefficients are statistically significant at the 5 % level at the minimum, indicating an economically significant association. For example, the coefficients of *SEATS* are 0.002 in Model 2, 0.022 in Model 4 and 0.006 in Model 6. This implies that when the average number of independent directors' directorships increases by one, the *ROE* of focal firms increases by 0.2 percentage points, *TURN* increases by 2.2 percentage points, and the industry-adjusted *TFP* increases by 0.6 percentage points. These estimates appear to be significant, given the magnitude of average *ROE*, *TURN* and *TFP*. For example, the sample average of *TFP* is 1.6 %, so a 0.6 percentage point increase in *TFP* implies 37.5 % (=0.6/1.6) of the sample mean.

The control variables show the expected signs. Firms' operating performance is positively related to *LEVE*, *GROWTH*, *FCF*, *TOP1* and *BO*. Operating performance is negatively related to *AGE* and *VOL*, implying that older firms perform worse than younger firms and that high risk impairs firms' performance. These results are consistent with previous findings.

Table 6 reports the results of the regressions examining whether reputable directors are associated with better corporate governance outcomes. *SEATS* in year *t*-1 is negatively related to the two measures of agency costs, *ACOST1* and *ACOST2*, and positively related to *DIV* in year *t* after controlling for firm and board characteristics. These results indicate that firms with reputable independent directors suffer from fewer agency costs that arise from conflicts of interest either between shareholders and managers or between majority and

Table 5
Multiple directorships and firms' operating performance. This table reports the results of regressions examining the effect of multiple directorships on firms' profitability (measured by *ROE*), operating efficiency (measured by *TURN*) and total factor productivity (measured by *TFP*), using a sample of 20,448 firm-year observations in China. The variables are defined in the Appendix. The *T*-statistics, based on standard errors adjusted for Huber–White, are in round brackets. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels (two-tailed), respectively.

Variables	*ROE*		*TURN*		*TFP*	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
SEATS	**0.004*** **	**0.002*** **	**0.034*** **	**0.022*** **	**0.009*** **	**0.006** **
	[6.055]	**[3.226]**	**[7.984]**	**[5.345]**	**[3.288]**	**[2.382]**
SIZE		0.005***		0.004		−0.017***
		[7.792]		[0.973]		[-7.114]
LEVE		0.046***		0.371***		0.046***
		[12.341]		[18.426]		[3.487]
AGE		−0.002		−0.019***		−0.010**
		[-1.560]		[-2.890]		[-2.418]
GROWTH		0.020***		0.072***		0.036***
		[16.996]		[10.357]		[7.641]
FCF		0.289***		0.785***		0.787***
		[34.873]		[16.057]		[25.079]
VOL		−0.080		−1.106*		−1.377***
		[-0.786]		[-1.877]		[-3.712]
SOE		−0.013***		0.044***		0.026***
		[-9.604]		[5.625]		[5.165]
TOP1		0.029***		0.229***		0.082***
		[8.148]		[10.916]		[5.862]
BOARDSIZE		−0.000		0.003		0.001
		[-0.154]		[1.307]		[0.791]
INDEPENDENCE		−0.034***		−0.058		−0.107***
		[-3.233]		[-0.894]		[-2.668]
DUAL		−0.001		−0.018**		−0.016***
		[-0.752]		[-2.122]		[-2.776]
MO		0.019***		−0.031		−0.002
		[2.742]		[-0.821]		[-0.062]
BO		0.010**		0.016		0.015
		[1.970]		[0.548]		[0.738]
Constant	0.071***	−0.075***	0.700***	0.330***	0.026	0.317***
	[9.812]	[-4.900]	[14.814]	[3.690]	[0.860]	[5.524]
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	20,448	20,448	20,448	20,448	20,448	20,448
F value	21.467	66.019	163.134	138.430	2.164	20.065
Adjusted R^2	0.036	0.167	0.214	0.266	0.003	0.056

minority shareholders, and have more cash dividends available to outside minority shareholders than firms without such directors. Thus, consistent with our expectations, reputation concerns motivate reputable independent directors to fulfil their monitoring roles and reduce agency problems.

Table 7 shows the results of the regressions investigating the association between financial reporting quality and independent directors' reputations. If reputable independent directors fulfil their monitoring roles and constrain agency problems, then we expect them to improve focal firms' financial reporting quality. The logit regression results shown in Table 7 support this conjecture. *SEATS* is negatively related to both *MAO* and *IRREGULARITY* at least at the 5 % significance level. This implies that firms with reputable independent directors are less likely to receive modified audit opinions and practice financial disclosure-related irregularities than their counterparts.[6]

[6] We also attempt to investigate the effect of reputable independent directors on other types of irregularities, i.e., market trading-related and operation-related irregularities. However, we fail to find significant results. A possible reason is that there are fewer cases of market trading-related and operation-related irregularities than financial disclosure-related irregularities in our sample.

Table 6
Multiple directorships and corporate governance. This table reports the results of regressions examining the effect of multiple directorships on corporate agency costs resulting from conflicts of interest between shareholders and managers (measured by *ACOST1*) and between majority and minority shareholders (measured by *ACOST2*), and on cash dividend payout (measured by *DIV*), using a sample of 20,448 firm-year observations in China. The variables are defined in the Appendix. The *T*-statistics, based on standard errors adjusted for Huber–White, are in round brackets. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

Variables	*ACOST1*		*ACOST2*		*DIV*	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
SEATS	**−0.005*** **	**−0.001***	**−0.001*** **	**−0.001*** **	**0.014*** **	**0.013*** **
	[-7.227]	**[-1.750]**	**[-4.500]**	**[-3.423]**	**[4.839]**	**[4.424]**
SIZE		−0.016***		−0.003***		0.031***
		[-26.644]		[-10.479]		[15.104]
LEVE		−0.055***		0.032***		−0.301***
		[-15.990]		[18.981]		[-25.501]
AGE		0.011***		0.005***		−0.056***
		[10.857]		[11.330]		[-12.437]
GROWTH		−0.010***		−0.002***		−0.027***
		[-9.606]		[-3.670]		[-8.126]
FCF		−0.024***		−0.033***		0.187***
		[-3.446]		[-9.140]		[6.890]
VOL		0.354***		0.191***		−3.442***
		[3.960]		[4.593]		[-9.527]
SOE		−0.003**		−0.005***		0.000
		[-2.330]		[-7.916]		[0.078]
TOP1		−0.032***		−0.014***		0.157***
		[-10.545]		[-9.796]		[10.427]
BOARDSIZE		0.001***		−0.000*		0.006***
		[4.588]		[-1.806]		[4.908]
INDEPENDENCE		0.048***		0.002		−0.106**
		[5.124]		[0.471]		[-2.392]
DUAL		0.001		−0.001**		−0.008
		[1.026]		[-2.166]		[-1.301]
MO		0.009		−0.000		0.009
		[1.302]		[-0.121]		[0.263]
BO		0.002		0.001		0.034
		[0.456]		[0.593]		[1.404]
Constant	0.079***	0.390***	0.047***	0.097***	0.329***	−0.115*
	[11.860]	[27.868]	[11.784]	[13.318]	[6.952]	[-1.820]
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	20,448	20,448	20,448	20,448	20,448	20,448
F value	90.507	142.641	47.409	52.580	20.833	72.881
Adjusted R^2	0.143	0.264	0.125	0.190	0.024	0.103

Overall, the results in Tables 3–7 show that independent directors' reputations are positively associated with firm performance in the following year. These results support the argument that reputation concerns motivate independent directors to effectively fulfil advising and monitoring roles on corporate boards, thereby alleviating agency problems and improving firm performance.

4.2. Determinants of hiring reputable independent directors

In this subsection, we explore why firms hire reputable independent directors. As independent directors also choose firms, we essentially investigate the correspondence between firms and reputable independent directors. Following previous studies (e.g., Masulis and Mobbs, 2014), we expect reputable independent directors to prefer large firms and state-owned firms that offer more visibility and reputation benefits. We also expect firms in competitive environments to be more likely to demand reputable independent directors' expertise and connec-

Table 7
Multiple directorships and financial reporting quality. This table reports the results of regressions examining the effect of multiple directorships on corporate financial reporting quality, as measured by two variables, modified audit opinion (*MAO*) and financial disclosure irregularity (*IRREGULARITY*), using a sample of 20,448 firm-year observations in China. The variables are defined in the Appendix. The Z-statistics, based on standard errors adjusted for Huber–White, are in round brackets. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

Variables	*MAO*		*IRREGULARITY*	
	Model 1	Model 2	Model 3	Model 4
SEATS	**−0.337*** **	**−0.213*** **	**−0.120*** **	**−0.080** **
	[-5.051]	**[-3.134]**	**[-3.287]**	**[-2.174]**
SIZE		−0.631***		−0.204***
		[-12.149]		[-7.330]
LEVE		3.647***		1.714***
		[12.455]		[11.344]
AGE		0.531***		−0.001
		[4.436]		[-0.023]
GROWTH		−0.060		0.029
		[-0.675]		[0.586]
FCF		−2.028***		−2.159***
		[-3.142]		[-6.051]
VOL		10.137		2.228
		[1.249]		[0.480]
SOE		−0.379***		−0.256***
		[-3.588]		[-4.014]
TOP1		−1.396***		−0.746***
		[-3.669]		[-3.896]
BOARDSIZE		0.080***		0.011
		[2.740]		[0.605]
INDEPENDENCE		0.635		−0.430
		[0.602]		[-0.743]
DUAL		−0.139		0.234***
		[-0.975]		[3.256]
MO		1.611		−1.254***
		[1.503]		[-2.959]
BO		−1.366*		0.407
		[-1.773]		[1.419]
Constant	−3.205***	6.538***	−2.673***	1.226*
	[-8.287]	[4.908]	[-10.371]	[1.681]
Industry fixed-effects	Yes	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes
No. of observations	20,448	20,448	20,448	20,448
Log likelihood	−2319.542	−1982.970	−5756.363	−5583.650
Pseudo R^2	0.024	0.166	0.025	0.054

tions. In addition, large boards of directors naturally endow firms with a high probability of hiring reputable independent directors.

Empirically, we use logit regressions to estimate the probability of hiring reputable independent directors. We construct a dummy variable, *High_directorships*, which equals 1 if a firm hires one or more independent directors with more than two directorships in other listed firms, and 0 otherwise, as the dependent variable. We examine potential determinants such as board size (*BOARDSIZE*), SOE (*SOE*), product market competition (*HHI*), measured by the Herfindahl–Hirschman index of a focal firm's industry concentration based on sales income and regional marketization level (*MKT*), measured by the provincial composite marketization index compiled by Wang et al. (2016). Following Giannetti et al. (2015), we control for the firm and board

characteristics of *SIZE*, *LEVE*, *AGE*, *GROWTH*, *FCF*, *VOL*, *TOP1*, *INDEPENDENCE*, *DUAL*, *MO*, and *BO*.

Table 8 reports the results of the regressions. Reputable independent directors are more likely to be directors of large SOEs, consistent with our expectations. Firms with large boards of directors have a higher likelihood of hiring reputable independent directors than those with small boards. Consistent with our expectations, firms in highly competitive industries or in regions with high levels of marketization have stronger demands for reputable independent directors than their counterparts; the former are therefore more likely to hire reputable independent directors. In addition, firms of a large size and with free cash flows have higher

Table 8

Determinants of firms hiring independent directors with multiple directorships. This table reports the results of logistic regressions examining the determinants of firms hiring independent directors with multiple directorships. The dependent variable is a dummy, *High_directorships*, which equals 1 if a firm hires one or more independent directors with more than two directorships in other listed firms, and 0 otherwise. The variables are defined in the Appendix. The Z-statistics, based on standard errors adjusted for Huber–White, are in round brackets. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

Variables	Prob. (*High_directorships* = 1)				
	Model 1	Model 2	Model 3	Model 4	Model 5
BOARDSIZE	**0.059*** **				**0.059*** **
	[6.185]				**[6.193]**
SOE		**0.080** **			**0.072***
		[2.118]			**[1.877]**
HHI			**−1.124** **		**−1.155** **
			[-2.313]		**[-2.374]**
MKT				**0.076*** **	**0.080*** **
				[7.552]	**[7.865]**
SIZE	0.168***	0.189***	0.193***	0.185***	0.153***
	[10.133]	[11.632]	[12.030]	[11.505]	[9.122]
LEVE	0.062	0.069	0.072	0.120	0.126
	[0.698]	[0.774]	[0.807]	[1.346]	[1.412]
AGE	0.006	−0.019	−0.007	0.009	0.008
	[0.175]	[-0.596]	[-0.204]	[0.295]	[0.235]
GROWTH	0.007	0.006	0.002	0.008	0.017
	[0.269]	[0.227]	[0.069]	[0.306]	[0.638]
FCF	0.842***	0.860***	0.862***	0.821***	0.823***
	[4.085]	[4.178]	[4.190]	[3.989]	[3.984]
VOL	−1.655	−1.807	−1.911	−1.459	−1.636
	[-0.610]	[-0.667]	[-0.705]	[-0.537]	[-0.601]
TOP1	−0.105	−0.195*	−0.153	−0.182*	−0.163
	[-1.007]	[-1.842]	[-1.470]	[-1.749]	[-1.524]
INDEPENDENCE	0.723**	0.010	−0.025	0.038	0.786**
	[2.300]	[0.035]	[-0.086]	[0.130]	[2.492]
DUAL	−0.034	−0.044	−0.055	−0.075*	−0.040
	[-0.785]	[-1.024]	[-1.287]	[-1.754]	[-0.917]
MO	0.347	0.391*	0.427*	0.437*	0.320
	[1.526]	[1.718]	[1.882]	[1.914]	[1.396]
BO	−0.212	−0.226	−0.295*	−0.373**	−0.228
	[-1.317]	[-1.382]	[-1.837]	[-2.313]	[-1.385]
Constant	−4.439***	−4.076***	−4.077***	−4.742***	−4.795***
	[-10.470]	[-9.551]	[-9.582]	[-11.028]	[-10.959]
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes	Yes
No. of observations	20,448	20,448	20,448	20,448	20,448
Log likelihood	−13122.646	−13139.434	−13138.838	−13112.184	−13086.575
Pseudo R^2	0.056	0.055	0.055	0.057	0.059

Prob.: probability.

chances of hiring reputable directors than other firms. The other control variables are not significantly associated with the decision to appoint reputable independent directors.

4.3. Addressing endogeneity issues

Our empirical analyses may be subject to endogeneity issues. One issue is self-selection bias, as firms and reputable independent directors select each other to work together. The results in Table 8 show that some firms are more likely to have reputable independent directors than others. The self-selection issue indicates that our results may be driven by observable and unobservable firm characteristics that determine both the selection of reputable directors and firm performance. In our multivariate regressions, we include several observable firm and board characteristics, but there is a possibility that we omit other characteristics. To address this concern, we use the Heckman procedure for the correction of self-selection. The procedure has two stages. In the first stage of the probit regression, we use Model 5 in Table 8 to estimate firms' probability of hiring reputable independent directors. We then calculate the inverse Mills ratio based on these estimates. In the second stage, we add the inverse Mills ratio to Equation (1) to re-estimate the main regressions. Table 9 reports the results of the regressions in the second stage. We find *SEATS* to be positively related to all of the measures of firm performance and governance quality, consistent with the results reported in Tables 5–7.

Another concern is reverse causality. Although we relate firm performance and governance quality in year *t* to independent directors' reputations in year *t*-1, there is a possibility that better performing firms can simply afford to hire more reputable independent directors, or that firms with better governance attract reputable independent directors. To address this concern, we use instrument variables and two-stage regressions. Specifically, we use two reasonable instrument variables. One is *UNIVERSITY*, calculated as the natural logarithm of the sum of one and the number of key universities belonging to the 985 Project (similar to Ivy League universities in America) and/or universities with accounting as the national key discipline in the local province (Huang et al., 2016). The other is *AIR*, measured as the natural logarithm of the sum of one and the annual released amount of SO_2, provided by China's National Bureau of Statistics. As professors from key universities, particularly those in the accounting discipline, have more opportunities to serve on boards in China, *UNIVERSITY* captures the local supply of reputable independent directors with multiple directorships and influences the probability of a focal firm hiring a reputable independent director. Similarly, if local air pollution is severe, it will be relatively hard for local firms to hire reputable independent directors from other provinces (Sun et al., 2019). In such cases, local firms will have limited choice and be forced to employ local candidates as independent directors in regions with severe air pollution. Local candidates will thus have relatively higher probabilities of holding multiple directorships without competition from candidates from other provinces. In other words, *AIR* can capture the local supply of reputable independent directors. However, both *UNIVERSITY* and *AIR* are not directly related to a specific firm's performance and governance quality. In empirical tests, we first regress firm-year *SEATS* on these two instrument variables and obtain the predicted value for *SEATS*. We then replace *SEATS* in Equation (1) with the predicted value and re-estimate the regressions. Table 10 reports the results of the regressions using predicted *SEATS* as the explanatory variable. In Model 1, the results of the first stage regression are consistent with our prediction; both the instrument variables have significantly positive coefficients at the 1 % level. The results of the second stage regression show that *SEATS* has coefficients with the predicted signs at the 5 % significance level at the minimum in most models, except for Model 4, Model 7 and Model 8. Overall, the results in Tables 9 and 10 show that our main results are robust to endogeneity concerns using the Heckman procedure and instrument variables.

4.4. A test for the measure of independent directors' reputations

In the above regression analyses, we solely focus on multiple directorships to capture and measure independent directors' reputations. However, several recent studies suggest that independent directors rank directorships based on firm size and allocate more effort to the large firms they serve (Masulis and Mobbs, 2014, 2016, 2017; Sila et al., 2017; Bryan and Mason, 2020). This finding indicates that directorship of large firms may intensify independent directors' reputation incentives and also help improve their reputations when they perform well. Therefore, service in large firms can capture independent directors' reputations. We construct a new

Table 9

Heckman two-stage selection model to address endogeneity problems. This table reports the second-stage regression results from the Heckman two-stage selection model. In the first stage of the probit regression, we regress *High_SEATS* on *HHI*, *MKT* and all of the control variables in the main regression analysis. The dummy variable *High_SEATS* equals 1 if the value of *SEATS* is > 1, and 0 otherwise. The inverse Mills ratio (*INVMILLS*) is acquired from the first-stage regression and added to the second-stage regression as an additional control variable. The variables are defined in the Appendix. The T/Z-statistics, based on standard errors adjusted for Huber–White, are in round brackets. ***, ** and * denote significance at the 1 %, 5 % and 10 % levels (two-tailed), respectively.

Variables	*ROE*	*TURN*	*TFP*	*ACOST1*	*ACOST2*	*DIV*	*MAO*	*IRREGULARITY*
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
SEATS	**0.002*** **	**0.017*** **	**0.006** **	**−0.001**	**−0.001*** **	**0.011*** **	**−0.219*** **	**−0.071***
	[2.801]	**[3.994]**	**[2.256]**	**[-1.433]**	**[-2.825]**	**[3.944]**	**[-3.230]**	**[-1.906]**
SIZE	0.002*	−0.063***	−0.021***	−0.013***	−0.001**	0.015***	−0.694***	−0.087**
	[1.954]	[-12.443]	[-6.046]	[-16.166]	[-2.529]	[4.502]	[-9.001]	[-2.112]
LEVE	0.043***	0.304***	0.042***	−0.053***	0.034***	−0.317***	3.584***	1.839***
	[11.328]	[14.960]	[3.123]	[-15.184]	[19.802]	[-26.353]	[11.932]	[12.018]
AGE	−0.002**	−0.032***	−0.011***	0.011***	0.005***	−0.059***	0.513***	0.021
	[-2.217]	[-4.977]	[-2.588]	[11.220]	[12.165]	[-13.087]	[4.347]	[0.347]
GROWTH	0.021***	0.076***	0.036***	−0.010***	−0.002***	−0.026***	−0.057	0.021
	[17.229]	[11.076]	[7.695]	[-9.748]	[-3.956]	[-7.767]	[-0.638]	[0.426]
FCF	0.267***	0.345***	0.761***	−0.009	−0.020***	0.085***	−2.452***	−1.386***
	[28.806]	[6.316]	[21.608]	[-1.164]	[-4.882]	[2.662]	[-3.362]	[-3.413]
VOL	−0.105	−1.592***	−1.406***	0.371***	0.206***	−3.555***	9.603	2.885
	[-1.031]	[-2.722]	[-3.788]	[4.139]	[4.949]	[-9.848]	[1.181]	[0.619]
SOE	−0.014***	0.012	0.024***	−0.002	−0.004***	−0.007	−0.413***	−0.199***
	[-10.699]	[1.490]	[4.629]	[-1.346]	[-6.350]	[-1.332]	[-3.731]	[-3.055]
TOP1	0.028***	0.215***	0.081***	−0.031***	−0.014***	0.154***	−1.413***	−0.716***
	[7.926]	[10.316]	[5.794]	[-10.376]	[-9.508]	[10.204]	[-3.703]	[-3.733]
BOARDSIZE	0.001**	0.018***	0.002	0.001**	−0.001***	0.010***	0.094***	−0.017
	[2.108]	[8.531]	[1.377]	[2.419]	[-4.566]	[7.030]	[2.950]	[-0.904]
INDEPENDENCE	−0.006	0.480***	−0.076*	0.030***	−0.014***	0.019	1.129	−1.388**
	[-0.540]	[6.934]	[-1.701]	[2.865]	[-2.840]	[0.393]	[0.999]	[-2.204]
DUAL	−0.000	−0.005	−0.015***	0.001	−0.002***	−0.005	−0.129	0.210***
	[-0.315]	[-0.642]	[-2.638]	[0.699]	[-2.794]	[-0.807]	[-0.906]	[2.922]
MO	0.011	−0.196***	−0.011	0.015**	0.005*	−0.029	1.470	−0.954**
	[1.503]	[-5.039]	[-0.401]	[2.062]	[1.943]	[-0.841]	[1.357]	[-2.220]
BO	0.013***	0.081***	0.019	−0.000	−0.001	0.049**	−1.344*	0.290
	[2.611]	[2.831]	[0.921]	[-0.005]	[-0.466]	[2.040]	[-1.737]	[1.009]
	−0.049***	−0.967***	−0.057	0.033***	0.029***	−0.225***	−0.903	1.693***
	[-5.451]	[-18.767]	[-1.549]	[4.134]	[6.843]	[-6.040]	[-1.136]	[4.099]
Constant	0.081***	3.402***	0.488***	0.283***	0.017	0.465***	8.516***	−2.418**
	[2.656]	[18.735]	[4.320]	[10.912]	[1.284]	[3.967]	[3.907]	[-2.052]
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	20,448	20,448	20,448	20,448	20,448	20,448	20,448	20,448
F value / Log likelihood	90.507	142.641	47.409	52.580	20.833	72.881	−1982.339	−5576.382
Adjusted / Pseudo R^2	0.143	0.264	0.125	0.190	0.024	0.103	0.166	0.055

reputation variable, *SEATS_SIZE*, based on both multiple directorships and service in large firms for a robustness check. Specifically, an independent director's reputation strength equals 1 if an independent director serves more than two listed firms, including the focal firm, in year *t*-1 or any large firm ranking in the first one-third based on total assets in year *t*-1, equals 2 if an independent director serves more than two listed firms, including the focal firm in year *t*-1 and any large firm ranking in the first one-third based on total assets in year *t*-1, and 0 otherwise.[7] Then, *SEATS_SIZE* equals the average value of each independent director's reputation strength in a focal firm in year *t*-1.

[7] We choose two directorships as a cut-off because the average number of directorships for all independent directors is close to two in Chinese listed firms.

Table 10

Instrumental variables two-stage least squares (2SLS) regression to address endogeneity problems This table reports the results of an instrumental variables 2SLS regression model. In the first stage, we include two instrumental variables, *UNIVERSITY* and *AIR*. *UNIVERSITY* is calculated as the natural logarithm of the sum of 1 and the number of key universities belonging to the 985 Project (similar to Ivy League universities in America) and/or universities with accounting as the national key discipline in the local province. *AIR* is calculated as the natural logarithm of the sum of 1 plus the annual released amount of SO_2, provided by China's National Bureau of Statistics. In the second stage, we take the predicted value of *SEATS* from the first stage regression as the independent variable. The variables are defined in the Appendix. The T/Z-statistics, based on standard errors adjusted for Huber–White, are in round brackets. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

Variables	*Frist stage regression*	*Second stage regression*							
	SEATS	*ROE*	*TURN*	*TFP*	*ACOST1*	*ACOST2*	*DIV*	*MAO*	*IRREGULARITY*
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
SEATS		**0.056****	**0.788*****	**−0.032**	**−0.072*****	**−0.069*****	**−0.026**	**0.001**	**−0.250*****
		[2.557]	**[4.804]**	**[-0.437]**	**[-3.306]**	**[-4.549]**	**[-0.342]**	**[0.029]**	**[-2.889]**
UNIVERSITY	**0.043*****								
	[5.107]								
AIR	**0.027*****								
	[4.178]								
SIZE	0.067***	0.002	−0.049***	−0.014**	−0.011***	0.002	0.033***	−0.022***	−0.001
	[11.955]	[0.951]	[-3.899]	[-2.536]	[-6.416]	[1.433]	[5.944]	[-6.191]	[-0.152]
LEVE	0.053*	0.044***	0.337***	0.048***	−0.052***	0.035***	−0.300***	0.129***	0.153***
	[1.773]	[10.572]	[10.836]	[3.497]	[-12.910]	[12.905]	[-24.312]	[11.914]	[10.179]
AGE	0.018*	−0.003**	−0.032***	−0.009**	0.012***	0.006***	−0.055***	0.014***	0.008
	[1.650]	[-2.058]	[-2.969]	[-2.154]	[9.061]	[6.896]	[-11.701]	[6.197]	[1.417]
GROWTH	−0.008	0.021***	0.078***	0.035***	−0.010***	−0.002***	−0.028***	−0.003	−0.001
	[-0.894]	[16.086]	[7.994]	[7.481]	[-8.592]	[-3.001]	[-8.044]	[-0.833]	[-0.123]
FCF	0.331***	0.272***	0.530***	0.800***	−0.000	−0.010	0.200***	−0.059**	−0.090**
	[4.778]	[23.297]	[5.872]	[20.123]	[-0.038]	[-1.298]	[5.333]	[-2.551]	[-2.051]
VOL	0.730	−0.113	−1.576*	−1.353***	0.398***	0.233***	−3.418***	−0.088	0.173
	[0.800]	[-0.997]	[-1.717]	[-3.616]	[3.543]	[3.045]	[-9.344]	[-0.354]	[0.395]
SOE	0.036***	−0.015***	0.017	0.028***	−0.000	−0.002**	0.002	−0.016***	−0.013*
	[2.815]	[-8.851]	[1.247]	[4.688]	[-0.112]	[-2.074]	[0.303]	[-4.512]	[-1.901]
TOP1	0.024	0.027***	0.207***	0.083***	−0.029***	−0.012***	0.158***	−0.024***	−0.040**
	[0.677]	[6.746]	[5.881]	[5.887]	[-7.465]	[-4.250]	[10.331]	[-3.294]	[-2.496]
BOARDSIZE	−0.017***	0.001*	0.016***	0.000	0.000	−0.001***	0.006***	0.003**	−0.003
	[-5.677]	[1.692]	[3.862]	[0.170]	[0.150]	[-3.971]	[3.149]	[2.395]	[-1.531]
INDEPENDENCE	−0.466***	−0.008	0.304**	−0.126**	0.015	−0.030***	−0.124**	0.045	−0.143**
	[-4.574]	[-0.543]	[2.425]	[-2.388]	[0.955]	[-2.763]	[-2.193]	[1.398]	[-2.223]
DUAL	−0.019	−0.000	−0.005	−0.016***	0.000	−0.003**	−0.008	−0.004	0.015**
	[-1.318]	[-0.101]	[-0.326]	[-2.822]	[0.060]	[-2.102]	[-1.370]	[-1.144]	[2.034]
MO	0.148*	0.012	−0.143*	0.004	0.020**	0.010	0.015	0.023	−0.060
	[1.901]	[1.303]	[-1.921]	[0.134]	[2.039]	[1.549]	[0.406]	[1.561]	[-1.558]
BO	−0.081	0.014**	0.071	0.012	−0.003	−0.004	0.031	−0.026***	0.013
	[-1.451]	[2.254]	[1.374]	[0.575]	[-0.465]	[-0.868]	[1.265]	[-2.795]	[0.493]
Constant	−0.890***	−0.058***	0.212	0.416***	0.433***	0.066***	−0.161***	0.398***	0.360***

Table 10 (*continued*)

Variables	*Frist stage regression*	*Second stage regression*							
	SEATS	*ROE*	*TURN*	*TFP*	*ACOST1*	*ACOST2*	*DIV*	*MAO*	*IRREGULARITY*
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
	[-6.309]	[-3.238]	[1.510]	[6.936]	[23.697]	[5.434]	[-2.887]	[9.689]	[5.367]
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	20,448	20,448	20,448	20,448	20,448	20,448	20,448	20,448	20,448
F / Wald Chi2 value	49.456	2566.384	2477.398	928.887	3857.981	1082.824	3360.865	348.395	442.284
Adjusted R^2	0.095	–	–	0.047	–	–	0.095	0.045	–

We use the new reputation variable as the independent variable to re-test the effect of independent directors' reputations on firm performance. The results are shown in Table 11. *SEATS_SIZE* has coefficients with the predicted signs at the 1 % significance level in all the models, except for Model 4, Model 7 and Model 8. Overall, Table 11 shows that our main results are robust to alternative measures of independent directors' reputations.

4.5. A test for the policy change

In China, the government issued a regulatory policy known as the 18th Decree on 19 October 2013. This new regulation prohibited retired government officials from serving as independent directors of listed firms. As a result, a large number of independent directors, particularly those with multiple directorships, resigned their

Table 11

Regression results for alternative measure of independent directors' reputation This table reports the results for an alternative measure of independent directors' reputation (*SEATS_SIZE*). *SEATS_SIZE* equals the average value of all independent director's reputational strengths in a focal firm in year/t. The reputational strength of an independent director equals 1 if the independent director serves more than two listed firms, including the focal firm, in year/t or any large firm ranking in the first one-third based on total assets in year/t, equals 2 if the independent director serves more than two listed firms, including the focal firm, in year/t and any large firm ranking in the first one-third based on total assets in year/t, and 0 otherwise. The variables are defined in the Appendix. The *T*-statistics, based on standard errors adjusted for Huber–White, are in round brackets. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

Variables	*ROE*	*TURN*	*TFP*	*ACOST1*	*ACOST2*	*DIV*	*MAO*	*IRREGULARITY*
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
SEATS_SIZE	**0.006*** **	**0.033*** **	**0.021*** **	**0.001**	**−0.002*** **	**0.025*** **	**0.029**	**−0.102***
	[4.950]	**[4.757]**	**[4.756]**	**[1.011]**	**[-4.596]**	**[5.146]**	**[0.289]**	**[-1.687]**
SIZE	0.004***	−0.004	−0.022***	−0.016***	−0.003***	0.025***	−0.657***	−0.182***
	[5.279]	[-0.934]	[-8.341]	[–23.896]	[-8.050]	[10.717]	[-11.474]	[-5.671]
LEVE	0.046***	0.369***	0.045***	−0.056***	0.032***	−0.303***	3.635***	1.721***
	[12.218]	[18.304]	[3.378]	[-16.043]	[19.085]	[-25.655]	[12.332]	[11.370]
AGE	−0.002*	−0.020***	−0.011***	0.010***	0.005***	−0.057***	0.536***	0.002
	[-1.754]	[-3.072]	[-2.623]	[10.787]	[11.539]	[-12.633]	[4.491]	[0.031]
GROWTH	0.020***	0.072***	0.036***	−0.010***	−0.002***	−0.027***	−0.058	0.029
	[16.963]	[10.343]	[7.714]	[-9.567]	[-3.699]	[-8.083]	[-0.645]	[0.579]
FCF	0.289***	0.784***	0.784***	−0.025***	−0.033***	0.187***	−2.118***	−2.156***
	[34.787]	[16.050]	[24.988]	[-3.549]	[-9.055]	[6.890]	[-3.265]	[-6.044]
VOL	−0.085	−1.137*	−1.412***	0.353***	0.194***	−3.452***	10.260	2.341
	[-0.835]	[-1.929]	[-3.803]	[3.945]	[4.659]	[-9.550]	[1.273]	[0.503]
SOE	−0.013***	0.045***	0.026***	−0.003**	−0.005***	0.001	−0.393***	−0.260***
	[-9.545]	[5.722]	[5.192]	[-2.372]	[-7.954]	[0.112]	[-3.709]	[-4.069]
TOP1	0.029***	0.228***	0.082***	−0.032***	−0.014***	0.157***	−1.382***	−0.756***
	[8.083]	[10.861]	[5.857]	[-10.540]	[-9.781]	[10.396]	[-3.629]	[-3.947]
BOARDSIZE	−0.000	0.003	0.001	0.001***	−0.000*	0.006***	0.085***	0.011
	[-0.127]	[1.263]	[0.784]	[4.679]	[-1.778]	[4.879]	[2.872]	[0.643]
INDEPENDENCE	−0.033***	−0.056	−0.107***	0.049***	0.002	−0.107**	0.784	−0.423
	[-3.204]	[-0.865]	[-2.670]	[5.157]	[0.498]	[-2.415]	[0.745]	[-0.730]
DUAL	−0.001	−0.018**	−0.015***	0.001	−0.001**	−0.007	−0.136	0.233***
	[-0.700]	[-2.079]	[-2.728]	[1.082]	[-2.227]	[-1.244]	[-0.953]	[3.245]
MO	0.019***	−0.031	−0.001	0.009	−0.000	0.007	1.578	−1.296***
	[2.751]	[-0.806]	[-0.036]	[1.323]	[-0.131]	[0.215]	[1.468]	[-3.053]
BO	0.010**	0.015	0.014	0.002	0.001	0.034	−1.367*	0.416
	[1.996]	[0.530]	[0.688]	[0.415]	[0.612]	[1.421]	[-1.761]	[1.450]
Constant	−0.048***	0.483***	0.420***	0.396***	0.086***	0.000	6.734***	0.710
	[-2.926]	[5.122]	[6.810]	[25.750]	[11.369]	[0.007]	[4.820]	[0.879]
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	20,426	20,426	20,426	20,426	20,426	20,426	20,426	20,426
F value / Log likelihood	66.360	137.167	20.723	142.998	52.453	72.434	−1982.873	−5580.458
Adjusted / Pseudo R^2	0.167	0.265	0.057	0.264	0.190	0.103	0.165	0.054

Table 12
Regression results for testing the impact of a policy change. This table reports the results obtained after partitioning the full sample based on a policy change issued by the government on October 19, 2013, which resulted in a turnover of independent directors. The indicator variable *Change* equals 1 if the year of observations is>2013, 0 zero otherwise. The variables are defined in the Appendix. The *T*-statistics, based on standard errors adjusted for Huber–White, are in round brackets. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

Variables	*ROE*			*TURN*			*TFP*		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
	Change = 0	*Change* = 1	full sample	*Change* = 0	*Change* = 1	full sample	*Change* = 0	*Change* = 1	full sample
SEATS	**0.003*** **	**0.001**	**0.002*** **	**0.026*** **	**0.017*** **	**0.022*** **	**0.013*** **	**−0.000**	**0.006** **
	[3.001]	**[1.111]**	**[3.216]**	**[4.334]**	**[3.081]**	**[5.346]**	**[3.460]**	**[-0.122]**	**[2.375]**
PC			**−0.003*** **			**0.004**			**−0.007***
			[-2.919]			**[0.632]**			**[-1.789]**
SIZE	0.007***	0.003**	0.005***	0.011**	−0.005	0.004	−0.023***	−0.008**	−0.017***
	[8.316]	[2.317]	[7.807]	[2.312]	[-0.976]	[0.969]	[-7.733]	[-1.980]	[-7.101]
LEVE	0.047***	0.049***	0.046***	0.376***	0.379***	0.371***	0.055***	0.028	0.046***
	[9.861]	[8.078]	[12.364]	[14.001]	[12.332]	[18.424]	[3.189]	[1.321]	[3.503]
AGE	−0.004***	0.003**	−0.002	−0.018*	−0.010	−0.019***	−0.009	−0.010	−0.010**
	[-2.946]	[1.978]	[-1.580]	[-1.921]	[-1.098]	[-2.886]	[-1.635]	[-1.537]	[-2.429]
GROWTH	0.020***	0.019***	0.020***	0.082***	0.052***	0.072***	0.030***	0.044***	0.036***
	[13.031]	[10.299]	[16.987]	[8.281]	[5.795]	[10.360]	[4.820]	[6.292]	[7.636]
FCF	0.284***	0.295***	0.289***	0.757***	0.827***	0.785***	0.711***	0.944***	0.787***
	[27.222]	[21.437]	[34.886]	[11.847]	[11.126]	[16.060]	[18.087]	[17.820]	[25.064]
VOL	−0.502***	0.319**	−0.075	−3.300***	1.379*	−1.112*	−2.249***	−0.125	−1.366***
	[-3.372]	[2.249]	[-0.742]	[-3.744]	[1.732]	[-1.887]	[-4.451]	[-0.221]	[-3.683]
SOE	−0.013***	−0.014***	−0.013***	0.053***	0.022*	0.044***	0.031***	0.021**	0.027***
	[-7.416]	[-6.730]	[-9.455]	[5.114]	[1.876]	[5.579]	[4.772]	[2.503]	[5.248]
TOP1	0.025***	0.035***	0.029***	0.243***	0.195***	0.229***	0.085***	0.077***	0.082***
	[5.236]	[6.707]	[8.214]	[8.523]	[6.527]	[10.912]	[4.734]	[3.443]	[5.902]
BOARDSIZE	−0.000	0.000	0.000	0.004*	−0.002	0.002	0.002	0.000	0.001
	[-0.527]	[0.165]	[0.165]	[1.740]	[-0.600]	[1.229]	[1.162]	[0.085]	[0.987]
INDEPENDENCE	−0.042***	−0.031*	−0.032***	−0.091	−0.08	−0.060	−0.100*	−0.107	−0.103**
	[-2.950]	[-1.941]	[-3.052]	[-1.012]	[-0.891]	[-0.930]	[-1.903]	[-1.639]	[-2.553]
DUAL	−0.003	0.000	−0.001	−0.029**	−0.009	−0.018**	−0.014*	−0.018**	−0.016***
	[-1.307]	[0.188]	[-0.774]	[-2.420]	[-0.739]	[-2.117]	[-1.833]	[-2.237]	[-2.788]
MO	0.018*	0.017*	0.020***	−0.118*	0.012	−0.032	−0.025	0.017	−0.001
	[1.658]	[1.873]	[2.773]	[-1.763]	[0.257]	[-0.828]	[-0.585]	[0.459]	[-0.043]
BO	0.013*	0.008	0.010**	0.141***	−0.076**	0.015	0.032	−0.001	0.015
	[1.693]	[1.234]	[1.997]	[2.777]	[-2.312]	[0.542]	[1.048]	[-0.049]	[0.753]
Constant	−0.097***	−0.008	−0.057***	0.193	0.907***	0.734***	0.551***	0.156*	0.330***
	[-4.519]	[-0.330]	[-3.467]	[1.535]	[5.748]	[6.614]	[6.509]	[1.743]	[6.379]
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	12,152	8,296	20,448	12,152	8,296	20,448	12,152	8,296	20,448
F value	51.011	32.502	64.822	95.088	89.41	135.566	13.199	11.704	19.718
Adjusted R^2	0.177	0.156	0.167	0.263	0.256	0.266	0.053	0.065	0.057

board seats (Liu et al., 2018; Shi et al., 2018).[8] Therefore, we further investigate whether the policy change influences our main findings. We partition the full sample into two subsamples: before (*Change* = 0) and after the policy (*Change* = 1). *Change* is a dummy variable that equals 1 if the year of observations is>2013, and 0 otherwise. We then re-estimate the regressions in the two subsamples. The results are shown in Table 12. *SEATS* has positive and significant coefficients for all three measures of firm performance in the subsample before the policy, but has insignificant or significant but small coefficients in the subsample after the policy.

[8] Taking advantage of this exogenous policy shock, we attempted to construct a difference-in-differences design to test our main findings. We failed to find support from this test. This may be due to confounding effects of the policy shock. For example, the policy may cut off focal firms' political connections by prohibiting government officials from serving as independent directors, but political connections are valuable for or have substantial effects on focal firms in China (Liu et al., 2018).

Table 13
Regression results for the cross-sectional analyses.

Panel A Partitioning the results based on the local marketization environment. Panel A reports the results obtained after partitioning the full sample based on the local marketization environment. The indicator variable *MKT* equals 1 if the marketization index of the region where a focal firm is registered is higher than the mean marketization index of all regions across China, and 0 otherwise. The variables are defined in the Appendix. The *T*-statistics, based on standard errors adjusted for Huber–White, are in round brackets. ***, ** and * denote significance at the 1 %, 5 % and 10 % levels (two-tailed), respectively.

Variables	*ROE*		*TURN*		*TFP*	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	MKT = 0	*MKT* = 1	*MKT* = 0	*MKT* = 1	*MKT* = 0	*MKT* = 1
SEATS	**0.002****	**0.002****	**0.031*****	**0.008**	**0.012*****	**0.003**
	[2.123]	**[2.068]**	**[4.515]**	**[1.467]**	**[2.651]**	**[0.832]**
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−0.091***	−0.083***	−0.239*	0.798***	0.469***	0.299***
	[-3.965]	[-3.938]	[-1.827]	[6.681]	[5.159]	[3.825]
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	9,367	11,081	9,367	11,081	9,367	11,081
F value	38.475	32.817	58.485	101.974	12.761	11.089
Adjusted R^2	0.182	0.160	0.243	0.314	0.063	0.061

Panel B Partitioning the results based on the nature of property rights. Panel B reports the results obtained after partitioning the full sample based on the nature of property rights. The indicator variable *SOE* equals 1 if a focal firm's ultimate controlling shareholder is the government, and 0 otherwise. The variables are defined in the Appendix. The *T*-statistics, based on standard errors adjusted for Huber–White, are in round brackets. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

Variables	*ROE*		*TURN*		*TFP*	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	SOE = 0	*SOE* = 1	*SOE* = 0	*SOE* = 1	*SOE* = 0	*SOE* = 1
SEATS	**0.003*****	**0.002***	**0.021*****	**0.024*****	**0.011*****	**0.003**
	[2.623]	**[1.687]**	**[4.021]**	**[3.709]**	**[2.681]**	**[0.711]**
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−0.114***	−0.102***	0.636***	−0.319***	0.327***	0.476***
	[-4.658]	[-3.637]	[4.731]	[-2.763]	[3.740]	[4.078]
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	10,261	10,187	10,261	10,187	10,261	10,187
F value	34.650	39.789	54.026	103.495	11.398	14.314
Adjusted R^2	0.174	0.176	0.224	0.314	0.061	0.062

Panel C Partitioning the results based on political connections. Panel C reports the results obtained after partitioning the full sample based on the focal firm's political connections. The indicator variable *FPC* equals 1 if a focal firm's CEO has political connections, and 0 otherwise. The variables are defined in the Appendix. The *T*-statistics, based on standard errors adjusted for Huber–White, are in round brackets. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

Variables	*ROE*		*TURN*		*TFP*	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	FPC = 0	*FPC* = 1	*FPC* = 0	*FPC* = 1	*FPC* = 0	*FPC* = 1
SEATS	**0.003*****	**−0.001**	**0.016*****	**0.052*****	**0.007****	**0.003**
	[3.924]	**[-0.897]**	**[3.490]**	**[5.524]**	**[2.459]**	**[0.447]**
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−0.036*	−0.109***	0.913***	−0.442**	0.342***	0.212
	[-1.952]	[-2.920]	[6.992]	[-2.173]	[6.091]	[1.505]
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	16,862	3,586	16,862	3,586	16,862	3,586
F value	53.619	16.456	112.8	34.071	17.002	5.135
Adjusted R^2	0.161	0.214	0.266	0.294	0.058	0.063

(*continued on next page*)

Table 13 (*continued*)

Panel D Partitioning the results based on industry competition. Panel D reports the results obtained after partitioning the full sample based on industry competition. The indicator variable *Low* equals 1 if the Herfindahl index of a focal firm's industry concentration based on sales income (i.e., *HHI*) is higher than the mean Herfindahl index of all industries, and 0 otherwise. The variables are defined in the Appendix. The *T*-statistics, based on standard errors adjusted for Huber–White, are in round brackets. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

Variables	*ROE*		*TURN*		*TFP*	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Low = 1	*Low* = 0	*Low* = 1	*Low* = 0	*Low* = 1	*Low* = 0
SEATS	**0.002*** **	**0.001**	**0.034*** **	**−0.005**	**0.006***	**0.008**
	[2.811]	**[1.047]**	**[6.518]**	**[-0.797]**	**[1.891]**	**[1.457]**
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−0.082***	−0.021	−0.030	0.507***	0.403***	0.167*
	[-4.050]	[-0.911]	[-0.274]	[3.709]	[6.090]	[1.820]
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	14,091	6,357	14,091	6,357	14,091	6,357
F value	61.792	22.400	139.109	40.287	17.968	7.751
Adjusted R^2	0.178	0.151	0.278	0.164	0.058	0.054

Panel E Partitioning the results based on analyst coverage. Panel E reports the results obtained after partitioning the full sample based on analyst coverage. The indicator variable *High1* equals 1 if a focal firm's analyst coverage is larger than its mean value in the full sample, and 0 otherwise. The variables are defined in the Appendix. The *T*-statistics, based on standard errors adjusted for Huber–White, are in round brackets. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

Variables	*ROE*		*TURN*		*TFP*	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	High1 = 0	*High1* = 1	*High1* = 0	*High1* = 1	*High1* = 0	*High1* = 1
SEATS	**0.002** **	**0.001**	**0.022*** **	**0.019*** **	**0.010** **	**0.000**
	[2.441]	**[1.154]**	**[3.687]**	**[3.323]**	**[2.572]**	**[0.077]**
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.116***	0.097***	0.633***	0.740***	0.562***	0.438***
	[5.080]	[3.933]	[4.421]	[5.006]	[6.043]	[4.721]
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	10,763	9,685	10,763	9,685	10,763	9,685
F value	22.795	49.912	63.681	111.152	10.150	15.521
Adjusted R^2	0.118	0.239	0.231	0.339	0.050	0.078

Panel F Partitioning the results based on institutional ownership. Panel F reports the results obtained after partitioning the full sample based on institutional ownership. The indicator variable *High2* equals 1 if a focal firm's institutional ownership is larger than its mean value in the full sample, and 0 otherwise. The variables are defined in the Appendix. The *T*-statistics, based on standard errors adjusted for Huber–White, are in round brackets. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

Variables	*ROE*		*TURN*		*TFP*	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	High2 = 0	*High2* = 1	*High2* = 0	*High2* = 1	*High2* = 0	*High2* = 1
SEATS	**0.004*** **	**0.000**	**0.028*** **	**0.014** **	**0.010*** **	**0.001**
	[4.162]	**[0.231]**	**[4.979]**	**[2.358]**	**[2.720]**	**[0.342]**
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−0.004	−0.029	0.305**	1.171***	0.431***	0.381***
	[-0.176]	[-1.076]	[2.323]	[5.644]	[5.160]	[4.022]
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	11,939	8,509	11,939	8,509	11,939	8,509
F value	38.329	38.359	61.269	103.023	9.353	15.179
Adjusted R^2	0.163	0.212	0.238	0.314	0.041	0.090

These results suggest that our main findings are largely valid only before the policy change. As the policy resulted in the turnover of government official directors concerned with their reputations and likely to have multiple directorships (i.e., reputable directors in this study), the results in Table 12 further support for our main findings of reputation concerns motivating independent directors to effectively play governance roles and contribute to firm performance.

However, there is an alternative explanation for the strong results before the policy change: the political relationships of independent directors improve focal firms' performance. To address this concern, we include the political relationships of independent directors as a control variable,[9] denoted as *PC*, which equals 1 if an independent director is or was a governmental official, delegate of the People's Congress or member of a political consultative conference, and 0 otherwise. As the results of Model 3, Model 6 and Model 9 in Table 12 show, *SEATS* in year *t*-1 remains positively related to our three measures of operating performance in year *t* after controlling for firm and board characteristics, including the political relationships of independent directors. Interestingly, *PC* is negatively related to *ROE* and *TFP*, indicating that the political relationships of independent directors negatively affect firm performance. Therefore, the potential alternative explanation does not change our main findings.

4.6. Cross-sectional analyses

We conduct two cross-sectional analyses. The first is related to China's unique institutions, where we investigate whether the reputation mechanism of independent directors depends on or interacts with these institutions. We refer to three factors related to China's institutions: regional marketization environment, the nature of property rights and political connections. We know that the level of marketization environment varies considerably across regions in China, which provides the opportunity to investigate the role of the formal marketization environment in a country sample. In China, the proportion of SOEs is large; they are heavily supervised by governments and operate differently from non-SOEs. Thus, it is necessary and interesting to compare the effects of independent directors' reputations between SOEs and non-SOEs. Moreover, political connections are common worldwide, especially in emerging economies like China. Political connections can be used by business firms as informal institutions to compensate for the underdevelopment of formal institutions, to smooth their operations and survive (Liu et al., 2018; Shi et al., 2018). To determine the situational influence of these three factors, we conduct three partitioning analyses: 1) partitioning the full sample into two subsamples based on the mean marketization index of all regions across China, measured as the marketization index compiled by Wang et al. (2018); 2) partitioning the full sample into two subsamples based on the nature of the property rights of the ultimate owners of the focal firms; and 3) partitioning the full sample into two subsamples based on the political connections of the focal firms, measured as in Fan et al. (2007). Then, we re-estimate the regressions in each subsample. The results are shown in Panels A–C of Table 13.

As shown in Panel A of Table 13, *SEATS* has positive and significant coefficients for all the three measures of firm performance in the subsample of low local marketization environment ($MKT = 0$), but a significantly positive coefficient only when taking *ROE* as the dependent variable in the subsample of high local marketization environment ($MKT = 1$). In Panel B of Table 13, *SEATS* has positive and significant coefficients in the subsample of non-SOEs ($SOE = 0$) for all the three measures of firm performance, but significantly positive coefficients only when taking *ROE* and *TURN* as the dependent variables in the subsample of SOEs ($SOE = 1$). In Panel C of Table 13, *SEATS* has positive and significant coefficients for all three measures of firm performance in the subsample of firms without political connections ($FPC = 0$), but a significantly positive coefficient only when taking *TURN* as the dependent variable in the subsample of firms with political connections ($FPC = 1$). These results, taken together, indicate that the reputation mechanism of independent directors works well as a whole when formal or informal institutions are relatively weak in China. That is, reputable independent directors compensate for weak institutions and play effective governance roles.

[9] Indeed, we attempt to control for the effect of political relationships of the CEO or chairman of board of directors and find similar, consistent results.

Another set of cross-sectional analyses aim to investigate whether and how the system of independent directors, as a component of internal governance, interact with other external governance mechanisms. We refer to three external governance factors: product market competition, analyst coverage and institutional ownership. The literature demonstrates that corporate insiders are subject to significant external supervising and constraints when focal firms face high product market competition, are followed by many analysts or have large ownership of sophisticated institutional investors. In such cases, the focal firms may suffer from few agency problems. Therefore, we predict that the positive effect of reputable independent directors on firm performance is less pronounced in these firms than in their counterparts. To test this prediction, we conduct three partitioning analyses: 1) partitioning the full sample into two subsamples based on the mean product market competition, measured as the Herfindahl index of a focal firm's industry concentration based on sales income; 2) partitioning the full sample into two subsamples based on the mean analyst coverage, measured as the natural logarithm of the sum of one plus the number of analysts following a focal firm; and 3) partitioning the full sample into two subsamples based on the mean institutional ownership. Then, we re-estimate the regressions in each subsample. The results are shown in Panels D–F of Table 13.

As shown in Panel D of Table 13, *SEATS* has positive and significant coefficients for all three measures of firm performance in the subsample of low product market competition ($Low = 1$), but insignificant coefficients in the subsample of high product market competition ($Low = 0$). In Panel E of Table 13, *SEATS* has positive and significant coefficients in the subsample of low analyst coverage ($High1 = 0$), but a significant (positive) coefficient only when taking *TURN* as the dependent variable in the subsample of high analyst coverage ($High1 = 1$). In Panel F of Table 13, *SEATS* has positive and significant coefficients in the subsample of low institutional ownership ($High2 = 0$), but a significant coefficient only when taking *TURN* as the dependent variable in the subsample of high institutional ownership ($High2 = 1$).

These results also suggest that the reputation mechanism of independent directors works well when external governance is weak. In other words, there is a substitution effect between internal (i.e., the system of independent directors) and external governance.

5. Conclusions

We investigate whether reputable independent directors can effectively perform advising and monitoring duties in markets with weak investor protections. In such markets, firms usually have controlling shareholders with strong incentives to expropriate from minority shareholders and enjoy the private benefits of control. These controlling shareholders also handpick the independent directors. Therefore, it is likely that independent directors do not have the incentives or power to monitor the management in markets with weak investor protections and rampant agency conflicts. Motivated by studies that find that reputation concerns motivate independent directors to monitor and discipline managers (e.g., Fama and Jensen, 1983; Farrell and Whidbee, 2000; Harford, 2003; Yermack, 2004; Masulis and Mobbs, 2014, 2016, 2017; Sila et al., 2017; Bryan and Mason, 2020), we examine the association between independent directors' reputations and firm performance in China, where investor protections are weak but the capital market is fast-growing.

Our empirical results show that independent directors' reputation, as measured by the number of directorships, is positively related to firm performance. Specifically, we find that reputable independent directors are associated with high profitability, high operating efficiency and high total factor productivity. Firms with reputable independent directors suffer from fewer agency costs, pay more cash dividends and are less likely to receive modified audit opinions and engage in financial disclosure-related irregularities than their counterparts. The results suggest that reputable independent directors contribute to firms' operating performance and governance quality. Further cross-sectional analyses reveal that the reputation mechanism of independent directors works well when formal or informal institutions and external governance are weak, displaying a substitution effect.

The results support the argument that reputation concerns motivate independent directors to perform their duties, even in markets with weak investor protection. Therefore, this study extends previous research on directors' reputations in the U.S. and other developed markets. This study also adds to the growing literature on the characteristics of independent directors and boards in China, such as studies on female (Liu et al., 2014; Luo et al., 2017), foreign (Giannetti et al., 2015) and independent directors (Firth et al., 2007; Conyon and He,

2011; Liang et al., 2013; Liu et al., 2015). As our findings show that reputable independent directors can compensate for weak institutions and external governance in emerging markets to play effective governance roles, and are thus associated with better firm performance and governance. Our results have valuable implications for investors who search for quality investment opportunities and for policymakers who aspire to improve governance quality.

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:. Variable definitions

Variables	Definitions
SEATS	The average number of board seats held by an independent director in other listed firms in year *t*-1.
ROE	The ratio of net income to total equity at the end of year *t*.
TURN	The ratio of sales to total assets at the end of year *t*.
TFP	The firm's total factor productivity at the end of year *t*, defined as in Giannetti et al. (2015). *TFP* equals the residual of the regression of the natural logarithm of sales on the natural logarithm of total assets, the natural logarithm of the total number of employees and the natural logarithm of cash payments for raw materials and services for all firms in an industry-year.
ACOST1	The ratio of administrative expenses divided by revenue at the end of year *t*.
ACOST2	The ratio of other receivables divided by total assets at the end of year *t*.
DIV	The annual cash dividend per share over the book value of assets per share of a firm at year *t*.
MAO	An indicator variable that equals 1 if a firm gets a modified audit opinion other than an unqualified audit opinion, and 0 otherwise.
IRREGULARITY	An indicator variable that equals 1 if a firm commits a financial disclosure related irregularity in the year at least once, and 0 otherwise.
SIZE	The natural logarithm of total assets at the end of year *t*-1.
LEVE	The ratio of total liabilities to total assets at the end of year *t*-1.
AGE	The natural logarithm of the sum of 1 plus the years elapsed since the initial public offering.
GROWTH	The annual percentage change in sales in year *t*-1.
FCF	The net operating cash flow scaled by total assets at the end of year *t*-1.
VOL	The standard deviation of a firm's daily stock returns during year *t*-1.
SOE	A dummy variable that equals 1 if a firm's ultimate controlling shareholder is the government, and 0 otherwise.
TOP1	Fraction of shares held by the largest shareholder in year *t*-1.
BOARDSIZE	The number of board members at the end of year *t*-1.
INDEPENDENCE	The number of independent directors divided by the number of board members at the end of year *t*-1.
DUAL	A dummy variable that equals 1 if the CEO and the chair of the board are the same person in year *t*-1, and 0 otherwise.
MO	Fraction of shares held by senior managers of a firm at the end of year *t*-1.
BO	Fraction of shares held by all board directors at the end of year *t*-1.

(*continued*)

Variables	Definitions
SEATS_SIZE	The average value of all independent director's reputational strength in a focal firm in year *t*-1. The reputational strength of an independent director equals 1 if the independent director serves more than two listed firms, including the focal firm, in year *t*-1 or any large firm ranking in the first one-third based on total assets in year *t*-1, equals 2 if the independent director serves more than two listed firms, including the focal firm, in year *t*-1 and any large firm ranking in the first one-third based on total assets in year *t*-1, and 0 otherwise.
PC	A dummy variable that equals 1 if an independent director is or was a governmental official, delegate of the People's Congress or member of a political consultative conference in a focal firm in year *t*-1, and 0 otherwise.

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Risk-preparedness mechanism and audit quality: Evidence from mandatory increase of professional indemnity insurance and professional risk fund

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ABSTRACT

We examine the risk-preparing benefits of Chinese audit firms' professional indemnity insurance (PII) and professional risk fund (PRF) by using the *Notice on Adjusting the Application Requirement of Audit Firms for Securities Qualifications* as an exogenous shock. This policy requires audit firms to raise the sum of the cumulative compensation limit of their PII and PRF from 6 million to 80 million yuan. It is found, first, that the capital market regards this policy revision as a signal to strengthen investor protection and responds positively; client firms with high audit risks have a stronger response. Second, auditors' governance of financial information has strengthened, resulting in the significant improvement of their clients' financial reporting quality, with a stronger effect on firms with higher earnings management risk. There is no evidence that audit firms pass the costs on to their clients. Finally, the mismatch between auditors and new client firms is alleviated. We show that in an emerging market with weak investor protection, establishing a sound risk-preparedness mechanism for audit firms and strengthening the capacity for civil compensation ex post greatly improve the adaptive degree between international auditing standards and the legal environment of China, thereby enhancing the overall service quality of the audit market.

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1. Introduction

In economies with relatively sound class action systems, such as the United States (U.S.) and the United Kingdom (U.K.), the purchase of professional indemnity insurance (PII) is the main means by which auditors prepare for potential professional risks. The annual insurance premium of the international Big Four audit firms accounts for 8 % of their business income (Tang and Zhou, 2018). The U.K., Australia, Singapore and other countries stipulate that audit firms and members of audit associations should be covered by PII. In China, audit firms are free to choose PII or the professional risk fund (PRF) to prepare for potential litigation risks, and the total amount of both should meet the minimum limit requirements. PRFs entail setting aside a portion of an audit firm's annual revenue as a reserve for potential civil compensation and related legal costs. If the audit firm assumes liability in civil litigation, it can allocate the compensation from the accumulated PRF (Xu and Zhang, 2012). In contrast, PII for auditors is a professional insurance service provided by a third-party insurance company specifically for the certified public accountant (CPA) industry. Once an insurance contract is established, the insurance company covers any economic losses as well as compensation payable to a plaintiff due to the covered auditors' negligence in the auditing process (Peng and Zhang, 2013). Thus, PII and PRF form audit firms' main mechanism of risk-preparedness and source of funds to pay legal costs, guaranteeing the firms' ability to compensate potential litigants and to protect their investors' interests and the public interest to a certain extent. On 30 July 2021, a notice titled *Opinions of the General Office of the State Council on Further Standardizing the Order of Financial Audit and Promoting the Healthy Development of the Certified Public Accountant Industry* was issued in the name of the State Council, requiring audit firms to improve their audit risk–bearing capacity and strengthening supervision on the provision of PII and PRF. Article 12 of the notice lists its goals:

> Improve the audit risk-taking capacity of audit firms. Improve the PII system and revise the *Interim Measures for Professional Indemnity Insurance of Audit Firms.* Take full account of the objective differences in customer groups and risk status of audit firms and refine the insurance amount and other relevant requirements according to the development of the capital market as well as the status quo of securities business. Strengthen supervision over the provision of PII and PRF, standardize the management and use of PRFs and urge audit firms to improve their risk-prevention capabilities. Explore the implementation of industry-concentrated insurance.

Theoretically, there are two competing explanations for the economic effects of PII and PRFs. The first explanation is that PII and PRFs play a positive governance role, while helping audit firms alleviate professional risks, which in turn facilitates the development of high-quality audit services. The third-party PII provider plays a dual role of knowledge-provider and external supervisor. Frank et al. (2021) find that insurance companies have the motivation and ability to share and transfer risk management knowledge to the audit firms that they insure through free consulting services, premium incentives and other mechanisms. Audit firms can better avoid risks and raise their standards of service by absorbing such risk-control knowledge and making full use of insurance companies' advice. Furthermore, as the settlement costs that the insurance companies must pay out depend on the insured audit firms' business level and litigation risk, insurance companies are also motivated to supervise auditors, whose audit quality and credit level shall be enhanced by the insurer's supervision (Ben Shahar and Logue, 2012). As for PRFs, they tie up funds, which could result in substantial opportunity costs. Furthermore, to avoid the need to replenish PRF accounts when the funds are used, which increases the opportunity cost, audit firms are likely to engage in less risk-taking behavior, which ultimately has a positive impact on audit quality (Deng et al., 2021). The funds accumulated in a PRF account also help to maintain auditors' risk awareness (Xue et al., 2020).

The opposing explanation of the effects of PII and PRFs highlights possible negative implications. Specifically, although the risk-transfer effect of PII and PRFs helps audit firms to control potential civil compensation risks, it also weakens the deterrent effect of legal punishment, and the resulting low litigation risk may induce low-quality audit services (Lennox and Li, 2012; Chy et al., 2021). Driven by the moral hazard problem, auditors who hold PII or PRFs may reduce their diligence and prudence in the process of audit work and, ultimately, reduce the audit quality (Wang et al., 2020).

However, due to data limitations and other reasons, empirical research on auditors' PII and PRFs remains scarce. There are only a few studies using data from China. Using proprietary information from 2010 to 2012 about Chinese audit firms' PII, Qiu and Wu (2014) investigate audit firms' characteristics of demand for PII. Wang et al. (2020) find that audit quality is significantly improved after small audit firms purchase PII and perceive that the improvement in audit quality is due to the external supervision role of the insurance company. Xue et al. (2020) find that audit firms with higher PRFs tend to avoid high-risk clients when undertaking audit engagements for the first time. Deng et al. (2021) examine the economic consequences of audit firms' insurance-holding behavior and find that audit firms with larger PRF provisions exhibit a higher probability and magnitude of audit adjustments, whereas audit firms that hold more PII exhibit a lower probability and magnitude of audit adjustments.

Nevertheless, the above studies (Qiu and Wu, 2014; Wang et al., 2020; Xue et al., 2020; Deng et al., 2021) use the amount of PII and PRFs as explanatory variables because of data limitations. However, this amount may stem from internal decisions made by an audit firm after considering its own quality control system, number of CPAs as well as other factors, which may cause endogeneity problems. Xue et al. (2020) call on scholars to look for exogenous shocks in future research so as to better identify causal problems. In this study, we use the *Notice on Adjusting the Application Requirement of Audit Firms for Securities Qualifications* (Notice [2012], or policy revision) as an exogenous shock to determine the implications of Chinese audit firms' risk-preparedness mechanisms, specifically PII and PRFs. According to Notice [2012], audit firms are required to raise the sum of the cumulative compensation limit of PII and PRFs from 6 million to 80 million yuan. The compulsory increase in the amount of PII and PRFs provides an excellent experimental scenario in which to examine the economic consequences of PII and PRFs, which will help to overcome the endogeneity problems encountered in previous studies.

We find that, first, investors have a positive market reaction to the policy of the Ministry of Finance to mandate audit firms' increase of the total amount of PII and PRFs, and we find that the positive reaction is stronger for non-state-owned firms, new client firms, small client firms and firms with high earnings management risk in this event window. In other words, investors regard the policy revision as a signal that audit firms' compensation ability and capacity to defend against risk will improve. This indicates the prospect of strengthening investor protection, resulting in a positive response. Second, we find that audit firms' PII and PRFs play a more positive role and client firms' financial reporting quality is improved following the policy revision. A more obvious improvement is found wherein the client firm is identified as the firm with higher risk of earnings management. We find no evidence that audit firms pass the input costs of PII and PRFs on to their clients; thus, there is no evidence that audit fees increase simultaneously with the policy revision. Finally, after the policy revision, the mismatch between auditors and new firm clients has also been alleviated.

We contribute to the literature and practice in several ways. First, we extend the research on PII and PRFs (Qiu and Wu, 2014; Xue et al., 2020; Deng et al., 2021). We examine the risk-preparing benefits of PII and PRFs in audit firms by using the quasi-experimental setting provided by compulsory policy revision, which can better establish causal relationships and alleviate endogenous problems more effectively.

Second, we verify part of the conclusions of Simunic et al. (2017) regarding the Chinese legal system and audit quality from a theoretical perspective. Simunic et al. (2017) propose that although China adopted the International Standards on Auditing (ISA), its low-risk legal and institutional environment render ISA unsuitable. To address this, China may create a legal environment that is more suitable for the effective play of ISA by perfecting the securities market litigation law as well as the risk-preparedness mechanism of audit firms, thereby improving the overall service quality of the audit market.

Third, we contribute to the theory and research on audit quality by examining a mechanism based on auditor allocation optimization that possibly links PII and PRFs to enhanced audit quality. Research typically confirms the positive effect of PII and PRFs on audit quality, attributing it to the external supervision function of insurance companies after audit firms purchase PII. However, the regulatory motivation and capacity of insurance companies are controversial (Arrow, 1963; Pauly, 1968). Our findings respond to questions posed by Wu (2009) about how to mitigate the mismatch anomaly of auditor resources through system design. Audit firms can mitigate the risk-aversion behavior of individual auditors by preparing for litigation risk and encouraging experienced auditors to undertake engagement of new client firms, especially high-risk firms, thereby ensuring the audit quality for new clients.

Finally, our findings offer policy implications. We analyze the effects of audit firms' internal risk-preparedness mechanisms (i.e., PII and PRFs) on auditor behavior and audit quality. Our findings provide a reference for regulators and audit firms by clarifying the mechanisms and determining the efficacy of the two risk-prevention alternatives.

2. Institutional background and policy changes

Since the establishment of China's capital market in the 1990 s, China's policy regarding audit firms' PII and PRFs and the associated regulations have undergone many changes. Regulations on audit firms' PRFs dominated the early period. Subsequently, with the development of the insurance industry, PII of audit firms has also seen vigorous development. In this section, we summarize the chronological evolution of the PII and PRF system in China's audit firms.

In December 1993, the Ministry of Finance promulgated the *Trial Procedures for the Establishment and Approval of Partnership Audit Firms*, in which Article 16 stipulates, "Partnership audit firms should set up a fund to protect against malpractice risks or purchase professional indemnity insurance. The amount of funds withdrawn each year shall not be less than 10 % of audit firms' business income." In 1994, the Ministry of Finance issued the *Interim Provisions on Certain Issues of Audit Firms' Financial Management*, Article 10 of which reads, "[A] PRF shall be accrued yearly at 10 % of business revenue as a reserve for inevitable work mistakes," again clarifying that audit firms must reserve part of their business income to fund possible civil litigation compensation.

In October 2005, the Ministry of Finance promulgated the *Management Measures for PRF in Audit Firms (Draft)*. Article 9 states, "If the balance of risk funds stored in the special account reaches more than 3 times the average annual audit business revenue of the audit firm in the last three years, or the balance of risk funds reaches more than 5 times the average annual audit business revenue in the last three years, the withdrawal may be suspended." This addresses the ceiling problem of PRF by limiting the total amount of risk funds to be held in reserve.

In March 2007, to encourage audit firms to "enhance their awareness of professional liability risks and improve their ability to resist professional liability risks," the Ministry of Finance formulated the *Management Measures for PRF in Audit Firms*. Article 3 states, "Audit firms shall accrue PRF yearly based on the audit business revenue, at a proportion of no less than 5 %," thereby reducing the reserving ratio from 10 % to 5 %. In addition, Article 4 points out that audit firms can also build up their capacity to protect themselves against risks by purchasing PII, which may be used to offset the amount of PRF accrued in the insurance benefit year according to a certain proportion.

In April 2007, the *Notice of the Ministry of Finance and China Securities Regulatory Commission on Issues Concerning Audit Firms Engaging in Securities and Futures Related Businesses* (Notice [2007]) set forth the following requirement: "[W]hen applying for securities qualification, audit firms shall meet the following conditions.... Fifthly, the sum of the accumulative compensation limit of the PII of the audit firm and the accumulative PRF shall not be less than 6 million yuan." In January 2010, the Ministry of Finance issued the *Interim Measures for the Management of Branch Offices of Audit Firms*, Article 11 of which stipulates that "audit firms should uniformly purchase PII or accrue PRF." According to these two regulations, China's audit firms can freely choose PII and/or PRFs to deal with potential litigation risks, and the total amount available from the two alternatives should reach the minimum requirement of 6 million yuan.

In 2012, the Ministry of Finance set new PII and PRF minimum limits for audit firms. On 30 January 2012, the Ministry of Finance promulgated Notice [2012], revising audit firms' mandatory amount of reserves to protect against litigation risk, stating, "The sum of the compensation limit of PII and accumulated PRF should be no less than 80 million yuan.".

In June 2015, the Ministry of Finance and the China Insurance Regulatory Commission issued the *Interim Measures for PII of Audit Firms*, of which Article 3 states, "Audit firms are encouraged to hold PII according to the operation situation and development needs. If the accumulative compensation limit of PII insured by an audit firm reaches the amount prescribed in Article 9 or 10 of these Measures, the audit firm shall no longer accrue PRF." Articles 8 to 10 provide for the accumulative compensation limit of PII, for example, "For audit firms engaged in high-risk audit services such as listed companies and financial enterprises, the accumulative

Table 1
Policy adjustments involved in Notice [2012].

Revised content	Notice [2007]	Notice [2012]
Establishment time	Established for more than 3 years	Established for more than 5 years
Business revenue	Business revenue from audit engagements of the previous year should be no less than 16 million yuan.	Prior year business revenue shall be no less than 80 million, of which revenue from audit engagements should be no less than 60 million yuan.
Number of CPAs	No fewer than 80 auditors; no fewer than 35 auditors who have held a CPA certificate in the last 5 years and have been working continuously	No fewer than 200 auditors; no fewer than 120 auditors who have held a CPA certificate in the last 5 years and have been working continuously
Number of audit partners	–	At least 25 audit partners
PII and PRFs reserve amount	**No less than 6 million yuan**	**No less than 80 million yuan**
Other aspects	–	Additional requirements for securities qualified audit firms to set up branches, etc.

compensation limit shall not be less than the higher amount calculated according to the following two methods: (1) the product of 1 million yuan and the number of partners; (2) 50 million yuan ..."

Audit firms are free to choose PII and/or PRFs to prepare for litigation risk; however, most audit firms chose to use only PRFs before 2010. Starting in 2010, regulators began to promote organizational restructuring for audit firms, and such firms took on more risks. Against this background, audit firms began to purchase PII, transferring part of their professional risks to insurance companies. By the end of 2010, about 63 % of securities-qualified audit firms had purchased PII. By the end of 2015, the PII purchase rate had reached 92 % (excluding the Big Four audit firms) (Qiu and Wu, 2014). Thus, audit firms began to use both PII and PRF to cushion themselves against potential civil litigation risks. Meanwhile, the Ministry of Finance encouraged audit firms to hold more PII. As the *Interim Measures for PII of Audit Firms*, issued in 2015, pointed out, "Audit firms established before the implementation of these measures are encouraged to complete the transition from accruing PFR to holding PII as soon as possible within 5 years."

3. Research questions and hypotheses

3.1. Market response to increase of audit firms' PII and PRF compensation amounts

We take the release of Notice [2012] as the research event. Notice [2012] revises the mandatory amount of audit firms' reserves to address litigation risk; specifically, it states that "the sum of compensation limit of PII and accumulated PRF should be no less than 80 million yuan." The policy revision adjusts the criteria for securities qualification, including audit firms' size, business revenue, number of CPAs, time since establishment and PII and PRFs reserves. To achieve a more nuanced understanding of the revised content of Notice [2012] and ensure that the substantive revised content is relatively "clean" for further event study research, we compare the original text of Notice [2007] to Notice [2012] and summarize the policy adjustments in Table 1, below. Notably, the increase in the required sum of PII and accumulated PRF compensation amounts from 6 million yuan to 80 million yuan represents an increase of over one order of magnitude. This kind of substantive change shows the determination of the Ministry of Finance and the China Securities Regulatory Commission (CSRC) to require audit firms to improve their risk-resistance ability, especially with respect to civil compensation ability *ex post*.

We also conduct a comparative analysis of audit firms' policy adjustment items before (i.e., in 2011[1]) and after (i.e., in 2012) the policy was promulgated, based on information about the top 100 audit firms disclosed

[1] As audit firms only disclosed their business revenue information in 2011, the information regarding revenue from audit engagements and CPAs' age range in Table 2 are from 2009 or 2010.

Table 2
Audit firms' revenue and number of certified public accountants in 2010 and 2012.

Year	Audit firm	Rank	Business revenue (million [yuan])	Revenue from audit engagements (million [yuan])	Number of CPAs	Number of CPAs under the age of 35
2011	HuaMing (Ernest & Young)	3	2,277.49	1,861.11	816	844
2012	HuaMing (Ernest & Young)	4	2,236.46		884	
2011	TianYuanQuan	41	115.25	60.09	179	97
2012	TianYuanQuan	39	118.48		223	
2011	BeiJingXingHua	19	354.14	169.59	526	228
2012	BeiJingXingHua	16	524.81		509	
2011	YongTuo	26	175.78	87.22	293	191
2012	YongTuo	26	186.83		314	
2011	BeiJingZhongZhengTianTong	38	142.85	52.70	247	142
2012	BeiJingZhongZhengTianTong	37	161.17		253	
2011	HuaZhen (KPMG)	4	1,928.42	1,507.26	588	643
2012	HuaZhen (KPMG)	6	2,135.76		615	
2011	DaHua	10	820.30	397.06	868	407
2012	DaHua	10	1,020.98		960	
2011	DaXin	11	986.58	393.85	826	390
2012	DaXin	7	1,591.56		1,056	
2011	Huayong (Deloitte & Touche)	2	2,928.44	1,655.95	728	670
2012	Huayong (Deloitte & Touche)	2	3,044.51		747	
2011	FuJianHuaXing	42	90.83	62.52	121	94
2012	FuJianHuaXing	40	102.39		154	
2011	ZhengZhongZhuJiang	40	117.99	55.64	123	86
2012	ZhengZhongZhuJiang	35	152.03		133	
2011	GuoFuHaoHua	9	887.48	433.52	899	553
2013	RuiHua	3	2,775.93		2,335	
2011	HuaPuTianJian	21	335.62	109.74	263	144
2012	HuaPuTianJian	25	342.32		268	
2011	HuaYin	56	119.46	60.39	264	143
2012	HuaYinWuZhou	18	354.10		440	
2011	GongZhengTianYe	29	211.96	111.12	135	70
2012	GongZhengTianYe	29	224.04		158	
2011	SuYaJinCheng	28	203.77	112.07	173	82
2012	SuYaJinCheng	24	323.27		206	
2011	TianHeng	31	203.37	107.38	139	95
2013	TianHeng	21	414.42		284	
2010	JingDuTianHua	16	346.79	263.52	482	320
2011	LiXin	5	1,703.27	490.94	1,431	502
2012	LiXin	5	2,162.82		1,612	
2011	LiXinZhongLianMinDu	39	115.16	49.91	147	94
2012	LiXinZhongLianMinDu	30	182.54		290	
2011	LiAnDa	17	390.62	304.22	676	533

Table 2 (*continued*)

Year	Audit firm	Rank	Business revenue (million [yuan])	Revenue from audit engagements (million [yuan])	Number of CPAs	Number of CPAs under the age of 35
2012	LiAnDa	19	434.62		525	
2011	ZhongTian (PricewaterhouseCoopers)	1	2,956.74	2,438.84	771	651
2012	ZhongTian (PricewaterhouseCoopers)	1	3,226.29		895	
2011	ShanDongZhengYuanHeXin	53	60.65		114	
2012	ShanDongZhengYuanHeXin	76	69.21		113	
2011	ShangHaiShangHui	47	99.62	78.58	135	94
2012	ShangHaiShangHui	43	111.38		128	
2011	ShangHaiZhongHuaHuYin	25	266.63	124.46	167	89
2012	ShangHaiZhongHuaHuYin	23	323.87		252	
2011	SiChuanHuaXin (Group)	36	120.91	63.08	195	71
2012	SiChuanHuaXin (Group)	34	157.54		214	
2011	TianJian	7	911.22	385.17	1,047	587
2012	TianJian	8	1,105.15		1,169	
2011	TianZhiGuoJi	12	768.83	345.80	704	477
2012	TianZhiGuoJi	11	811.95		714	
2011	Sigmar	37	116.77	66.43	178	107
2012	Sigmar	31	167.84		221	
2011	Shinewing	8	841.39	439.08	1,051	817
2012	Shinewing	9	1,041.03		983	
2011	AsiaPacific (Group)	45	85.08	36.23	217	114
2012	AsiaPacific (Group)	41	114.21		252	
2011	ZhiTong	13	676.76		701	
2012	ZhiTong	12	746.13		724	
2011	ZhongHui	15	486.43	67.54	217	165
2012	ZhongHui	14	529.23		269	
2011	ZhongQinWanXin	24	194.57	126.60	320	225
2012	ZhongQinWanXin	27	244.27		316	
2011	ChinaAuditAsiaPacific	14	468.86	351.91	575	389
2012	ChinaAuditAsiaPacific	13	572.32		642	
2011	Jonten	22	242.78	101.12	321	191
2012	Jonten	20	351.28		394	
2011	ZhongXi	46	133.91	65.23	206	115
2012	ZhongXi	38	162.75		243	
2011	ZhongXingCaiGuangHua	20	261.38	71.70	545	170
2012	ZhongXingCaiGuangHua	17	880.75		563	
2011	ZhongZhun	30	205.05	146.13	370	227
2012	ZhongZhun	28	235.32		308	
2011	Union Power	18	374.84		343	
2012	Union Power	15	440.82		353	

by CISA every year. We present the results in Table 2, below. In view of the policy adjustments involved in Notice [2012], we find that the 40 audit firms applying for securities qualification all have a long history, having been registered and engaged in the audit business since 2000 or earlier. Therefore, the adjustment of audit firms' required establishment time in Notice [2012] is shown to have no effect. Second, in terms of audit firms' revenue, nearly all of the firms reached the new criteria of 80 million yuan (total business revenue) and 60 million yuan (revenue from audit engagements) before the promulgation of Notice [2012]. Most of the firms also met the requirement of 200 auditors before that time. Given that we cannot obtain the number of employees holding CPA certificates in audit firms in the previous 5 years, we use the number of CPAs under the age of 35 disclosed by CICPA to roughly estimate the figure. We find that most of the audit firms reached the criteria of 120 auditors before Notice [2012] was promulgated.

As audit firms' business revenue and number of talents met the new requirements before Notice [2012] was promulgated, the audit firms were more likely to focus on increasing their PII and PRF reserves, thereby improving their *ex ante* risk resistance capacity and civil compensation ability *ex post*. Therefore, we propose that after the implementation of Notice [2012], the main regulatory pressure perceived by audit firms concerned the areas in which they had not yet met the requirements, that is, the amount of PII and PRF reserves. Against this background, we take Notice [2012] as an exogenous policy revision requiring audit firms to increase the amount of their PII and PRFs reserves.

On the one hand, from the perspective of client firms and investors, the development of CPAs' PII and PRFs guarantees compensation for client firms' losses, improves the social reputation of audit firms and safeguards the interests of investors and the public. We expect that investors took Notice [2012] as a strong signal regarding the improvement of audit firms' capacity to withstand risks and the improvement of investor protection, causing a positive stock price reaction in the capital market. On the other hand, according to the moral hazard hypothesis, the audit firms' responsibility for compensating for litigation losses is transferred to the insurance companies, which greatly reduces the deterrent effect of litigation (Götze and Gürtle, 2020). That is, driven by the moral hazard problem, auditors may reduce their diligence and prudence in their performance of audit work, thus reducing the credibility of the financial reports, which may generate negative reactions from investors. Given the potential positive and negative effects of the mandatory increase in the total amount of PII and PRF reserves, it is unknown whether and in what direction the market reacts to such a policy revision. Based on the above discussion, we propose the following alternative hypotheses:

H1-a. There is a positive response in the capital market after audit firms are compelled to increase their PII and PRF reserves.

H1-b. There is a negative response in the capital market after audit firms are compelled to increase their PII and PRF reserves.

We further consider the impact of cross-section differences between client firms in reaction intensity. There are differences in audit risks between client firms. Smaller firm size, greater potential legal risk, lower corporate governance efficiency, lower audit firm reputation and lower customer concentration, *ceteris paribus*, result in greater client firm audit risk (Wang et al., 2014). Audit firms should carefully consider such factors when pricing audit services for high-risk firms. This type of listed company, specifically non-state-owned enterprises, new client firms, firms with small size and those with high earnings management risk may be associated with greater audit risk and are more likely to make false statements (Wu et al., 2010).

Investors of such listed companies may perceive higher risk and may, therefore, have higher expectations for the insurance efficacy of financial audits and be more concerned about the compensation capacity of audit firms. That is, investors of different types of client firms may have reacted differently to Notice [2012]. On the one hand, investors may perceive a new requirement that audit firms be more fully prepared for potential litigation risks as meaning that their invested capital is guaranteed to a greater extent, leading to a positive stock price reaction in the capital market. On the other hand, if investors are more concerned about auditors' moral hazard problem caused by an increase of the PII and PRF quota, they are more likely to have a negative atti-

tude toward firms with high audit risks, thereby inducing a negative stock price reaction in the capital market. Therefore, determining the relationship between the cross-sectional differences of client firms and the associated market reaction should provide a more nuanced understanding of the reaction to the policy revision in the capital market as well as the effect of Notice [2012] expected by investors. Such a determination lays the groundwork for further research on the actual economic consequences of the policy. Based on the above inferences, we propose the following hypotheses:

H2-a. After the mandated increase of audit firms' PII and PRF reserves, the capital market responds more positively to listed companies with high audit risk.

H2-b. After the mandated increase of audit firms' PII and PRF reserves, the capital market responds more negatively to listed companies with high audit risk.

3.2. Economic effect ex post of mandatory increase of audit firms' PII and PRF reserves

3.2.1. Audit quality effects

Audit firms' risk-preparedness behavior of purchasing insurance may have both positive and negative effects on audit quality. On the one hand, as discussed above, third-party insurance companies have the incentive to share risk management knowledge with the insured audit firms and to play an active external supervisor role, leading to improved audit quality (O'Sullivan, 1997; Donelson and Yust, 2017; Frank et al., 2021).

At the underwriting stage, an insurer calculates premium rates based on the insured audit firm's history of litigation, industry reputation and internal quality control management system. Article 7 of the *Interim Measures for PII of Audit Firms* issued by the Ministry of Finance and the CIRC on 30 June 2015 states, "Insurance companies shall establish a market-based floating premium rate mechanism and adjust the premium rate according to the risk status as well as the historical payout records of audit firms, so as to promote the strengthening of quality control and risk management of audit firms," clearly requiring insurance companies to examine the litigation risk and industry reputation of the audit firms they insure. Therefore, to obtain more favorable premium rates, audit firms require better internal management systems and may develop a positive tendency to guarantee the quality of their own services. At the same time, as insurance companies' claim-settlement costs depend on the business acumen and litigation risk levels of their audit firm clients, insurers are also motivated to supervise the auditors, thereby improving their audit quality and credit level (Ben-Shahar and Logue, 2012; Donelson and Yust, 2017). In addition to this external supervision, the insurer also provides knowledge to its auditor clients. Frank et al. (2021) find that insurance companies have the incentive and ability to share and transfer risk-management knowledge to the audit firms that buy their insurance. Insurers can transfer such knowledge through a variety of mechanisms, including free advisory services and premium incentives. Audit firms, especially small audit firms with limited resources, rely on and benefit from this knowledge. By taking advantage of insurance companies' extensive knowledge of risk management and heeding their advice, audit firms can better understand the risks they face in a particular engagement, position themselves accordingly and reduce the losses associated with their audit services (O'Sullivan, 1997).

On the other hand, according to the risk transfer effect of insurance and the moral hazard hypothesis, PII enables audit firms to transfer part of their litigation risk to insurance agencies, reducing the *ex-post* compensation risk of auditors, thereby possibly inducing opportunistic behaviors (Gillan and Panasian, 2015; Götze and Gürtle, 2020; Deng et al., 2021). Insurance is often considered as an *ex-post* compensation mechanism to reduce the cost of risky activities through risk pooling and risk transfer and is now widely used in a number of areas, such as food safety, personal safety and securities (Ben-Shahar and Logue, 2012). As a kind of liability insurance, PII provides policyholders with protection against litigation risk. By paying a small premium, auditors can pass on part of their loss to the insurance industry. As the insurer assumes the role of payer of last resort, PII mitigates the professional risk of auditors, diminishes the deterrent effect of legal discipline and reduces the cost of audit failure (Wang et al., 2020). Studies show a positive correlation between litigation risk and audit quality. That is, higher litigation risk encourages auditors to work hard, whereas lower litigation risk is more likely to induce lower-quality audit services (Lennox and Li, 2012; Rothenberg, 2019; Chy et al., 2021). Francis and Krishnan (2002) and Lee and Mande (2003) find that following the passage of

the Private Securities Litigation Reform Act[2] (the Act) by the U.S. Congress, the exposure of audit firms to civil litigation decreased, resulting in U.S. auditors' becoming "less strict" with their clients and an increase in client firms' discretionary accruals. Moreover, the impact was more pronounced for larger audit firms. The U. S. Big Six audit firms were less likely to issue modified audit opinions after the Act, whereas this effect was not seen in the non-Big Six audit firms (Geiger et al., 2006). Similarly, the Notice [2012] adjusted audit firms' amount of risk-preparedness—that is, the sum of cumulative compensation limit of PII and PRF reserves—from 6 million to 80 million yuan. Under this mandatory requirement, audit firms may accrue more in PRFs or hold more PII to absorb part of the civil liability risk internally by accumulating risk funds or transfer part of the risk to third-party insurers, respectively. These two litigation-risk responses serve to control audit firms' potential legal exposure, which may have a negative impact on audit quality and may induce *ex ante* opportunistic behavior on the part of auditors (Götze and Gürtle, 2020). Gillan and Panasian (2015) find that management's diligence and prudence decrease when companies purchase their directors' and officers' liability insurance (D&O liability insurance). By the same token, it can be surmised that auditors who hold PII, driven by moral hazard, are less diligent and prudent in the course of their audit work, ultimately compromising audit quality.

In the case of audit firms' PRF, the risk compensation effect and the potential moral hazard issues have a negative impact on audit quality. However, the problems of idle capital cost (opportunity cost) and the large amount of funds accumulated in audit firms' PRF account may help to maintain auditors' risk awareness and thus improve the quality of audits. The annual accrual of an audit firm's PRF is transferred to its dedicated risk fund account after the year-end closing of the accounts. If the audit firm suffers a civil lawsuit and assumes compensation liability, it may first pay from the risk fund account (Xu and Zhang, 2012). It follows that PRF can only be used for civil litigation payouts and cannot be easily diverted to other uses. However, the number of civil cases successfully litigated against audit firms is relatively small, and most audit firms' PRFs have been left idle, resulting in opportunity cost. The requirement in Notice [2012] that auditors accrue more PRF reserves or hold more PII increases the associated opportunity cost; therefore, audit firms prefer not to use the amount of risk funds already accumulated, which would necessitate allocating more funds to the PRF or PII (Deng et al., 2021). For this reason, audit firms may become more conservative when undertaking audit engagements, to avoid having to deplete the accumulated risk fund in the event of audit failure. Furthermore, the risk funds accumulated in audit firms' books serve as a constant reminder of the professional risks faced by CPAs in conducting audits, thereby urging auditors to exercise due professional care in their practice (Xu and Zhang, 2012; Xue et al., 2020).

Moreover, with reference to the incentive effect of D&O liability insurance on management (O'Sullivan, 1997; Ling, 2020), the risk-preparedness mechanism of PII and PRFs somewhat relieves auditors of their risk concerns and mitigates their risk-averse behavior. This may help mitigate the "brain drain" of high-end CPA talents and contribute to the quality of audit services. Examining the allocation of auditors among client firms, Wu (2009) finds that new, high-risk client firms are staffed with less experienced auditors, which is attributed to the personal risk-averse behavior of experienced auditors. Audit firms' PII and PRFs have weakened auditors' fear of litigation for negligence and oversight, thus motivating more experienced auditors to be proactive in contributing to the improvement of service quality in the auditing profession.

Although all Chinese audit firms and the client firms they audit were hit by Notice [2012] at the same time, different audit risks result in different effects from the policy revision. Audit firms received signals from the Ministry of Finance to increase their reserves in preparation for litigation and to improve investor protection. In response, the audit firms applied different risk-management strategies with respect to their more vulnerable client firms (e.g., firms with high audit risk and high earnings management risk), including in the allocation of auditors (Wu, 2009).

To avoid exacerbating opportunity costs by draining their PRFs in litigation, audit firms may take the initiative to raise their awareness of professional risks and mitigate them by implementing more audit procedures when undertaking audit engagements of client firms with higher levels of earnings management risk. Further-

[2] On 22 December 1995, the U.S. Congress passed the Private Securities Litigation Reform Act, which changed the auditors' allocation system of litigation compensation as well as the upper limit of loss compensation, and it changed the unlimited joint and several liability of audit firms in the Securities Act of 1933 and the Securities Exchange Act of 1934 to mixed proportional liability.

more, the risk-management knowledge transferred from insurers to audit firms is especially valuable with respect to such client firms. Insurance companies pay particular attention to audit firms' business modules or clients displaying higher risk and provide targeted risk management advice accordingly. With audit firms' active adoption of their insurers' opinions and knowledge, the quality of such clients' audits is enhanced.

In summary, there are both positive and negative effects of audit firms' PII and PRFs on audit quality; it is not known which effect is superior. Based on the above inferences, the following opposing hypotheses are proposed:

H3-a. After the mandated increase of audit firms' PII and PRF reserves, client firms' financial reporting quality improves, with a more obvious improvement for firms with higher levels of earnings management risk.

H3-b. After the mandated increase of audit firms' PII and PRF reserves, client firms' financial reporting quality declines, with a more obvious decline for firms with higher levels of earnings management risk.

3.2.2. Audit fee effects

As mentioned above, the policy adjustments due to Notice [2012] may have an impact on audit quality, and the resulting changes in audit input, audit costs, legal risks and other factors may also affect the pricing of audits. Simunic (1980) incorporates the audit clients' risk factor into the audit pricing model, and other scholars conduct research and further refine the audit pricing model (Houston et al., 2005). That is, audit fees are mainly influenced by two major components, namely audit costs and risk premiums. On the one hand, PII and PRFs reduce the risk premium and counteract the triggering of audit risk, which in turn may reduce audit fees. Most research supports a positive correlation between legal risk and audit fees (Magnan, 2008; Choi et al., 2018). Seetharaman et al. (2002) examine the impact of the litigation environment in auditors' countries on audit fees and find that auditors seek compensation for the stress and risk associated with high legal risk by increasing their audit fees. With a sample of audit clients from 15 countries with different legal systems, Choi et al. (2008) confirm that a country's litigation environment is an important factor in determining audit effort, audit fees and audit fee differences between Big Four and non-Big Four audit firms.

On the other hand, the amount paid for PII and the opportunity costs caused by charging PRFs against audit firms' revenue may lead to higher audit costs and, ultimately, higher audit fees. As large and small audit firms differ in their ability to absorb premium costs, small and medium audit firms, having relatively weak internal management systems and low wealth accumulation, have a greater incentive to pass on premium costs to audit clients (Wang et al., 2020).

This raises the question of whether the reduced risk premium on audit fees compensates for the increased audit costs and opportunity costs related to increased mandated amounts for audit firms' PII and PRFs. Based on the above inferences, the following opposing hypotheses are proposed:

H4-a. After the mandated increase of audit firms' PII and PRF reserves, client firms' audit fees increase, with a more significant increase for firms with higher levels of earnings management risk.

H4-b. After the mandated increase of audit firms' PII and PRF reserves, client firm's audit fees decrease, with a more significant decrease for firms with higher levels of earnings management risk.

3.2.3. Auditor resource misallocation

Wu (2009) examines personnel allocation in audit firms and finds that small and medium-sized audit firms assign auditors who are insufficiently experienced to new, high-risk client firms. Wu (2009) argues that the anomaly of such auditor mismatching may be due to the risk aversion behavior of experienced auditors. As regulators pay more attention to auditors and audit firms that undertake new clients, this creates resistance in experienced auditors to taking on high-risk clients (Wu, 2009). Wu (2009) raises the question of whether audit firms might adopt mechanisms to mitigate this "mismatch anomaly" and ensure the audit quality of new clients.

Audit firms' PII and PRF systems may alleviate the problem of auditor misallocation. According to the incentive effect of D&O liability insurance on managers (O'Sullivan, 1997; Ling, 2020), the risk-preparedness mechanism of audit firms relieves auditors of extra worries, which may alleviate the risk aversion behavior of individual auditors. Specifically, audit firms' PII and PRFs diminish auditors' fear of being sued for negligence, thus motivating them to engage with high-risk clientele. This may also help to alleviate the brain drain of high-end CPA talents, which is conducive to the improvement of audit service quality.

Research (Qiu and Wu, 2014; Wang et al., 2020; Xue et al., 2020; Deng et al., 2021) confirms the positive effect of PII and PRFs on audit quality but mostly attributes it to the external supervision role of the insurance company. In fact, the motivation and ability of insurance companies to regulate audit firms is a controversial topic (Arrow, 1963; Pauly, 1968). If auditors are more effectively allocated between high-risk, new client firms and old client firms following the policy revision in 2012, can we assume that improved audit quality is partly due to the mitigation of auditor misallocation?

Auditors' personal characteristics, such as industry expertise, years on the job, gender and other demographic characteristics are shown to have effects on audit quality and audit fees (Luo et al., 2014; Wang et al., 2014; Han, 2016). Chin and Chi (2009) find that auditors' industry expertise can reduce the occurrence of financial report restatement. Chen et al. (2008) find auditors' experience to lead to a significant decline in client firms' absolute value of discretionary accruals after controlling audit firms' tenure, in the setting of Taiwan's double-auditor signature system. Liu et al. (2010) document that auditors' industry expertise can improve audit quality in China's audit market. Yuan and Han (2012) investigate further through role-division of two auditors and find that the industry specialization and audit experience of the engagement audit partner can significantly improve the audit quality, while these characteristics of the review partner do not significantly affect audit quality. Pan et al. (2019) find that these two types of auditors seem to be instrumental in promoting the comparability of firms' accounting information.

Studies document the positive correlation between auditors' individual practical experience and audit quality. An auditor's understanding of the macro environment and customers' business modes grows with experience. Experienced auditors are more familiar with the whole audit process, common audit risks in financial reports and accounts prone to error; thus, they are more likely to find client firms' misstatements or intentional manipulations (Wang et al., 2016). Under reputation theory, as auditors engage in more audit projects, the cost of audit failure via reputation loss also increases. Thus, experienced auditors are more motivated to maintain their audit quality (Yuan and Han, 2012). Therefore, we expect that after the mandatory increase of PII and PRFs reserves, the risk aversion behavior of auditors is alleviated and auditors are more effectively allocated among new clients. This may be another potential explanation of the increased audit quality after the policy revision. Based on the above inference, we propose the following hypothesis:

H5: After the mandated increase of audit firms' PII and PRF reserves, the anomaly of auditor misallocation is alleviated, with audit firms assigning more experienced auditors to new client firms with high levels of earnings management risk.

4. Research design

4.1. Research design for H1 and H2

To test H1-a, we adopt the event research method and examine the cumulative abnormal rate of return of the policy revision in the event window, testing the direction and intensity of investor reaction caused by Notice [2012]. Specifically, we regard 30 January 2012 as the event day, and we select the event day as the observation window.[3] We choose the 120 trading days before this event (-31, −150) as the estimation window. The market model ($R_{i,t} = \beta_0 + \beta_1 R_{m,t} + \varepsilon_{i,t}$) is regarded as the predictive model of the normal return of the stock, with which the abnormal return (AR) of a single stock is calculated. Based on this, we calculate the cumulative abnormal return (CAR) of a single stock of a listed company within a given window. We expect

[3] In an event study, the earliest possible date of information release can be selected to avoid the impact of "information dilution." The policy was signed on 21 January 2012; however, according to the announcement on the official website of the Ministry of Finance, Notice [2012] was publicly issued on the official website for the first time on 30 January 2012. Therefore, we select this date as the event date in this study. After changing the event window to (-1, +1), (0, 1), (-2, +2) and other commonly used windows, the results remain significant.

that on the event day, the abnormal return of all sample firms is significantly greater than 0 (H1-a) or significantly less than 0 (H1-b).[4]

To test H2, we construct the following multivariate regression model:

$$AR = \beta_0 + \beta_1 Treat + \beta_2 Nonsoe + \beta_3 Newclient + \beta_4 Firm\_size + \beta_5 Controls + \beta_6 \times \sum Industry + \varepsilon \quad (1)$$

where the dependent variable, *AR*, is the abnormal return of a single stock of an A-share listed company on the day of the event. The main variables of concern are client firms' earnings management risk (*Treat*), a variable identifying whether it is a non-state-owned enterprise (*Nonsoe*), a variable identifying whether it is a new client for audit engagement (*Newclient*) and the firm size (*Firm_size*). We also control the relevant characteristics of listed companies in the year before the incident, including *Lev*, *Roa* and *Big4*, and we control the fixed effects of industry.

4.2. Research design for H3 and H4

As China's accounting and auditing policies are mostly implemented nationwide, affecting all audit firms and the listed companies that they audit, it is difficult to use the traditional difference-in-differences design to divide the research samples into a treatment group affected by the policy and a control group unaffected by the policy. However, although all of the client firms are affected by the mandatory increase of the PII and PRF quota in 2012, the degree of influence differs according to the firms' levels of audit risk. Referring to Li et al. (2020), we use the influence intensity of Notice [2012] on each firm to group the treatment firms and control firms. As client firms with high levels of earnings management risk possess more audit risks and stronger motivation to make false statements, the auditors of those firms are more likely to assume the associated liability for compensation due to audit failure. In other words, firms with high levels of earnings management risk are more vulnerable to the policy revision. If the client firm's earnings per share is between 0 and 0.01, for the purpose of avoiding supervision, it may control profits through earnings management. The audit risk level of such small-profit enterprises is relatively high (Li and Zhou, 2013). Therefore, in this study, client firms with high levels of earnings management risk are regarded as the treatment group, which is more influenced by Notice [2012]. If the client firm belongs to the treatment group, the variable *Treatment* is set to 1, and 0 otherwise. The PII and PRF–related policy revision leads to differences in the same client firm with the same audit firm before and after the policy as well as differences between firms with different audit risk levels at each time point. The estimation based on a difference-in-differences model effectively controls the influence of other coinciding factors and *ex-ante* differences in firms' characteristics. Thus, the causal effect brought by the policy revision is identified.[5]

To test H3 and H4, we construct the audit quality model (2) and audit fee model (3) as follows:

[4] To eliminate the influence of other information released on the event date as much as possible, we also conduct the following work. Referring to the practice of Li and Shen (2010) and Xu and Xin (2011), we rule out media events in the *China Securities Journal*, *Securities Daily*, *Securities Times*, *Shanghai Securities News*, *China Business*, *21st Century Business Herald*, *Economic Observer* and *China Business News*, which are the eight most widely influential, well-known and authoritative national financial newspapers in China. The original reports from these papers are recorded in a Chinese major newspaper full-text database. We do not find any other good economic news on 30 January 2012 concerning the A-share market. In the absence of other major good news, if a significant positive anomaly in the capital market on the event day is found in this study, we assume that it is related to the issuance of Notice [2012].

[5] To exclude the influence of other alternative explanations as much as possible, we manually collect data regarding the sum of the audit firms' cumulative compensation limit of PII and PRF in the earliest available year (2018). We attempt to explain the effect of PII and PRFs on audit quality, audit fee and auditor allocation from the perspective of the degree of increase in audit firms' PII and PRFs. As of 2018, the PII and PRF reserves of only six of the audit firms exactly reached the mandatory requirement of 80 million yuan in Notice [2012] (the "mandatory meet" group), while the other 34 audit firms voluntarily accrued excess PII and PRF reserves (the "voluntary excess" group). We perform a grouped regression on models (2)–(4) according to whether the audit firms voluntarily accrued excess PII and PRFs. The empirical results show that only in the "voluntary excess" group do PII and PRF reserves have a significant effect on improving audit quality and alleviating auditor mismatch, and only in the "mandatory meet" group do audit fees increase after the policy is enacted. We believe that audit firms that voluntarily accrue excess PII and PRF reserves are more affected by Notice [2012] than the audit firms that barely meet the threshold of 80 million. Therefore, the impact of Notice [2012] on improving audit quality and mitigating auditor misallocation of "mandatory meet" audit firms is more obvious.

$$DA = \beta_0 + \beta_1 Post + \beta_2 Treat + \beta_3 Post * Treat + \beta_4 Controls + \beta_5 \sum Industry + \varepsilon \quad (2)$$

$$Auditfee = \beta_0 + \beta_1 Post + \beta_2 Treat + \beta_3 Post * Treat + \beta_4 Controls + \beta_5 \sum Industry + \varepsilon \quad (3)$$

where *POST* is a time indicator variable, set to 1 after Notice [2012] is issued, and 0 otherwise. We focus on the coefficients of the interaction term *Treat*Post*. According to H3-a, after the enactment of Notice [2012], the financial reporting quality of listed companies is improved due to the active supervision and risk management knowledge-sharing of insurance companies. In contrast, according to H3-b, the audit quality is damaged due to the opportunistic behavior of auditors triggered by the risk-transfer function of PII and PRFs. Thus, we expect the coefficient of *Treat*Post* in model (2) to be significant, but we are uncertain about the sign direction. In addition, following Heo et al. (2021) and Ernstberger et al. (2020), we also control the fundamental characteristics of listed companies. The control variables in model (2) are *Big4*, *Firm_size*, *Nonsoe*, *Lev*, *Roa*, *Dloss*, *Age*, *BM*, *CFO*, *Newclient* and *Firstshare*. We also control fixed effects at the industry level of the sample[6] and calculate cluster-robust standard errors at the industry level.

According to H4, if the coefficient of *Treat*Post* in audit pricing model (3) is significantly positive, H4-a is verified, indicating that the inhibitory effect of PII and PRFs on risk premiums cannot offset the rising effect of audit cost and that audit fees are ultimately increased after the policy revision. In contrast, if the coefficient of *Treat*Post* is significantly negative, H4-b is verified. Following Hsieh et al. (2020) and Florou et al. (2019), we control characteristics of both audit firms and their clients. Specifically, the control variables are *Big4*, *Firm_size*, *Nonsoe*, *Lev*, *Roa*, *Dloss*, *Age*, *BM*, *Current* and *Inv_rec*. We also control fixed effects at the industry level and calculate cluster-robust standard errors at the industry level.

4.3. Research design for H5

Balsam et al. (2003) point out that auditors' practical experience comes from their accumulation and repeated implementation of the same matters. The number of each auditor's yearly audit engagements varies greatly; therefore, it is not comprehensive to measure an auditor's practical experience by years on the job. Therefore, more recent studies use variables such as the number of auditors' cumulative engagements to measure auditors' personal experience (Wu, 2009; Yuan and Han, 2012).

Han (2016) finds that the number of a review partner's cumulative audit engagements is usually higher than that of an engagement partner (19.733 and 6.113, respectively). Furthermore, the experience and industry expertise of an engagement partner may significantly improve audit quality, while a review partner's does not (Yuan and Han, 2012). In other words, engagement audit partners, who have an impact on the level of audit quality, possess less professional experience than review partners. Therefore, in the current study, we take the natural logarithm of the number of an auditor's cumulative audit engagements as a proxy variable that measures the auditor's work experience, taking the minimum number of projects for which two auditors are responsible. We construct the following multivariate regression model (4):

$$Exp = \beta_0 + \beta_1 Post + \beta_2 Treat + \beta_3 Newclient + \beta_4 Treat * Post + \beta_5 Treat * Post * Newclient + \beta_6 Treat * Newclient + \beta_7 Post * Newclient + \beta_8 Controls + \beta_9 \sum Industry + \varepsilon \quad (4)$$

According to H5, if the coefficient of *Treat*Post*Newclient* in model (4) is significantly positive, H5 is verified, indicating that after Notice [2012] is issued, audit firms tend to allocate more experienced auditors to new clients with greater audit risk (i.e., earnings management risk), and the anomaly of auditor misallocation is alleviated. This may be another explanation for the improvement of audit quality.

4.4. Research sample, variable definitions and data sources

Using China A-share-listed enterprises as the sample, this paper mainly studies the risk-preparing benefits of audit firms' PII and PRFs. We exclude firms in the financial sector, firms with "special treatment" (ST) sta-

[6] As the dummy variable of *POST* is added to models (2)–(4), the time fixed effect is not controlled, to prevent multilinear problems.

Table 3
Variable definitions.

Variable	Definition
AR	The abnormal return in the event window
CAR	The cumulative abnormal return within a given window
DA	The absolute value of discretionary accruals calculated based on the performance-adjusted Jones model
Auditfee	Natural logarithm of audit fees
Exp	Natural logarithm of the number of all previous audit reports of listed companies signed by the auditor (taking the minimum number of projects for which two auditors are responsible)
Post	The time indicator variable that equals 1 after Notice [2012] is issued, and 0 otherwise
Treat	A dummy variable that equals 1 if the client firm's earnings per share is between 0 and 0.01, and 0 otherwise
Firm_size	Natural logarithm of total assets
Nonsoe	A dummy variable representing the nature of the ownership of the company, set at 1 if the firm is a non-SOE, and 0 otherwise
Lev	The ratio of total liabilities to total assets
Roa	The ratio of net profit to total assets
Dloss	An indicator equal to 1 if firms have a negative net profit, and 0 otherwise
Age	Number of years that the firm has been listed
CFO	The ratio of operating cash flow to total assets
Current	The ratio of current assets to current liabilities
BM	The ratio of book value to market value
Inv_rec	The ratio of the sum of total receivables and total inventory to total assets
Newclient	A dummy variable that equals 1 if the firm changes the audit firm in the year, and 0 otherwise
First_share	Percentage of shareholding of the largest shareholder
OP	A dummy variable that equals 1 if previous year's annual report is issued by an auditor with a modified audit opinion, and 0 otherwise

tus and those with missing data. The annual rank of audit firms comes from the CISA website, and other financial data from 2008 to 2015 are drawn from the CSMAR database. All of the continuous variables are winsorized at the 1 % and 99 % levels to mitigate the potential problem of outliers. Table 3 provides the specific definitions of the variables used in this study.

5. Empirical results

5.1. Descriptive statistics

Table 4 reports the descriptive statistics of the main variables. The minimum value of the main dependent variable, *DA*, is 0.0009, and the maximum value is 0.4164, indicating that the quality of financial reports varies between listed companies. This is the prerequisite for us to study the factors affecting the difference in financial report quality between listed companies. It is shown that 51.29 % of the firms are non-state-owned firms and that 8.29 % of the client firms' earnings per share is between 0 and 0.01. This kind of small-profit enterprise has motivation to manipulate profits; therefore, their earnings management risk level is high. The statistical results of the other variables are close to those in previous studies, and no normal value is found.

Table 5 reports the Pearson correlation coefficient among variables, and the results show that *Post* is significantly negatively correlated with *DA* (–0.104) and significantly positively correlated with *Auditfee* (0.202), which indicates that the overall audit quality improved after the release of Notice [2012]. However, the causality must be tested through subsequent regressions. The absolute values of the correlation coefficients among the variables are less than 0.5, indicating that there is no serious multicollinearity problem.

5.2. Market response to mandatory increase of audit firms' PII and PRFs

We choose the event day as the short window and test whether 1,863 client firms' abnormal return on that day is significantly greater than 0. Table 6 reports the *t*-test on abnormal returns on the event day.

Table 4
Descriptive statistics results[7].

Variable	N	Mean	SD	Min.	p25	Median	p75	Max.
AR	1,863	0.0113	0.0159	–0.0232	0.0013	0.0101	0.0196	0.0669
DA	13,264	0.0741	0.0734	0.0009	0.0241	0.0527	0.099	0.4164
Auditfee	13,264	13.5674	0.7294	12.3014	13.1224	13.4588	13.9108	16.3881
Post	13,264	0.6261	0.4838	0	0	1	1	1
Big4	13,264	0.0635	0.2438	0	0	0	0	1
Treat	13,264	0.0829	0.2757	0	0	0	0	1
Firm_size	13,264	22.0188	1.264	19.6887	21.0973	21.8329	22.7386	25.8784
Nonsoe	13,264	0.5129	0.4999	0	0	1	1	1
Lev	13,264	0.4493	0.2107	0.047	0.283	0.4544	0.6163	0.8834
Roa	13,264	0.04	0.051	–0.1494	0.0141	0.036	0.0652	0.194
Dloss	13,264	0.0898	0.2859	0	0	0	0	1
Age	13,264	9.517	6.0896	0	4	9	15	25
Current	13,264	2.41	2.8583	0.2746	1.0432	1.5265	2.4814	19.2405
BM	13,264	0.6076	0.2402	0.1197	0.4196	0.6112	0.7996	1.0876
CFO	13,264	0.0449	0.0746	–0.1864	0.004	0.044	0.0885	0.2496
Inv_rec	13,264	0.2716	0.1771	0.0055	0.1379	0.2457	0.3709	0.784
Newclient	13,264	0.1643	0.3705	0	0	0	0	1
Firstshare	13,264	36.6343	15.5886	0.29	24.03	35.027	47.88	89.99
Exp	12,902	0.4509	0.5172	0	0	0	0.6931	2.3026
OP	12,902	0.0184	0.1343	0	0	0	0	1

Note: The data of 362 audit opinions are missing; therefore, the sample size of auditor allocation model (4) is 12,902.

As shown in Table 6, the abnormal return on the day of the event is significantly greater than 0 at the 1% level. This indicates that when audit firms were required to raise the sum of their cumulative compensation amounts of PII and PRFs from 6 million to 80 million yuan, the security market released a strong signal to strengthen investor protection. In response, investors expected higher audit quality and greater information transparency, which is reflected in a positive response in the capital market. This is consistent with H1-a. The market's average abnormal return (*AAR*) on the event day is 0.011416, indicating that the market as a whole made a positive evaluation and reaction to the release of Notice [2012], which again verifies H1-a.

Based on this, we calculate the cumulative abnormal return (*CAR*) of a single stock of a listed company within the given window (–1, +1). We check whether the cumulative abnormal returns of the 1,863 companies within this window are significantly greater than zero. The *t*-value in Table 7 shows that the cumulative abnormal returns are significantly greater than zero at the 1 % level, which is consistent with H1-a.

In the further transverse check, Table 8 shows the regression results with the abnormal return on event day as the explanatory variable, and with *Nonsoe*, *Firm_size*, *Newclient* and *Treat* as the main observed variables. The results in Table 8 show that the coefficients of *Treat*, *Nonsoe* and *Newclient* are significantly positive, whereas the coefficient of *Firm_size* is negative, which indicates that the market reaction is more obvious for client firms with greater risk of earnings management, as well as for non-state-owned, new client firms of small size. Such firms have greater audit risks, and their investors, accordingly, have greater perceived risks; thus they may hold higher expectations for the insurance effect of financial statement audits and care more about the economic compensation ability of audit firms. Therefore, we find that client firms with higher audit risks have a more positive market reaction within this event window, and H2-a is supported.

[7] There are missing values of the dependent variable *Exp* in model (4); thus, the number of observations is less than 13,264. In addition, because we need only calculate the abnormal market return on the day when Notice [2012] was released, there are only 1,863 observations of variable *AR* in 2012 used in model (1).

Table 5
Correlation coefficients.

Variable	*DA*	*Auditfee*	*Post*	*Big4*	*Treat*	*Firm_size*	*Nonsoe*	*Lev*	*Roa*	*Dloss*	*Age*	*Current*	*BM*	*CFO*	*Inv_rec*	*Newclient*	*Firstshare*
DA	1																
Auditfee	–0.048***	1															
Post	–0.104***	0.202***	1														
Big4	–0.035***	0.519***	–0.029***	1													
Treat	0.031***	–0.009	0.031***	–0.023***	1												
Firm_size	–0.013	0.770***	0.073***	0.388***	–0.055***	1											
Nonsoe	0.040***	–0.215***	0.174***	–0.142***	–0.056***	–0.341***	1										
Lev	0.094***	0.324***	–0.105***	0.105***	0.169***	0.492***	–0.312***	1									
Roa	0.033***	–0.023***	–0.065***	0.043***	–0.607***	–0.017*	0.132***	–0.397***	1								
Dloss	0.027***	–0.001	0.037***	–0.022**	0.943***	–0.046***	–0.064***	0.180***	–0.609***	1							
Age	0.048***	0.238***	0.040***	0.059***	0.097***	0.285***	–0.408***	0.379***	–0.172***	0.108***	1						
Current	–0.031***	–0.242***	0.069***	–0.096***	–0.094***	–0.304***	0.261***	–0.625***	0.224***	–0.101***	–0.305***	1					
BM	–0.023***	0.312***	–0.078***	0.184***	–0.006	0.510***	–0.212***	0.363***	–0.220***	0.001	0.039***	–0.177***	1				
CFO	–0.248***	0.046***	–0.039***	0.085***	–0.152***	0.030***	–0.039***	–0.144***	0.377***	–0.155***	–0.021**	–0.001	–0.122***	1			
Inv_rec	0.176***	–0.030***	0.013	–0.059***	–0.033***	–0.001	0.109***	0.275***	–0.074***	–0.038***	0.004	–0.088***	0.030***	–0.336***	1		
Newclient	0.049***	–0.074***	–0.099***	0.001	0.003	–0.052***	–0.025***	0.001	0.021**	–0.004	–0.064***	0.029***	0.065***	0.010	0.010	1	
Firstshare	0.021**	0.180***	–0.035***	0.146***	–0.052***	0.262***	–0.205***	0.081***	0.082***	–0.051***	–0.058***	–0.056***	0.193***	0.064***	–0.010	0.030***	1

Note: This table presents the Pearson correlation coefficients. *, ** and *** indicate significance at the 0.1, 0.5 and 0.01 levels, respectively.

5.3. Economic effect of mandatory increase of audit firms' PII and PRF reserves on audit quality and audit pricing

Table 9 reports the regression results for models (3) and (4). Column (1) of Table 9 displays the impact of compulsory increase of PII and PRFs on audit quality, namely that the coefficient of *Treat*Post* is significantly negative (–0.0101). The increasing effect of insurance companies' external supervision and risk control knowledge transfer on audit quality offsets the reducing effect of PII's risk transfer and auditors' moral hazard on audit quality, which ultimately leads to the improvement of the financial statement quality of client firms. Thus, H3-a is verified.

Column (2) examines the impact of the compulsory increase in PII and PRF reserves on audit fees. The coefficient of *Treat*Post* is positive (0.0218) but insignificant, indicating that there is no evidence that audit firms transfer the costs of PII and PRFs to their clients, resulting in an increase in audit fees. This finding may be attributed to the fierce competition in China's audit market. As a service provider, the audit firm is weaker in terms of bargaining power than the client; hence, it is difficult for audit firms to transfer the costs of PII and PRFs to their clients. In addition, when negotiating audit fees with audit firms, client firms generally sign the engagement contracts for a term of years to obtain fee discounts, resulting in a slow transmission of the impact of PII and PRF reserve increases on audit fees.

5.4. Economic effect of mandatory increase of audit firms' PII and PRFs on auditor allocation

The results in Table 10 show that the coefficient of the term *Treat*Post*Newclient* is significantly positive, indicating that after Notice [2012] is issued, audit firms tend to allocate more experienced auditors to new clients with greater audit risk, and the risk aversion behavior of individual auditors is alleviated. This may be another explanation for the improvement in audit quality after the mandatory increase in the PII and PRF quotas.

5.5. Robustness tests

5.5.1. Parallel trend test

Following Bertrand and Mullainathan (2003), we incorporate the interaction terms between *Treat* and a series of time dummy variables into model (2) and present the dynamic effect test diagram in Fig. 1, where *pre_1* is a dummy variable that equals 1 for the first year before the policy revision, and 0 otherwise; *current* is a dummy variable that equals 1 for the year Notice [2012] took effect, and 0 otherwise; and *post_1* is a dummy variable that equals 1 for the first year after policy adjustments, and 0 otherwise. To prevent multi-

Table 6
Abnormal return on the day of the mandatory increase of audit firms' PII and PRF reserves.

	Obs.	Mean	St. Err.	*t*-value
AR	1,863	0.011	0.001	28.317***

Note: This table reports the results of the abnormal return on the event day. *, ** and *** indicate significance at the 0.1, 0.5 and 0.01 levels, respectively.

Table7
Cumulative abnormal return in the (–1, 1) window of the mandatory increase of audit firms' PII and PRF reserves.

	Obs.	Mean	St Err	t value
CAR	1,863	0.009	0.001	12.3***

Note: This table reports the results of cumulative abnormal return with the (–1, 1) window. *, ** and *** indicate significance at the 0.1, 0.5 and 0.01 levels, respectively.

collinearity problems, *pre_3* (the year of 2009) is selected as the base period. The results show that before Notice [2012] is issued, the coefficients of the interaction terms between *Treat* and each time dummy variable are not significant (except that *pre_2* is significant and negative). However, in the year of Notice [2012] and the second and third years after the policy is implemented (*post_2* and *post_3*), the coefficients of the interaction terms between *Treat* and those time dummy variables are significantly negative. This shows that after the mandatory increase of the PII and PRF quotas, the audit quality of client firms with high earnings management risk is significantly improved, and the impact of this policy is sustainable.

Table 8
Transverse check to the market reaction.

Variable	IV: *AR*	
	Coefficient	*t*-value
Treat	0.0031*	1.83
Nonsoe	0.0015**	2.13
Newclient	0.0028***	3.18
Firm_size	–0.0037***	–10.15
Big4	–0.0006	–0.58
Lev	0.0007	0.35
Roa	0.0081	1.40
Constant	0.0979***	10.31
Industry	Yes	
N		1863
Adj. R^2		0.1843

Note: This table reports the OLS regression results for Eq. (1). *, ** and *** indicate significance at the 0.1, 0.5 and 0.01 levels, respectively. *t*-statistics are based on standard errors adjusted for industry-level clustering.

Table 9
Effects of mandatory increase of audit firms' PII and PRF reserves on audit quality and audit pricing.

Variable	IV: *DA*		IV: *Auditfee*	
	Coefficient	*t*-value	Coefficient	*t*-value
Post	–0.0135**	–2.56	0.2022***	19.53
Treat	0.0353***	3.89	–0.0373	–0.74
*Treat*Post*	–0.0101**	–2.15	0.0218	0.44
Big4	–0.0024	–0.95	0.7984***	25.83
Firm_Size	–0.0022	–1.47	0.4153***	21.86
Nonsoe	0.0091***	4.50	0.0682***	2.95
Lev	0.0438***	6.59	–0.1799***	–3.91
Roa	0.3605***	6.68	–0.5533**	–2.27
Dloss	0.0043	0.83	0.064	1.36
Age	0.0003	1.72	0.0051	1.58
BM	–0.0149***	–3.46	–0.1989***	–3.27
CFO	–0.288***	–6.12		
Newclient	0.0089**	2.89		
Firstshare	0.0002***	3.85		
Current			–0.0109***	–5.12
Inv_rec			0.0841	1.04
Constant	0.1054***	3.43	4.4194***	12.22
Industry	Yes		Yes	
N		13,264		13,264
Adj. R^2		0.154		0.695

Note: This table reports the OLS regression results for Eqs. (2)–(3). *, ** and *** indicate significance at the 0.1, 0.5 and 0.01 levels, respectively. *t*-statistics are based on standard errors adjusted for industry-level clustering.

Table 10
Effects of mandatory increase of audit firms' PII and PRF reserves on auditor allocation.

Variable	IV: *Exp*	
	Coefficient	*t*-value
Post	0.0237	1.63
Treat	–0.0108	–0.22
Newclient	–0.0227*	–1.75
*Treat*Post*	–0.0498	–1.50
*Post*Newclient*	–0.0573***	–3.55
*Treat*Post*Newclient*	0.1606**	2.53
*Treat*Newclient*	–0.0638**	–2.29
Firm_Size	–0.0009	–0.13
Lev	–0.2094***	–3.12
Op	–0.0361	–0.92
Age	–0.0031	–1.49
Big4	–0.3043***	–16.32
Dloss	0.0374	0.72
Inv_rec	–0.0081	–0.19
Constant	0.5233***	3.70
Industry	Yes	
N		12,902
Adj. R^2		0.041

Note: This table reports the OLS regression results for Eq. (4). *, ** and *** indicate significance at the 0.1, 0.5 and 0.01 levels, respectively. *t*-statistics are based on standard errors adjusted for industry-level clustering.

5.5.2. Placebo test

Based on the proportion of the treatment group and the control group, the samples are randomly assigned to either the control group or the treatment group, then the difference-in-differences regression model is carried out again. We repeat this process 1,000 times to obtain 1,000 estimated coefficients and *t*-values of *Treat*Post*, and we show their distribution in Fig. 2. As shown, the *t*-values of the coefficients of *Treat*Post* in the randomized placebo test are mostly distributed around 0; that is, the regression coefficients are not statistically significant.

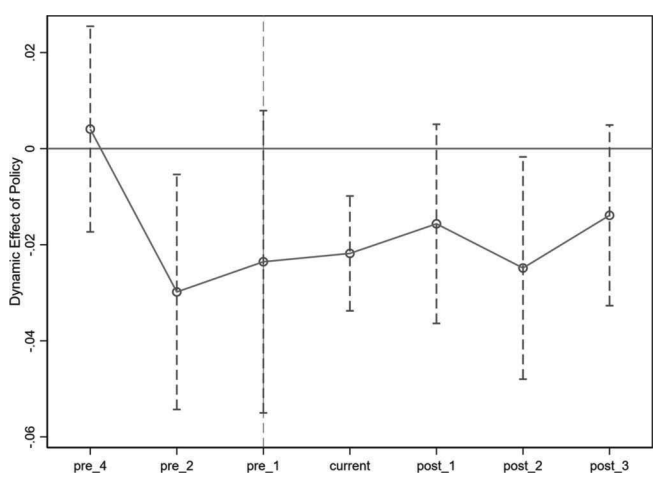

Fig. 1. Parallel trend test.

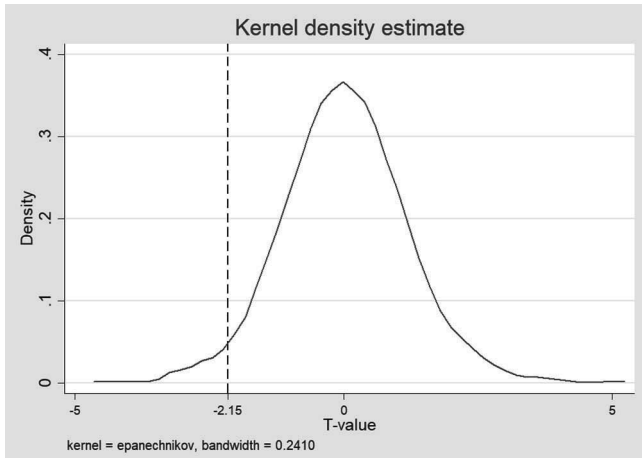

Fig. 2. Placebo test.

6. Conclusion

We empirically examine the market reaction to Notice [2012] by using data from 2008 to 2015 and further investigate the risk-preparing benefits of Chinese audit firms' PII and PRFs by using this policy revision as an exogenous shock. First, it is found that investors regard the mandatory increase of PII and PRF reserves as a signal to improve audit firms' civil litigation compensation ability and risk-preparedness capacity, producing the expectation of strengthening investor protection and causing the investors to respond positively. The non-state-owned firms, new client firms, small client firms and firms with high earnings management risk have a more positive reaction in this event window. Second, Notice [2012] has a significant effect. Specifically, the increase in audit firms' PII and PRF reserves play a more active role after the implementation of Notice [2012], resulting in a significant improvement in client firms' financial reporting quality. The audit quality of firms with higher earnings management risk is more obviously enhanced. Furthermore, there is no evidence that audit firms pass the input costs of their PII or PRFs on to their clients. Finally, and most importantly, the mismatch between auditors and new client firms is alleviated.

We contribute to the literature and practice in several ways. First, we examine the economic effects of policy related to PII and PRFs by using the quasi-experimental setting of a mandatory increase in PII and PRF reserves. This setting effectively alleviates endogenous problems. Furthermore, we use the event study method to examine the market reaction to the signal released by the CSRC and the Ministry of Finance of requiring audit firms to fully prepare for potential litigation risks and of enhancing investor protection, and we further examine cross-sectional differences between client firms.

Second, we propose another explanation for the improvement in audit quality after the mandatory increase in the PII and PRF quotas, namely the alleviation of auditor misallocation. Research typically confirms the positive effect of PII and PRFs on audit quality and attributes it to the external supervision function of insurance companies after audit firms purchase PII. However, the regulatory motivation and capacity of insurance companies are controversial (Arrow, 1963; Pauly, 1968). Our findings respond to questions posed by Wu (2009) regarding how to mitigate the mismatch anomaly of auditor resources through the audit system design. Audit firms can mitigate the risk aversion behavior of individual auditors by preparing for litigation risk and encouraging experienced auditors to undertake the engagement of new client firms, especially high-risk firms, thereby ensuring the audit quality of new clients.

Third, our empirical results verify the conclusion of Simunic et al. (2017) that countries with weak legal systems can improve the fitness of their own and international audit standards by enhancing the compensation capacity of audit firms, positively affecting the overall service quality of the audit industry. Audit firms' risk-preparedness mechanism (i.e., PII and PRFs), by improving the civil liability compensation ability of audit

firms, can improve the service quality of intermediary agencies. Our findings provide a reference for regulators and audit firms to clarify the mechanism and actual efficacy of the two risk-preparedness alternatives of PII and PRFs.

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Can differences in the background characteristics of the chairperson–CEO vertical dyad reduce management agency costs?—A perspective Based on the internal configuration of the top management team

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Top management team

ABSTRACT

We test whether differences in the background characteristics of firms' chairperson and CEO can reduce management agency costs. We find that when the chairperson is older, has a higher level of education, and has more overseas experience than the CEO, the management agency costs will be lower. A series of robustness tests do not change our conclusions. In further analysis, we find that the negative relationship between the two is more significant for SOEs or firms experiencing fierce market competition. Finally, we also find that the chairman-CEO's vertical dyad background characteristics differences can help to improve firm performance. Our study provides theoretical and practical implications for companies on how to best configure their top management team.

1. Introduction

With the development of modern enterprises, the separation of ownership and control can lead to agency costs when the interest of owners (investors) and agents (the management team) diverge (Jensen and Meckling, 1976). Management agency costs can harm firm value and investors' interest. Studies show that the size of the company (Yazdipour and Song, 1991), performance level (Angel et al., 2000), debt level (McKnight and Weir, 2009; D'Mello and Miranda, 2010), free cash flow (Jensen and Meckling, 1978), the shareholding proportion of largest shareholder (Singh and Davidson, 2003; McKnight and Weir, 2009), property rights (Li, 2007; Rossi

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et al., 2018) and internal governance (Jurkus and Park, 2011; Chen et al., 2012) can affect the management agency costs of a company. These findings are based on the traditional strategic theory and the assumption that people, including managers, are rational economic decision-makers who always make optimal decisions. However, the characteristics of managers themselves may have important effects on management agency costs. Based on cognitive psychology and bounded rationality, Hambrick and Mason (1984) put forward the upper-echelons theory, which assumes management heterogeneity. They consider that the differences in personal characteristics of management teams, such as gender, age, education and working tenure, can lead to difference in managers' analysis toward the business environment and resources. This has an important impact on the enterprise's investment, financing, mergers and acquisitions and other strategic activities. Thus, this theory corrects the shortcomings of traditional strategic theory. However, simply seeing the management team as a whole and only considering the overall mean or divergence of management team member characteristics from the perspective of whole team (Carpenter et al., 2004) may ignore the interactions between team members and the fact that the members importance to teams varies (Cao et al., 2010), which is deviating from the actual situation.

In fact, the management is not just one person, but a team managing the operation of the company. Thus, it is of theoretical and practical significance to examine the effective configuration of management team members. To address the flaws in the literature, Tsui and O'Reilly (1989) propose a relationship method to study demographic background characteristics, describing the relationship between superiors and subordinates in the team as a "vertical dyad" for different positions. In contrast with other studies, which only unilaterally consider individual or group characteristics, they expand the research to the differences in the background characteristics of vertical dyad linkage and develop a new means of integrating individual and group characteristics.

However, the literature on the "vertical dyad" mainly adopts the similar attraction theory to explain the influence of the vertical dyad between managers (such as differences in the vertical dyad members in age and academic qualifications). In fact, some differences under certain conditions can exert positive effects (Tsui and O'Reilly, 1989). According to Maslow's demand theory, people not only have "material needs" such as clothes and food, but also "non-material needs," such as self-esteem and self-realization. Both material and non-material needs can motivate people. Due to its unique historical and cultural background, China has a strong "comparative culture" and "self-esteem culture." The self that is constructed by Chinese people is a kind of "relationship self" (Gao and Ting-Toomey, 1998), and the comparison between the self, and the self and society is very important to Chinese self-value (Yau, 1988). This "other-oriented self-esteem" and "self-esteem attached to society" make Chinese individuals highly value their "status" and "prestige" within a group, which promotes people work hard to achieve such status and prestige (Goffman, 1959; Zhou Li'an, 2004; Liao and Wang, 2009; Liao et al., 2019). Therefore, when the vertical dyad linkage between managers is relatively strong, there may be an "emotional satisfaction" distinct from the economic benefits related to differences. Using similar attraction theory to explain this concept may have some defects under this situation. Social comparison theory may be the more suitable one to explain the existence of this "soft power" and its economic consequences. Traditional Chinese culture emphasizes that "virtue needs to match with talent." The more "emotional satisfaction" that the chairperson achieves from the advantages of their background that match their position, the stronger the coordination between the chairperson and the interests of the company, and the less tendency for chairpersons to engage in agency behavior and induce agency costs. According to the contrast effects emphasized in social comparison theory (Xing and Yu 2006), when the CEO is weaker than the chairperson in terms of their background characteristics, the chairperson usually possesses "soft power" over the CEO. Under this "soft power", the CEO may be more willing to accept the supervision from the chairperson out of their admiration and respect for the chairperson's background advantages.

Prior literature uses social norm theory to explain the effects of differences in the background characteristics of vertical dyad among executives. According to this theory, each social group has social norms that are commonly recognized, and people who violate such norms will be excluded by group members (Waldman and Avolio, 1986). When there are differences in demographic characteristics in line with the social norms, it encourages superiors to care for subordinates and provide them with developmental resources. Subordinates are more likely to be loyal to their superior in this situation, giving them incentives to follow and obey their superiors and enabling the superiors to supervise subordinates more easily than they would in the absence of

such relationships. However, the relevant mechanism is not verified when explaining the differences in the background characteristics of vertical dyads among executives using social norm theory. Thus, we conduct an analysis from the perspective of management agency costs and provide empirical evidence for the mechanism by which demographic characteristics that align with social norms can meet the non-material needs of superiors, leading to "emotional embodiment" and a greater likelihood that subordinates will follow and obey their superiors as under social norm theory.

We select A-share listed companies in Shanghai and Shenzhen for the period from 2008 to 2017 as a research sample to explore the influence of the differences in the background characteristics within the chairperson–CEO vertical dyad on management agency costs. We find that when the background characteristics of the chairperson are superior to (inferior to) those of the CEO, the management agency costs are lower (higher). We use the one-period lagged independent variable, propensity score matching (PSM) and difference-in-differences (DID) methods to alleviate the endogeneity problem. We calculate non-pecuniary compensation, excess administrative costs and the inter-generational age gap to alternatively measure the dependent and independent variables in the principal regression. To further control the influence of "hard power,", we exclude the samples involving duality from the regression analysis. After a series of robustness tests, the conclusions remain tenable. Further analysis excludes an alternative explanation of the impact of the chairperson's ability and finds that the relationship is more significant when there is a new chairperson and the CEO remains. The relationship is more significant among enterprises facing fierce market competition and SOEs than for other enterprises. To further verify the theoretical and logical mechanism of our study, we explore the influence of Chinese traditional culture and find that the relationship is stronger (weaker) in firms with stronger (weaker) collectivism, having a superior (inferior) chairperson, and having a superior (inferior) CEO. Finally, we find that differences in the background characteristics of the chairperson–CEO vertical dyad can help to improve a company's performance.

A strand of literature has focused on the individual characteristics of the chairperson or CEO, but few studies examine whether the differences in the advantages conferred by background characteristics within the chairperson–CEO vertical dyad affect management agency costs. As previously noted, management is not a single person, but a whole team, and thus investigating the configuration of members within the management team has strong theoretical and practical significance. Thus, the contributions of our study are as follows. First, from the perspective of the "soft factors" of executive background characteristics, we study the relationship between the background characteristics of the members of a vertical dyad and management agency costs. This research not only enriches the literature that focuses on the "hard factors," such as corporate governance, that influence management agency costs, but also supplements the upper-echelons theory. Second, our study deepens social norm theory by identifying the relevant mechanism that enables social norm theory to explain the differences in the background characteristics between the executives in a vertical dyad, which is not verified in the literature. We use the social comparison theory and the concept of non-material needs to further clarify why the hierarchical relationship that is in line with social norms can play a role. From the perspective of management agency costs, we provide empirical evidence that the alignment of demographic characteristics with social norms meets the non-material needs of superiors, which increases their "emotional embodiment" and means that subordinates are more likely to follow and obey their superiors than if the superiors lacked such qualities. Third, we empirically examine the influence of differences in the advantages conferred by background characteristics within the chairperson–CEO vertical dyad on management agency costs. The results will help listed companies form more appropriate management teams and hire more effective executives and members of the board of directors than if they ignore these background advantages. In addition, our study provides a new perspective for research on the effective configuration of management team members.

The remainder of our paper is organized as follows. Section 2 presents the literature review. Section 3 provides the theoretical analysis and hypothesis development. In Section 4, we explain the sample selection, data source and research design. In Section 5, we present the empirical tests and analysis of the results. Finally, Section 6 concludes the paper.

2. Literature review

2.1. Management agency costs

A review of the literature indicates that most research on the management agency costs' influencing factors explores the factors from internal and external aspects of the company. In terms of external factors, studies identify policies and regulations (Gao and Song, 2007), the economic environment (Martimort and Verdier, 2004), media (Wang and Dai, 2013), tax collection and administration (Zeng and Zhang, 2009), the audit industry (Griffin et al., 2014; Xie, 2011) and creditors (D'Mello and Miranda, 2010; Zhang and Jia, 2016) as influencing management agency costs. In terms of internal factors, studies have argued that equity concentration can suppress the motivation of the management to expropriate owners' interests and reduce agency problems (Shleifer and Vishny, 1997; Li et al., 2004; Gomes and Novaes, 2005; Nobanee and Abraham, 2017; Wu, Yao and Gong, 2017). Zeng and Chen (2006) find that state-owned enterprises have relatively higher agency costs than non-state-owned enterprises. Conversely, Li (2007) finds that enterprises with mixed property rights tend to have higher agency costs than state-owned enterprises. Shen and Wu (2012) show that managers in state-owned firms are less likely to occupy the interests of owners out of career considerations and thus reduce agency problems. Some studies argue that companies with higher proportions of management ownership tend to have lower agency costs (Jensen and Meckling, 1976; Angel et al., 2000; Wenting et al., 2016; Zhang, Qiu and Liu, 2016). However, others consider that management ownership and agency costs have a U-shaped relationship (Schooley and Bamey, 1994; Li and Zhang, 2014). In addition, many studies show that board size, the proportion of independent directors, executive compensation level, the number of board meetings and the gender of executives are significantly associated with agency costs (Chen et al., 2005; McKnight and Weir, 2009; Jurkus and Park, 2011; Tang and Qiu, 2014; Chen and Jia, 2015).

This overview of the relevant literature on management agency costs shows that few scholars analyze the individual background characteristics of the chairperson or CEO or how the differences in the advantages conferred by background characteristics within the chairperson–CEO vertical dyad affect management agency costs. Moreover, few scholars pay attention to this relationship in the context of social norms.

2.2. Differences in the demographic characteristics of the chairperson–CEO vertical dyad

Most studies involving vertical dyads incorporate individual position-level differences into the demographic characteristics framework. As the pioneers in this field, Tsui and O'Reilly (1989) find that differences between the characteristics of the superior and those of the subordinate within vertical dyads have negative impacts on the effectiveness ratings of subordinates by supervisors and the personal appeal of the subordinates to their superiors, while have positive impacts on the sense of role ambiguity for subordinates. This finding supports the similarity–attraction paradigm and Tsui et al. (1995); Tsui et al. (2002); Maume (2011); Lam et al. (2013); Karl et al. (2017) explain this findings by using social norm theory.

Later, they (Tsui et al., 1995; Tsui et al., 2002; Maume, 2011; Lam et al., 2013; Karl et al., 2017) point out that if a subordinate has a lower educational background and a shorter tenure than the superior, the subordinate is more likely to be viewed favorably by the superior than they would be otherwise. This suggests that in a vertical dyad, not only does similarity produce positive effects, but heterogeneity does also under certain conditions. This result raises the issue of how differences in the demographic characteristics of the individual members influence vertical dyads. Many more recent studies examine how these differences influence organizational behaviors, including Liden et al. (1996), Garcia et al. (2010) and Settoon et al. (2014), who illustrate that the combination of older superiors and younger subordinates achieves better performance than other combinations. He et al. (2010) find that differences in the background characteristics of the chairperson and management team within a vertical dyad have a positive impact on financial restatements and alleviate earnings management behaviors (He, 2015). Yang (2014) shows that differences in the age, gender and career experiences of the individuals within the chairperson–CEO vertical dyad have a significant and positive impact on the enterprise's entrepreneurship strategy orientation.

Thus, in summary, there are some research results concerning the influence of vertical dyad characteristic differences on company behaviors. However, the literature pays little attention to the influence of character-

istic differences within vertical dyads on management agency costs, despite such costs being a significant topic of modern corporate governance research. Consequently, we discuss how the differences in the characteristics of the individuals within chairperson–CEO vertical dyads are related to management agency costs and further explore the mechanism of the relationship to enhance the literature on configuring management teams to achieve optimal efficiency.

3. Theoretical analysis and research hypotheses

Based on role and social norm theories, Tsui et al. (1995) point out that when social categories, social status and population characteristics align with social norms—such as when a superior has a higher educational degree than that of their subordinate—it is easier for subordinates to obtain the favor of their superiors and it also means that subordinates tend to have stronger loyalty to their superiors than when there is misalignment with social norms. Leung, Koch and Lin (2002) note that the Chinese people's pursuit of interpersonal harmony is instrumental in smoothing such relationships. In China, if differences between the chairperson and CEOs are caused by inconsistencies in views or emotional displeasure rather than substantial differences in interests, then CEOs prefer to avoid conflict. In fact, when the differences within the chairperson–CEO vertical dyad characteristics align with social norms, both the chairperson and the CEO better share or manage the internal resources of the organization than when such characteristics do not align with social norms. A CEO does not pose a significant threat to the chairperson's position, power or interests when the relationships align with social norms. For CEOs, an older and more education chairperson provides more support and greater career opportunities compared with a younger and less educated chairperson. In addition, as noted earlier, there is a strong "comparative culture" and "self-esteem culture" in China. When the chairperson and CEO within a vertical dyad have relatively different background characteristics, it is possible for the generation of "soft power" that is different from the "hard power" arising from the positions themselves. According to the contrast effect of social comparison theory (Xing and Yu, 2006), when a CEO has a relatively weak background compared with the chairperson, they may reduce their self-evaluation level because of the upward comparison with the chairperson, whereas the chairperson will improve their own evaluation level in comparison to the weaker CEO; thus, the chairperson will have "soft power" over the CEO. When the chairperson has higher (lower) qualifications and prestige, their authority and influence in the enterprise will be greater (lower). The CEO will be more willing to accept the supervision of chairperson because of their admiration and respect for the chairperson, which reduces agency conflict and costs.

We focus on three dimensions of CEO–chairperson demographic characteristics, namely, age, educational degree and overseas background (i.e., work experience or study overseas), all of which are related to the socially optimal order.

3.1. Age

A managers' age affects their decision-making behaviors by influencing their experience and risk preferences. Managers of different ages have experienced differentiated growth environments and have different social experiences. Older managers tend to prefer stability, whereas younger managers are more willing to take risks (Hambrick and Mason, 1984). Tsui et al. (2002) emphasize emotional factors when analyzing the impact of different superior–subordinate vertical dyad characteristics on performance and there is no doubt that the chairperson–CEO relationship is influenced by emotional factors. In Eastern societies, age and career development are generally complements (Choi, 2007) in the sense that older employees tend to have more developed careers and experience than younger employees. Thus, when the chairperson is older than the CEO, the chairperson is usually more experienced than the CEO. Moreover, China has a longstanding cultural tradition of "respecting the old and loving the young." When the chairperson is older than the CEO, it tends to be easier for the CEO to accept their superior's supervision and respect their resolutions; similarly, the chairperson will tend to obtain more "emotional needs" than when the CEO is older. Therefore, when the chairperson is older than the CEO, the interests of the chairperson and the enterprise have stronger synergies than otherwise. In the situation where the chairperson is older than the CEO, they will generate "soft power," making it easier or more acceptable for the CEO to follow the supervision of the chairperson. The CEO will suppress their own

will and preferences and reduce behaviors that are purely for their own personal interests. Therefore, we propose the following hypothesis:

H_{1a}: When the chairperson is older than the CEO, management agency costs are reduced.

3.2. Degree

A person's educational degree influences their ability to adapt to environmental changes, process information and accept new ideas. Compared with less educated managers, managers with higher educational qualifications tend to have greater confidence, higher learning abilities, and greater adaptability, which assists them to make more strategic and appropriate decisions in a changing business environment. At the same time, a degree can reflect a manager's value, knowledge level and skills, which thus affects the manager's thinking style and strategic decision-making process (Wiersema and Bantel, 1992). The higher the education level of the top managers, the more professional theoretical knowledge they have and the stronger is their ability to screen, collect and process information. This can help them effectively use valuable information and gain recognition and prestige (Escriba-Esteve, 2009). Heterogeneity of education levels can provide diversified information for the company management team, which promotes positive communication between team members and enhances deep thinking among the team (Smith and Tushman, 2005). Furthermore, when the chairperson possesses higher educational qualifications than the CEO, they tend to have a sense of "superiority" and thus obtain the "non-material incentives", which make their interests better cooperate with the enterprises' interests and thus help reduce behavior that lead to agency costs. In addition, if the chairperson has a higher degree than the CEO, the former has "soft power" over the latter, such that the CEO will be more accepting of supervision by the chairperson and will follow their suggestions. This will weaken the CEO's power and reduce their incentives to behave in ways that are geared towards gaining private interests. Based on the above analyses, we propose the following hypothesis:

H_{1b}: When the chairperson has a higher level of education than the CEO, management agency costs are reduced.

3.3. Overseas background

A chairperson with an overseas background has theoretical knowledge and management skills that differ from those of managers with domestic backgrounds as the chairperson with an overseas background has acquired professional skills and advanced management experience overseas, which have expanded their perspective. In general, such a chairperson usually adopts a holistic perspective to analyze the international economic situation, which is conducive to good corporate governance. Therefore, in general, a chairperson with an overseas background will be highly independent, focused on their personal reputation and willing to pay more both economically and energetically. They have high expectations of themselves and impose high requirements on themselves, including in relation to their supervision duties. Thus, they tend to be more cautious and more responsible in supervising CEOs, and play a better role in firm governance compared with a chairperson who lacks such overseas experience. Having worked in a country with a mature overseas capital market (in contrast to China's), a chairperson who has studied or worked overseas may pursue economic benefits for their company more vigorously than a chairperson who lacks such experience. When the chairperson has an overseas background but the CEO does not, the chairperson's richer life experience will give them a sense of superiority over the CEO and thus help them get the "non-material incentives" from this superiority, which will lead to better coordination between the interests of the chairperson and those of the company and thus reduce tendency towards behaviors that create agency costs within the enterprise. Moreover, as the CEO lacks overseas experience, the chairperson has "soft power" over the CEO, who is then willing to accept advice and supervision, which reduces agency behaviors and helps protect the interests of shareholders. Accordingly, we propose the hypothesis $H1_c$.

H_{1c}: When the chairperson has an overseas background but the CEO does not, management agency costs are reduced.

3.4. Differences in comprehensive characteristics

According to the social norms theory, every social group has social norms that are recognized by all and a group member who violates these will be rejected by the other group members (Waldman et al., 1986). In the cultural background of high power gap, superiors often possess power well above the normal level, which inhibits communication and information sharing between superiors and subordinates and makes it difficult for subordinates to express their opinions freely (Ghosh, 2011). Studies have shown that Mexico and East Asian countries, such as China, are typical examples of countries with a high power gap (Pelled and Xin, 2000). In China's culture and society, people remain psychologically and behaviorally dependent on leaders and advocate power relationships and an orientation towards authority. The concepts of centralization and hierarchy are generally strong in the Chinese corporate culture. Compared with subordinates, superiors within corporations tend to be older, more highly educated and possess overseas backgrounds/experience, in line with social norms. Consequently, the chairperson of an enterprise in this context tends to have a sense of superiority over subordinates and can gain non-material incentives, which is conducive to the better coordination of the interests of the chairperson with the interests of company and reduce the tendency towards agency behaviors. Similarly, CEOs who are younger and have lower educational qualifications compared with the chairperson and no overseas background or experience have a strong sense of obedience towards the chairperson and a high degree of compliance with their decisions and thus demonstrate few excessive behaviors. Therefore, when there are such differences in the chairperson–CEO characteristics that align with social norms, they help the chairperson to supervise the CEO and improve the efficiency of strategic decision-making and teamwork. Consequently, such chairperson–CEO characteristics improve coordination, ease management conflicts and contradictions, and create a reasonable and clear division of labor and an effective internal control atmosphere, which then reduces management agency costs. Therefore, we propose the following hypothesis.

H_{1d}: When the differences in the overall advantages within the chairperson–CEO vertical dyad align with social norms (including age, education and overseas background characteristics), management agency costs are reduced.

4. Sample selection, data source and research design

4.1. Sample selection and data source

Our sample includes all A-share companies on the Shanghai and Shenzhen stock markets for the period from 2008 to 2017. After removing special treatment (ST and ST*) firms, financial firms and firms with missing data from the sample, we have 15,620 firm-year observations for 2,728 sample companies for our period of analysis.

The data used in this paper are obtained from the China Stock Market & Accounting Research (CSMAR) database. Information on the age, education and overseas backgrounds of each firm's chairperson and CEO are sourced from the resumes of the top management team provided by the CSMAR database. If the relevant information is not available, we manually collect it through the firms' official websites and professional financial news websites (such as Sina Finance or the Juchao Information Network). We winsorize all non-dummy variables at the 1 % and 99 % levels to mitigate the potential effects of outliers.

4.2. Variables

4.2.1. Measurement of management agency costs (MAP)

We use two indicators to measure a company's management agency costs. Referring to Wang et al. (2015) and Chen et al. (2005), the first index is perks (*Lnperks*), which is calculated directly based on the following expenses that can be classified as the management expenses and sales expenses incurred in the company: business entertainment, travel, office, communication, trolley, overseas training and board meeting expenses. A larger (smaller) value for this indicator denotes a more (less) severe management agency problem. Following Angel et al. (2000) and Li (2007), the second index is the management expense ratio (*Expense*), measured by

the proportion of management expenses to the total operating income. Again, the larger (smaller) the index, the more (less) serious are the management agency costs.

4.2.2. The measurement of the chairperson–CEO vertical dyad linkage

We use the following indicators to measure the chairperson–CEO vertical dyad linkage. *Agedif* denotes the age difference advantage between the chairperson and CEO; if the chairperson is older than the CEO, *Agedif* takes a value of 1 and 0 otherwise. Similarly, *Degreedif* is the educational difference advantage between the chairperson and the CEO; if the chairperson's degree is higher than the CEO's *Degreedif* equals 1 and 0 otherwise, where the ranking of educational qualifications is as follows, from lowest to highest, high school or technical secondary school below: 1; junior college: 2, bachelor's degree: 3, master's degree: 4, doctorate: 5. *Overseadif* is the advantage conferred by differences in the overseas backgrounds of the chairperson and CEO; if the chairperson has an overseas background but the CEO does not, *Overseadif* takes a value of 1 and 0 otherwise. An overseas background is classified as including overseas employment and overseas study. Finally, we add these three dimensions to obtain a comprehensive index *Betterdif* that indicates the overall advantages conferred by the differences within the chairperson–CEO vertical dyad.

4.2.3. Control variables

We control for other factors that may affect the management agency costs. These include firm size (*Size*), firm profitability (*ROA*), the asset–liability ratio (*Lev*), firm growth (*Nmr*), the largest shareholder's shareholding (*Top1*), the nature of property rights (i.e., state ownership) (*State*), board size (*Bsize*), the independent director ratio (*Indep*), executive compensation (*Pay*), free cash flow (*FCF*), firm listing time (*Age*), separation of cash flow and ownership rights (Separate), executive team size (*Msize*), the ratio of women in the executive team (*Mgend*), the average age of the executive team (*Mage*) and the executive team education (*Mgedr*). In addition, we control for the impacts of industry factors (*Ind*) and annual factors (*Year*). The specific definitions of each variable are shown in Table 1.

4.2.4. Model

Building on the analysis and hypotheses above, we construct the following regression model to test the association between the background characteristics of the chairperson–CEO vertical dyad and management agency costs:

$$MAP_{it} = \alpha_0 + \alpha_1 Dif_{it} + \alpha_2 Control_{it} + \varepsilon_{it} \quad (1)$$

Where MAP_{it} represents the management agency cost. Dif_{it} represents the three measurement dimensions (age, degree, overseas background) and the comprehensive indicator of the advantage conferred by the differences in all characteristics between the chairperson and CEO. $Control_{it}$ represents all of the control variables.

5. Empirical results and analysis

5.1. Descriptive statistics

Table 2 provides the descriptive statistics for the variables. It can be observed that the mean of *Lnperks* is 14.0200 and the standard deviation is 6.093, which is consistent with the literature (Wang et al., 2015). The mean of *Expense* is 0.1010, indicating that, on average, the management expenses of listed companies in China account for about 10.10 % of their operating income. In addition, in around 50.30 % of listed companies, the chairperson is older than the CEO, with a standard deviation of 0.5, 23.60 % of chairpersons have superior educational degrees than their CEOs, with a standard deviation of 0.4250 and 4.22 % of companies have a chairperson with an overseas background while the CEO without. The statistical results of the control variables are consistent with the results of the literature.

Table 1
Definition of the variables.

Variable properties	Variables	Symbol	Description
Dependent variables	Perks	*Lnperks*	The natural logarithm of perks
	Administrative expense rate	*Expense*	The proportion of management expenses to total operating income
Independent variables	Chairperson–CEO age-difference advantage	*Agedif*	An indicator variable that equals 1 if the chairperson is older than the CEO, and 0 otherwise
	Chairperson–CEO education-difference advantage	*Degreedif*	An indicator variable that equals 1 if the chairperson's education level is higher than the CEO's, and 0 otherwise
	Chairperson–CEO overseas background–difference advantage	*Overseadif*	An indicator variable that equals 1 if the chairperson has an overseas background (work experience or study) but the CEO does not, and 0 otherwise
	Advantage conferred by differences in the comprehensive index of the chairperson–CEO characteristics	*Betterdif*	The differences in all characteristics (age, education and overseas background) between the chairperson and CEO
Control variables	Firm size	*Size*	The natural logarithm of the total assets at the year
	Corporate profitability	*ROA*	Net profit divided by total assets
	Asset–liability ratio	*Lev*	Total liabilities divided by total assets
	Price-to-book ratio	*Nmr*	The price-to-book ratio
	The percentage shareholding of the largest shareholder	*Top1*	The percentage shareholding of the largest shareholder
	Nature of property rights (state ownership)	*State*	An indicator variable that equals 1 if the listed firm is state-owned, and 0 otherwise
	Board size	*Bsize*	The natural logarithm of the total number of directors on the board
	The percentage of independent directors	*Indep*	The number of independent directors divided by the total number of board members
	Executive compensation	*Pay*	The natural logarithm of total compensation for the three highest paid executives
	Free cash flow	*FCF*	Total cash flow from operating activities divided by total income
	Company listing time	*Age*	The number of years since listing
	The degree of separation between two rights	*Separate*	Difference between control rights and cash flow rights
	The number of executive team members	*Msize*	The total number of executives, excluding the chairperson
	The percentage of women on the executive team	*Mgend*	The proportion of women in the senior executive team, excluding the chairperson
	Executive team age	*Mage*	The average age of the executive team, excluding the chairperson
	Executive team education degree	*Mdegr*	The average education degree of the executive team, excluding the chairperson. High school or junior secondary school below: 1, junior college: 2, bachelor: 3, master: 4, doctor: 5
	Year	*Year*	Year dummy variable
	Industry	*Ind*	Industry dummy variable

5.2. Regression results and analysis

Table 3 reports the effect of the advantages conferred by differences in the background characteristics of the chairperson–CEO vertical dyad on management agency costs. It is evident that the coefficients of *Agedif* are significantly negative at the 1 % level. This indicates that when the chairperson is older than the CEO, management agency costs are alleviated to an extent, which supports our H_{1a}. When the dependent variable is *Lnperks*, the coefficient of *Degreedif* is positive but not significant. However, when the dependent variable is *Expense*, the coefficient is significantly negative. This suggests that when the chairperson's degree is superior to the CEO's, management behaviors oriented towards individual interests are restrained, supporting our H_{1b}. In column (3), there is a negative and significant correlation between *Lnperks* and *Overseadif*. In column (7), the correlation between *Expense* and *Overseadif* is postivie but insignificant. These results support our H_{1c}.

Table 2
Descriptive statistics of the variables.

Variable	N	Mean	Sd	Min	p50	Max
Lnperks	15,620	14.0159	6.0935	0.0000	16.2976	19.7145
Expense	15,620	0.1007	0.0792	0.0098	0.0827	0.4876
Agedif	15,620	0.5027	0.5000	0.0000	1.0000	1.0000
Degreedif	15,620	0.2362	0.4247	0.0000	0.0000	1.0000
Overseadif	15,620	0.0422	0.2010	0.0000	0.0000	1.0000
Betterdif	15,620	0.7811	0.7305	0.0000	1.0000	3.0000
Size	15,620	22.0687	1.2446	19.7645	21.8936	25.9276
ROA	15,620	0.0392	0.0498	–0.1458	0.0353	0.1882
Lev	15,620	0.4355	0.2073	0.0508	0.4335	0.8780
Nmr	15,620	3.8910	3.0677	0.7639	2.9937	19.4686
Top1	15,620	35.3091	14.8781	9.3100	33.4050	74.8200
State	15,620	0.4161	0.4929	0.0000	0.0000	1.0000
Bsize	15,620	2.2612	0.1758	1.7918	2.3026	2.7726
Indep	15,620	0.3727	0.0529	0.3333	0.3333	0.5714
Pay	15,620	14.1707	0.6963	12.4296	14.1591	16.0127
FCF	15,620	0.0746	0.1861	–0.7259	0.0704	0.6376
Age	15,620	10.7383	6.4204	2.0000	10.0000	24.0000
Separate	15,620	4.9493	7.6789	0.0000	0.0000	28.8247
Msize	15,620	13.2395	6.8316	1.0000	14.0000	30.0000
Mgend	15,620	0.1708	0.1430	0.0000	0.1539	0.6667
Mage	15,620	45.9717	9.4128	–2.0000	47.8938	57.6053
Mdegr	15,620	3.0566	0.8642	–1.0000	3.2500	4.1500

Betterdif has a negative effect on *Lnperks* and *Expense*, both of which are significant at the 1 % level, strongly supporting our H_{1d}. Results in Table 3 provide support for our argument ans suggest that differences in the background characteristics of the chairperson–CEO vertical dyad can reduce management agency costs.

5.3. Robustness tests

In this section, we test the robustness of the above conclusions by implementing the following four robustness tests.

5.3.1. Lagged independent variable

First, we run the regression by using one-period lagged independent variable to alleviate any potential endogeneity bias. The results are reported in Table 4, which are consistent with the theoretical analysis and the main regression results.

5.3.2. Propensity score matching (PSM) method

Following Ma et al. (2018), we use the PSM method to alleviate the self-selection problem. In first stage, we establish a *Probit* model and use a series of variables to match the samples following equation (2). We select factors including *Size, Lev, Age, Gage, Gdegree, Goversea, Msize, Mgend, Mage, Mdegr, Year and Industry* dummy variables. As *Betterdif* is not an indicator variable, we convert *Betterdif* to a 0–1 variable, where *Betterdif1* equals 1 if *Betterdif* ≥ 1, and 0 otherwise; and *Betterdif2* equals 1 when *Betterdif* ≥ 2, and 0 otherwise. We calculate the propensity score in the first stage of the regression and apply nearest neighbor, radius and kernel matching methods. The equation (2) is as follows:

$$Betterdif_{it} = \alpha_0 + \alpha_1 Size_{1it} + \alpha_2 Lev_{2it} + \alpha_3 Age_{it} + \alpha_4 Gage_{it} + \alpha_5 Gdegree_{it} + \alpha_6 Goversea_{it} + \alpha_7 Msize_{it} + \alpha_8 Mgend_{it} + \alpha_9 Mage_{it} + \alpha_{10} Mdegr_{it} + \varepsilon \quad (2)$$

Table 3
Regression results for the effect of differences in the background characteristics of the chairperson–CEO vertical dyad on management agency costs.

Variable	*Lnperks*				*Expense*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Agedif	–0.2795***				–0.0038***			
	(–3.76)				(–3.72)			
Degreedif		0.1017				–0.0054***		
		(1.17)				(–4.56)		
Overseadif			–0.4399**				0.0017	
			(–2.41)				(0.69)	
Betterdif				–0.1314***				–0.0035***
				(–2.58)				(–5.03)
Size	–0.1278**	–0.1395***	–0.1393***	–0.1345***	–0.0069***	–0.0071***	–0.0070***	–0.0069***
	(–2.48)	(–2.71)	(–2.70)	(–2.61)	(–9.74)	(–10.02)	(–9.99)	(–9.78)
Roa	3.0546***	2.9727***	2.9194***	2.9859***	–0.4464***	–0.4479***	–0.4474***	–0.4470***
	(3.37)	(3.28)	(3.22)	(3.29)	(–35.95)	(–36.09)	(–36.02)	(–36.03)
Lev	2.6731***	2.6929***	2.6907***	2.6925***	–0.1267***	–0.1260***	–0.1263***	–0.1265***
	(10.05)	(10.12)	(10.12)	(10.12)	(–34.81)	(–34.63)	(–34.70)	(–34.78)
Mmr	–0.0713***	–0.0710***	–0.0702***	–0.0709***	0.0054***	0.0054***	0.0054***	0.0054***
	(–4.60)	(–4.58)	(–4.53)	(–4.58)	(25.39)	(25.42)	(25.38)	(25.43)
Top1	–0.0149***	–0.0148***	–0.0147***	–0.0148***	–0.0003***	–0.0003***	–0.0003***	–0.0003***
	(–5.44)	(–5.37)	(–5.35)	(–5.39)	(–8.52)	(–8.42)	(–8.45)	(–8.49)
State	–0.1915**	–0.2390**	–0.2389**	–0.2018**	–0.0054***	–0.0054***	–0.0059***	–0.0052***
	(–1.98)	(–2.47)	(–2.48)	(–2.08)	(–4.06)	(–4.06)	(–4.44)	(–3.89)
Bsize	–0.1824	–0.2085	–0.2055	–0.1866	0.0137***	0.0138***	0.0135***	0.0139***
	(–0.69)	(–0.79)	(–0.78)	(–0.70)	(3.79)	(3.80)	(3.71)	(3.83)
Indep	–2.0720**	–1.9320**	–1.9439**	–1.9972**	0.0448***	0.0469***	0.0468***	0.0449***
	(–2.56)	(–2.38)	(–2.40)	(–2.46)	(4.04)	(4.23)	(4.22)	(4.05)
Pay	–0.0994	–0.0841	–0.0795	–0.0922	0.0066***	0.0067***	0.0068***	0.0066***
	(–1.50)	(–1.27)	(–1.20)	(–1.39)	(7.28)	(7.41)	(7.46)	(7.30)
FCF	–0.2433	–0.2440	–0.2420	–0.2437	–0.0078***	–0.0078***	–0.0078***	–0.0078***
	(–1.15)	(–1.15)	(–1.14)	(–1.15)	(–2.69)	(–2.70)	(–2.69)	(–2.69)
Age	–0.0592***	–0.0597***	–0.0588***	–0.0590***	0.0009***	0.0009***	0.0009***	0.0009***
	(–7.67)	(–7.73)	(–7.61)	(–7.64)	(8.81)	(8.83)	(8.73)	(8.91)
Separate	–0.0021	–0.0029	–0.0026	–0.0021	0.0001	0.0001	0.0001	0.0001
	(–0.43)	(–0.57)	(–0.51)	(–0.42)	(0.94)	(1.01)	(0.83)	(1.05)
Msize	0.0003	–0.0003	0.0004	0.0007	0.0001	0.0001	0.0001	0.0001
	(0.04)	(–0.05)	(0.07)	(0.11)	(1.28)	(1.45)	(1.23)	(1.45)
Mgend	0.1831	0.1791	0.1642	0.1720	0.0013	0.0010	0.0012	0.0011
	(0.67)	(0.66)	(0.60)	(0.63)	(0.34)	(0.27)	(0.33)	(0.28)
Mage	–0.0167***	–0.0166***	–0.0163***	–0.0162***	–0.0006***	–0.0006***	–0.0006***	–0.0006***
	(–2.82)	(–2.79)	(–2.76)	(–2.74)	(–7.03)	(–6.83)	(–6.97)	(–6.93)
Mdegr	0.1223*	0.1281*	0.1263*	0.1152*	0.0052***	0.0048***	0.0052***	0.0050***
	(1.75)	(1.83)	(1.81)	(1.65)	(5.44)	(5.07)	(5.41)	(5.25)
_cons	5.9624***	5.8362***	5.7861***	5.9400***	0.1734***	0.1743***	0.1725***	0.1739***
	(4.75)	(4.65)	(4.61)	(4.73)	(10.09)	(10.15)	(10.04)	(10.13)
Year, Ind	Control	Control	Control	Control	Control	Control	Control	Control
N	15,620	15,620	15,620	15,620	15,620	15,620	15,620	15,620
adj. R^2	0.4497	0.4493	0.4495	0.4495	0.3899	0.3902	0.3894	0.3904

Notes: Robust *t*-statistics are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$.

Table 5 shows the results before and after PSM matching. Regardless of which matching method is adopted, the comprehensive measure of the differences in the background characteristics within the chairperson–CEO vertical dyad has a negative and significant effect on *Lnperks* and *Expenses*, which is consistent with our theoretical analysis and the main regression results.

Table 4
Regression results for the one-period lagged independent variable.

Variable	*Lnperks*				*Expense*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
L.Agedif	–0.2403***				–0.0025**			
	(–3.10)				(–2.39)			
L.Degreedif		0.0082				–0.0056***		
		(0.09)				(–4.60)		
L.Overseadif			–0.5172***				0.0016	
			(–2.64)				(0.61)	
L.Betterdif				–0.1513***				–0.0030***
				(–2.82)				(–4.19)
_cons	6.4690***	6.4159***	6.3143***	6.4892***	0.1623***	0.1643***	0.1621***	0.1631***
	(4.89)	(4.85)	(4.78)	(4.91)	(9.24)	(9.35)	(9.22)	(9.29)
Control Variables, Year, Ind	Control	Control	Control	Control	Control	Control	Control	Control
N	14,489	14,489	14,489	14,489	14,489	14,489	14,489	14,489
adj. R^2	0.4367	0.4363	0.4366	0.4367	0.3948	0.3955	0.3946	0.3953

Notes: Robust *t*-statistics are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$.

Table 5
Results of the propensity score matching.

Variable	Method	Sample	Treat group	Control group	ATT	Standard error	t
Panel A: Lnperks							
Betterdif1	Nearest neighbor matching	Before matching	9,520	6,100	–0.6960	0.0998	–6.97***
		After matching	3,392	3,425	–0.3524	0.1553	–2.27**
	Radius matching	Before matching	9,520	6,100	–0.6960	0.0998	–6.97***
		After matching	9,515	6,096	–0.2351	0.1198	–1.96**
	Kernel matching	Before matching	9,520	6,100	–0.6960	0.0998	–6.97***
		After matching	9,515	6,099	–0.2410	0.1181	–2.04**
Betterdif2	Nearest neighbor matching	Before matching	2,528	13,092	–0.2182	0.1324	–1.65*
		After matching	2,020	1,933	–0.2318	0.2025	–1.14
	Radius matching	Before matching	2,528	13,092	–0.2182	0.1324	–1.65*
		After matching	2,526	12,997	–0.3431	0.1514	–2.27**
	Kernel matching	Before matching	2,528	13,092	–0.2182	0.1324	–1.65*
		After matching	2,527	12,999	–0.3332	0.1493	–2.23**
Panel B: Expense							
Betterdif1	Nearest neighbor matching	Before matching	9,520	6,100	–0.0149	0.0013	–11.52***
		After matching	3,392	3,425	–0.0034	0.0021	–1.61
	Radius matching	Before matching	9,520	6,100	–0.0149	0.0013	–11.52***
		After matching	9,515	6,096	–0.0040	0.0017	–2.43**
	Kernel matching	Before matching	9,520	6,100	–0.0149	0.0013	–11.52***
		After matching	9,515	6,099	–0.0042	0.0016	–2.56**
Betterdif2	Nearest neighbor matching	Before matching	2,528	13,092	–0.0104	0.0017	–6.03***
		After matching	2,020	1,933	–0.0040	0.0025	–1.62
	Radius matching	Before matching	2,528	13,092	–0.0104	0.0017	–6.03***
		After matching	2,526	12,997	–0.0049	0.0018	–2.72***
	Kernel matching	Before matching	2,528	13,092	–0.0104	0.0017	–6.03***
		After matching	2,527	12,999	–0.0045	0.0018	–2.59***

Notes: Robust *t*-statistics are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$.

5.3.3. Elimination of samples with a dual chairperson–CEO

As firms with a dual chairperson–CEO do not have the focal vertical dyad, we eliminate these firms from the sample to test whether the reduction in management agency costs is the result of the chairperson's "soft emotional factor" in relation to the CEO. Table 6 reports the results for this sample, which are consistent with our theoretical analysis and the main regression results. Indeed, the absolute value of the coefficients of *Betterdif* is larger than that of the main regression result shown in Table 3.

Table 6
Regression results for the sample without firms that have a dual chairperson–CEO.

Variable	*Lnperks*				*Expense*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Agedif	–0.5177***				–0.0053***			
	(–5.60)				(–4.33)			
Degreedif		0.0610				–0.0060***		
		(0.65)				(–4.82)		
Overseadif			–0.4628**				0.0024	
			(–2.46)				(0.96)	
Betterdif				–0.2830***				–0.0053***
				(–4.34)				(–6.10)
_cons	8.2208***	7.8736***	7.7912***	8.1687***	0.1990***	0.1992***	0.1964***	0.2007***
	(5.73)	(5.48)	(5.43)	(5.69)	(10.39)	(10.40)	(10.25)	(10.48)
Control Variables, Year, Ind	Control	Control	Control	Control	Control	Control	Control	Control
N	11,691	11,691	11,691	11,691	11,691	11,691	11,691	11,691
adj. R^2	0.4676	0.4662	0.4664	0.4670	0.3731	0.3733	0.3721	0.3740

Notes: Robust *t*-statistics are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$.

5.3.4. Alternative measures of the dependent variable

Next, we consider several alternative measures of the dependent variable to test the robustness of our results. We use excess perks (*Unperks*), the excess ratio of management expenses (*Unexpense*) and total capital turnover (*Turnover*) as alternative measures for management agency costs.

First, following Quan et al. (2010), we measure excess perks as the difference between management's perks and the expected normal level of perks determined by economic factors. Equation (3) below is used to estimate the expected normal perks:

$$\frac{Perks_{it}}{Asset_{it-1}} = \alpha_0 + \alpha_1 \frac{1}{Asset_{it-1}} + \alpha_2 \frac{\Delta sale_{it}}{Asset_{it-1}} + \alpha_3 \frac{PPE_{it}}{Asset_{it-1}} + \alpha_4 \frac{Inventory_{it}}{Asset_{it-1}} + \alpha_5 LnEmployee_{it} + \varepsilon_{it} \quad (3)$$

$Perks_{it}$ indicates the perks of executives, which is the value after deducting the remuneration of directors, executives and supervisors, bad debt provision, inventory falling price reserves and the amortization of intangible assets in the current year; $Asset_{it\text{-}1}$ is the total assets of the last period; $\Delta sale_{it}$ is the change in the main operating income during the period; PPE_{it} is the net value of fixed assets, such as plant, property and equipment; $Inventory_{it}$ is the total inventory of this period; and $LnEmployee_{it}$ is the natural logarithm of the total number of employees of the company. We use model (3) and conduct a regression of sample enterprises by year and industry. The predicted values of the dependent variables obtained by the regression indicate normal perks, and the difference between actual perks and normal perks is excess perks (*Unperks*).

Second, referring to Liu et al. (2017) and Du (2010), we use the difference between actual management expenses and the expected normal management expenses determined by economic factors to indicate excess management expenses. We use model (4) to estimate the expected normal management expenses:

$$\begin{aligned} Lnexpense_{it} = {} & \alpha_0 + \alpha_1 Lnsale_{it} + \alpha_2 Lev_{it} + \alpha_3 Growth_{it} + \alpha_4 Bsize_{it} + \alpha_5 Employee_{it} + \alpha_6 Big4_{it} + \alpha_7 Age_{it} \\ & + \alpha_8 \mathrm{Magin}_{it} + \alpha_9 H5_{it} + \eta Year_{it} + \lambda Ind_{it} + \varepsilon_{it} \end{aligned} \quad (4)$$

Lnexpense is the natural logarithm of management expenses; *Lnsale* is the natural logarithm of current operating income; *Lev* is the asset–liability ratio; *Grow* is the growth rate; *Staff* is the number of employees; *Sj* is the size of the auditing company, which is indicative of audit quality—if the audit firm of the listed company is one of the Big Four accounting firms, *Sj* equals 1 and 0 otherwise; *Age* is listing years; *Magin* is the gross profit margin, reflecting the profitability of the company; *H5* indicates the equity concentration, which is the index of the top five shareholders of the listed companies. We use model (4) to calculate the normal management expenses. Excess management expenses are calculated as the difference between actual and normal expenses and the ratio of excess management expenses scaled by the current operating income is the ratio of excess management expenses (*Unexpense*).

Table 7
Regression results for the effect of differences in the background characteristics of the chairperson-CEO vertical dyad on excess perks and the excess management expenses ratio.

Variable	*Unperks*				*Unexpense*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Agedif	–0.0010**				–0.0025***			
	(–2.14)				(–3.91)			
Degreedif		–0.0006				–0.0019**		
		(–1.13)				(–2.49)		
Overseadif			0.0016				0.0015	
			(1.42)				(0.95)	
Betterdif				–0.0005*				–0.0017***
				(–1.73)				(–3.82)
_cons	0.0217***	0.0217***	0.0218***	0.0217***	0.3724***	0.3724***	0.3711***	0.3730***
	(2.85)	(2.84)	(2.85)	(2.84)	(31.06)	(31.03)	(30.94)	(31.09)
Control Variables, Year, Ind	Control	Control	Control	Control	Control	Control	Control	Control
N	15,620	15,620	15,620	15,620	10,289	10,289	10,289	10,289
adj. R^2	0.1086	0.1084	0.1085	0.1085	0.6232	0.6229	0.6227	0.6232

Notes: Robust *t*-statistics are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$.

Table 8
Regression results for the effect of differences in the background characteristics of the chairperson-CEO vertical dyad on the asset turnover ratio.

Variable	*Turnover*			
	(1)	(2)	(3)	(4)
Agedif	0.0264***			
	(4.52)			
Degreedif		0.0213***		
		(3.11)		
Overseadif			–0.0279*	
			(–1.94)	
Betterdif				0.0176***
				(4.38)
_cons	0.2727***	0.2728***	0.2753***	0.2723***
	(2.76)	(2.76)	(2.78)	(2.75)
Control Variables, Year, Ind	Control	Control	Control	Control
N	15,619	15,619	15,619	15,619
adj. R^2	0.3821	0.3816	0.3814	0.3820

Notes: Robust *t*-statistics are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$.

Table 7 reports the results for excess perks (*Unperks*) and the ratio of excess management expenses (*Unexpense*). The results are consistent with the theoretical analysis and the main regression results.

Finally, following Ang et al. (2000) and Li (2007), we use asset turnover (*Turnover*) to measure management agency costs, which is equal to total operating income divided by total assets. The smaller the value of the index, the greater the management agency costs. Table 8 reports the results for the asset turnover rate and confirms that they are consistent with the previous results.

5.3.5. An alternative measure of the independent variable

In the context of China's historical economic development, an age gap of more than 10 years can create a "generation gap" between a CEO and chairperson due to their different experiences and cognition,which is often referred as the "inter-generational age gap" (Wang, 2018). To take this into account, we alter our measure of the chairperson–CEO age difference (*Agedif*') so that it equals 1 when the chairperson is more than 10 years older than the CEO, and 0 otherwise. The regression results, shown in Table 9, support our previous conclusions.

Table 9
Regression results for the effect of differences in the background characteristics of the chairperson-CEO vertical dyad on management agency costs using an alternative measure of age difference.

Variable	*Lnperks*		*Expense*	
	(1)	(2)	(3)	(4)
Agedif'	–0.2892***		–0.0044***	
	(–2.84)		(–3.14)	
Betterdif'		–0.1036*		–0.0040***
		(–1.70)		(–4.85)
_cons	5.8762***	5.8943***	0.1722***	0.1729***
	(4.68)	(4.70)	(10.03)	(10.07)
Control Variables, Year, Ind	Control	Control	Control	Control
N	15,620	15,620	15,620	15,620
adj. R^2	0.4495	0.4493	0.3898	0.3903

Notes: Robust *t*-statistics are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$.

5.3.6. Difference-in-differences (DID) analysis

Next, we conduct a DID analysis by selecting a sample of firms for which there was no change (a change) in the chairperson and CEO for the period from 2008 to 2017 and *Betterdif* ≥ 1 (*Betterdif* $\leq$ pre-change *Betterdif*) as a control (treatment) group. *Treat* equals 1 when a firm is in the treatment group, and 0 otherwise. Then, *Treat*Post* equals 1 from the year in which a firm in the treatment group experiences a change in the chairperson or CEO, and 0 otherwise. If a firm in the treatment group experiences several changes of the chairperson or CEO, we delete the observations from the second and subsequent changes.

According to our arguments, after the change of treatment group, the differences in the background characteristics of the chairperson–CEO vertical dyad should remain unchanged or become smaller and the coefficient of *Treat*Post* should be positive and significant. Tables 10 1 and 10 2 show the results of the DID regression analysis without and with the control variables, respectively. As shown in Table 10 1 and Table 10 2, the coefficient of *Treat*Post* is significantly positive, which is consistent with the logic of our study and provides further empirical evidence in support of our conclusions.

5.4. Further analysis

5.4.1. Exclusion of an alternative explanation: The abilities of the chairperson or the "soft emotional factor"?

We consider that the effect of the differences in the background characteristics of the chairperson–CEO vertical dyad in reducing management agency costs is due to China's unique cultural context. The differences in the background characteristics make the chairperson relatively more authoritative than the CEO, which meets the soft non-material emotional needs of the chairperson. At the same time, these differences may lead the CEO to respect the chairperson more and to cooperate with them to manage the enterprise, thus reducing

Table 10 1
Regression results for the DID model (without control variables).

Variable	*Lnperks*		*Expense*	
	Full sample	Excluding samples with duality	Full sample	Excluding samples with duality
*Treat*Post*	0.1760**	0.0682	0.0023**	0.0019*
	(2.24)	(0.75)	(2.26)	(1.81)
_cons	–0.4251	–0.4184	0.0956***	0.0975***
	(–1.60)	(–1.48)	(26.10)	(26.81)
Year, Code	0.1760**	0.0682	0.0023**	0.0019*
observed value	9987	8568	9987	8568
N	1654	1627	1654	1627
R^2	0.6556	0.6703	0.0288	0.0329

Notes: Robust *t*-statistics are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$.

Table 10 2
Regression results for the DID model (with control variables).

Variable	*Lnperks*		*Expense*	
	Full sample	Excluding samples with duality	Full sample	Excluding samples with duality
*Treat*Post*	0.2040***	0.1142	0.0021**	0.0020**
	(2.58)	(1.25)	(2.20)	(1.99)
_cons	–8.0006***	–8.3214***	0.2696***	0.2272***
	(–4.16)	(–3.99)	(10.40)	(8.29)
Control Variables, Year, Code	Control	Control	Control	Control
observed value	9987	8568	9987	8568
N	1654	1627	1654	1627
R^2	0.6589	0.6734	0.1547	0.1321

Notes: Robust *t*-statistics are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$.

the chairperson's supervision costs. However, an alternative explanation is that the differences in the background characteristics of the chairperson–CEO vertical dyad imply that the chairperson possesses superior skills to the CEO and can supervise and prevent any agency behavior and resulting costs by the CEO.

To exclude this alternative explanation, we use their age (*Cage*: the year of the data less the birth year of the chairperson), education (*Cdegree*: a chairperson with an educational background classified as high school or technical secondary school below: 1; junior college: 2; bachelor's degree: 3; master's degree: 4; and doctorate: 5) and an overseas background (*Coversea*: equals 1 for a chairperson with overseas work experience or study and 0 otherwise) to measure the ability of the chairperson and add these to model (1). If the chairperson's ability plays a major role, then the coefficients of this three variables should be negative and significant. However, we may find that the significance of the differences in background characteristics of the chairperson–CEO vertical dyad decreases and even becomes insignificant. Conversely, if the "soft power" of the chairperson plays a major role, then after controlling for the chairperson's ability, the differences in the background characteristics of the chairperson–CEO vertical dyad remain significant, while the relevant variables of the chairperson's ability may not be significantly negative.

Table 11 reports the results of the regression analysis. It indicates that after we add the variables related to the chairperson's ability to model (2), the absolute value of the coefficient of the differences in the background

Table 11
Regression results when adding variables to control for the chairperson's ability.

Variable	*Lnperks*				*Expense*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Agedif	–0.1381*				–0.0035***			
	(–1.67)				(–3.11)			
Degreedif		0.0992				–0.0083***		
		(1.04)				(–6.38)		
Overseadif			–0.8966***				–0.0038	
			(–3.40)				(–1.06)	
Betterdif				–0.0690				–0.0046***
				(–1.24)				(–6.05)
Cage	–0.0243***	–0.0290***	–0.0284***	–0.0264***	0.0000	–0.0001	–0.0001	0.0001
	(–3.88)	(–5.12)	(–5.02)	(–4.41)	(0.21)	(–1.04)	(–1.23)	(0.78)
Cdegree	–0.0130	–0.0328	–0.0120	0.0014	0.0016***	0.0033***	0.0016***	0.0025***
	(–0.29)	(–0.68)	(–0.27)	(0.03)	(2.62)	(5.00)	(2.65)	(4.05)
Coversea	–0.0300	–0.0221	0.4682**	0.0082	0.0029	0.0027	0.0051*	0.0052***
	(–0.21)	(–0.16)	(2.33)	(0.06)	(1.50)	(1.43)	(1.85)	(2.69)
_cons	6.5883***	6.6602***	6.6925***	6.6382***	0.1724***	0.1753***	0.1746***	0.1723***
	(5.19)	(5.25)	(5.28)	(5.23)	(9.93)	(10.11)	(10.06)	(9.94)
Control Variables, Year, Ind	Control	Control	Control	Control	Control	Control	Control	Control
N	15,620	15,620	15,620	15,620	15,620	15,620	15,620	15,620
adj. R^2	0.4503	0.4502	0.4506	0.4502	0.3904	0.3916	0.3900	0.3914

Notes: Robust *t*-statistics are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$.

characteristics of the chairperson–CEO vertical dyad decreases for perks, whereas the absolute value of the management expense ratio increases. The coefficients for both *Lnperks* and *Expense* are generally significant and negative. This illustrates that the mechanism of influence is the ''soft non-material emotional factor'' produced by the differences in the background characteristics of the chairperson–CEO vertical dyad rather than the chairperson's ability.

5.4.2. Is the effect of the differences in the background characteristics of the chairperson–CEO vertical dyad more pronounced when there is a new chairperson and the CEO remains unchanged?

To further verify the conclusions of our study, we test the effect of the differences in the background characteristics of the chairperson–CEO vertical dyad when there is a new chairperson but the CEO remains unchanged. First, we delete 3,929 observations involving chairperson–CEO duality from the original sample of 15,620, leaving 11,691 observations. Then, we set *Post* to equal 1 in the year in which the chairperson of the enterprise changes and the CEO does not change and the year after this change, and 0 otherwise. We find that there are 1,190 firms for which $Post = 1$. Table 12 reports the regression analysis results. It shows that the coefficients of *Betterdif*Post* are negative and significant, indicating that when there is a new chairperson and the CEO remains unchanged, the effect of the differences in the background characteristics of the chairperson–CEO vertical dyad becomes more important. When there is a new chairperson and the CEO remains unchanged, the chairperson's ''non-material soft emotional factor'' is more important due to their limited experience in their new position.

5.4.3. The effect of product market competition on the relationship between differences in the background characteristics of the chairperson–CEO vertical dyad and management agency costs

Corporate governance is the arrangement of control rights in essence, which can restrain management from pursuing only their own interests (Fama and Jensen, 1983). Product market competition also has a governance effect (He, 2014). Fierce market competition makes performance differences between firms in the same industry

Table 12
Results when there is a new chairperson and the CEO remains unchanged.

Variable	*Lnperks*				*Expense*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Agedif	–0.5357***				–0.0052***			
	(–5.43)				(–3.93)			
*Agedif*Post*	0.1090				–0.0026			
	(0.38)				(–0.67)			
Degreedif		0.1086				–0.0054***		
		(1.10)				(–4.08)		
*Degreedif*Post*		–0.4405				–0.0058		
		(–1.48)				(–1.45)		
Overseadif			–0.2902				0.0047*	
			(–1.45)				(1.77)	
*Overseadif*Post*			–1.4183**				–0.0186**	
			(–2.50)				(–2.45)	
Betterdif				–0.2437***				–0.0046***
				(–3.52)				(–5.01)
*Betterdif*Post*				–0.3536*				–0.0064**
				(–1.73)				(–2.33)
Post	–0.1552	0.1353	0.0874	0.2977	–0.0010	0.0006	–0.0004	0.0041
	(–0.72)	(0.75)	(0.58)	(1.21)	(–0.34)	(0.27)	(–0.19)	(1.24)
_cons	8.2396***	7.8876***	7.7644***	8.1875***	0.1998***	0.1996***	0.1963***	0.2011***
	(5.76)	(5.50)	(5.42)	(5.72)	(10.45)	(10.44)	(10.26)	(10.53)
Control Variables, Year, Ind	Control	Control	Control	Control	Control	Control	Control	Control
N	11,691	11,691	11,691	11,691	11,691	11,691	11,691	11,691
adj. R^2	0.4677	0.4664	0.4668	0.4673	0.3733	0.3736	0.3726	0.3746

Notes: Robust *t*-statistics are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$.

more transparent than when market competition is lacking (Shen and Guo, 2017). It also reduces information asymmetry between external shareholders and management, which means that diligent or unqualified managers can be more effectively identified. In addition, sufficient external market competition can reduce the supervision costs of shareholders and increase the effectiveness of the supervision and management mechanism. This reduces the management's self-interested motivations (Yao et al., 2018) and encourages them to work hard to maintain the corporation's market share (Tan and Wei, 2014). In this context, managers will face significant performance pressure and career anxiety, which will encourage them to seek external assistance. When the chairperson within the company's vertical dyad has background characteristic advantages over the CEO that align with social norms, the chairperson will tend to have a higher reputation in the company than if their background characteristics do not align with social norms (Yang, 2014). When management is sensitive to the senior authorities (Frances, 2004), they will be more inclined to take the advice of their superiors and obey their decisions, thus alleviating agency problems. Thus, the negative relationship between differences in the background characteristics of the chairperson–CEO vertical dyad (including age, education and overseas background) and management agency costs is more significant for firms experiencing fierce market competition. We use the Herfindahl–Hirschman index (*Hhi*) to capture the degree of market competition in the product industry; the higher the *Hhi*, the greater the degree of monopoly and the less competition there is in the industry. As reported in Table 13, the coefficient of the interaction term between *Betterdif* and *Hhi* is positive and significant at the 1 % level when the dependent variable is *Expense*. This indicates that for enterprises with a high (low) degree of product market competition, the negative relationship between differences in the background characteristics of the chairperson–CEO vertical dyad and management agency costs is more (less) significant, which is consistent with our theoretical analysis.

5.4.4. The effect of enterprise property rights on the relationship between differences in the background characteristics of the chairperson–CEO vertical dyad and management agency costs

Chinese people tend to be more sensitive to hierarchy and authoritative figures than people of other cultures (He, 2015). Executives of Chinese state-owned enterprises have dual identities as professional managers and government officials (Chen et al., 2014) and have a strong tendency to identify as government officials (Yang et al., 2013). Among China's SOEs, the traditional method of selecting and appointing executives based on administrative channels has not changed fundamentally, and a considerable proportion of senior executives have administrative rank (Yang, 2014). Therefore, compared with NSOEs, SOEs may be more serious about hierarchy and reverence for authoritative figures and emphasize the role of social norms. We expect that the effect of differences in background characteristics of the chairperson–CEO vertical dyad on management

Table 13
Relationship between product market competition and the effect of differences in the background characteristics of the chairperson–CEO vertical dyad on management agency costs.

Variable	*Lnperks*	*Expense*
	(1)	(2)
Betterdif	–0.1779***	–0.0057***
	(–2.59)	(–6.07)
Hhi	0.1107	–0.0230***
	(0.32)	(–4.79)
*Betterdif***Hhi*	0.2706	0.0125***
	(1.02)	(3.48)
_cons	5.8986***	0.1799***
	(4.70)	(10.48)
Control Variables, Year, Ind	Control	Control
N	15,620	15,620
adj. R^2	0.4496	0.3914

Notes: Robust *t*-statistics are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$.

Table 14
Interaction between enterprise property rights and differences in the background characteristics of the chairperson–CEO vertical dyad.

Variable	*Lnperks*	*Expense*
	(1)	(2)
Betterdif	–0.0606	–0.0037***
	(–0.92)	(–4.16)
State	–0.0448	–0.0056***
	(–0.34)	(–3.09)
*Betterdif*State*	–0.1782*	0.0006
	(–1.70)	(0.40)
_cons	5.9126***	0.1749***
	(4.72)	(10.20)
Control Variables, Year, Ind	Control	Control
N	15,620	15,620
adj. R^2	0.4496	0.3914

Notes: Robust *t*-statistics are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$.

agency costs is more pronounced in SOEs than in NSOEs. Table 14 shows the results of the regression analysis, which provides supporting evidence for our inferences.

5.4.5. Discussion of the influencing mechanism

In an environment characterized by relative equality, interactions between people are less affected by hierarchy (Yang, 2014) than in Chinese society, where people remain highly sensitive to hierarchical and authoritative figures (Brew and David, 2004). The advantageous effect of differences in the background characteristics of the chairperson–CEO vertical dyad in reducing management agency costs is grounded in the special historical and cultural background of China. There is a strong culture of collectivism in China and the power distance is relatively large compared with other countries, which profoundly affects the ''emotional appeal'' of management. Therefore, we consider that China's cultural characteristics may be the primary mechanism between the effect of differences in the background characteristics of the chairperson–CEO vertical dyad in reducing management agency costs.

He (2015) consider that given its historical background, China has formed a strong culture characterized by collectivism, great power distance, strong avoidance of uncertainty, and a tendency towards long-term goals. These culture characteristics make it easy for people to accept centralized leadership and the behaviors of superiors deeply affect and restrict subordinates. Jiang et al. (2019) argue that collectivism is stronger in the southern regions whereas individualism is stronger in the northern regions. Therefore, we split the sample into firms in the southern and northern regions of China according to the registration place of the listed companies. The southern regions include Jiangsu, Anhui, Hubei, Chongqing, Sichuan, Xizang, Yunnan, Guizhou, Hunan, Jiangxi, Guangxi, Guangdong, Fujian, Zhejiang, Shanghai and Hainan. The northern regions include Shandong, Henan, Shanxi, Shaanxi, Gansu, Qinghai, Xinjiang, Hebei, Tianjin, Beijing, Inner Mongolia, Liaoning, Jilin, Heilongjiang and Ningxia. We predict that in the southern regions, the chairperson's ''soft power'' over the CEO will have a greater effect in reducing management agency costs than in the less collectivist northern regions. Due to the length limitation, we do not report the corresponding empirical results here. The results show that the coefficient of *Betterdif* is negative and significant in the southern regions, but insignificant in the northern regions, which provides some support for our prediction.

Second, we discuss the influencing mechanism from the perspective of the chairperson and then the CEO in turn.

(1) From the perspective of the chairperson, according to Maslow's demand theory, people not only have physiological needs (such as food, clothing and shelter) but also ''emotional needs'' such as self-esteem and a desire for respect. China's historical background, distinctive collectivist culture, and the relatively

large power distance profoundly affect the "emotional appeal" of management. In this cultural background, and in the perception that the superiors need to be matched with "excellence", the more the interaction between superiors and subordinates complies with social norms, the better the "emotional experience" that superiors obtain in the enterprise. Then, the interests of superiors tend to be more coordinated with the interests of the enterprise than in other circumstances, which reduces management agency costs.

For the chairperson, if the above mechanism holds, the better the qualities and background characteristics of the chairperson, the more confident they are in making decisions (Landier and Thesmar, 2009). In this circumstance, the chairperson will have a strong expectation that their relationship with their subordinates will comply with social norms and that the subordinates will support the chairperson's decision-making arrangements. When the chairperson's authority is not (is) challenged, their emotional experience in the enterprise is better (poorer) and their alignment with the interests of the enterprise is stronger (weaker). We expect that the more excellent the qualities of the chairperson, the stronger the negative relationship between differences in the background characteristics of the chairperson–CEO vertical dyad (which align with social norms) and the management agency costs. Table 15 shows the effect of the chairperson characteristics. As columns (1) and (3) in Table 15 indicate, when the dependent variable is *Lnperks*, the interaction terms between *Betterdif* and chairperson age, and the interaction terms between *Betterdif* and overseas experience are both negative and significant. When the dependent variable is *Expense*, the coefficients are insignificant, but remain negative. Thus, the results of Table 15 support the existence of the hypothesized mechanisms to an extent.

(2) From the perspective of the CEO, vertical dyad characteristics that align with social norms not only make the chairperson and CEO feel a sense of security in their career development, but also help to balance the future rights and interests of both sides (He, 2015). Specifically, when the differences in the characteristics of the senior executive team conform to social norms, there will be a positive relationship and behavior between superiors and subordinates. The superiors give their subordinates resources support, development space and positive evaluations, while the subordinates exhibit loyalty and contribute to their superior's goals (He, 2015). Such a management team relationship provides a working environment

Table 15
Regression results for the effect of the chairperson's characteristics.

Variable	(1)	(2)	(3)	(4)	(5)	(6)
	Lnperks	*Lnperks*	*Lnperks*	*Expense*	*Expense*	*Expense*
Betterdif	0.9319**	–0.3179	–0.0518	0.0034	–0.0011	–0.0038***
	(2.25)	(–1.39)	(–0.91)	(0.59)	(–0.36)	(–4.91)
Cage	–0.0117			0.0000		
	(–1.40)			(0.39)		
*Betterdif*Cage*	–0.0192**			–0.0001		
	(–2.43)			(–1.20)		
Cdegree		0.0263			0.0031***	
		(0.42)			(3.66)	
*Betterdif*Cdegree*		0.0459			–0.0008	
		(0.77)			(–0.97)	
Coversea			0.6290***			0.0066**
			(3.03)			(2.34)
*Betterdif*Coversea*			–0.4955***			–0.0007
			(–3.67)			(–0.36)
_Cons	5.7448***	5.9902***	5.8677***	0.1693***	0.1697***	0.1765***
	(4.37)	(4.74)	(4.67)	(9.40)	(9.82)	(10.27)
Control Variable, Year, Ind	Control	Control	Control	Control	Control	Control
N	15,620	15,620	15,620	15,620	15,620	15,620
adj. R^2	0.4481	0.4472	0.4476	0.3878	0.3885	0.3881

Notes: Robust *t*-statistics are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$.

that best suppresses management agency behavior. The "better" the CEO, the greater their need for the background characteristics of the chairperson–CEO vertical dyad, which meets social norms, to enhance the loyalty and contribution of CEOs and thus better reduce management agency costs. We expect that CEOs with "better" (poorer) characteristics will lead to a stronger (weaker) negative correlation between the background characteristics of the vertical dyad that align with social norms and management agency costs. Table 16 shows the effect of the CEO characteristics; columns (1), (3) and (5) indicate that the coefficients of the interaction terms of the *Betterdif* and CEO characteristics variables are negative and sig-

Table 16
Regression results for the effect of CEO characteristics.

Variable	(1)	(2)	(3)	(4)	(5)	(6)
	Lnperks	*Lnperks*	*Lnperks*	*Expense*	*Expense*	*Expense*
Betterdif	1.0446**	–0.0887	–0.0795	0.0043	–0.0010	–0.0028***
	(2.49)	(–0.44)	(–1.52)	(0.74)	(–0.37)	(–3.97)
Gage	0.0106			0.0003**		
	(1.18)			(2.20)		
*Betterdif*Gage*	–0.0246***			–0.0002		
	(–2.87)			(–1.29)		
Gdegree		–0.0061			0.0046***	
		(–0.09)			(5.16)	
*Betterdif*Gdegree*		–0.0144			–0.0004	
		(–0.24)			(–0.54)	
Goversea			0.6255***			0.0110***
			(3.24)			(4.18)
*Betterdif*Goversea*			–0.9409***			–0.0105***
			(–4.26)			(–3.47)
_Cons	5.1501***	5.9145***	5.8629***	0.1628***	0.1704***	0.1752***
	(3.90)	(4.68)	(4.66)	(9.02)	(9.87)	(10.19)
Control Variables, Year, Ind	Control	Control	Control	Control	Control	Control
N	15,620	15,620	15,620	15,620	15,620	15,620
adj. R2	0.4475	0.4471	0.4478	0.3880	0.3895	0.3885

Notes: Robust *t*-statistics are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$.

Table 17
Regression results for the effect of differences in the background characteristics of the chairperson–CEO vertical dyad on enterprise performance.

Variable	*ROE*			
	(1)	(2)	(3)	(4)
Agedif	0.0046***			
	(3.12)			
Degreedif		0.0005		
		(0.31)		
Overseadif			–0.0068*	
			(–1.87)	
Betterdif				0.0018*
				(1.80)
_cons	–0.8394***	–0.8388***	–0.8397***	–0.8393***
	(–34.99)	(–34.93)	(–34.98)	(–34.97)
Control Variables, Year, Ind	Control	Control	Control	Control
N	15,619	15,619	15,619	15,619
adj. R^2	0.2370	0.2366	0.2367	0.2367

Notes: Robust *t*-statistics are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$.

nificant at the 1 % level. Columns (2), (4) and (5) indicate that the coefficients of the interaction terms between *Betterdif* and the CEO's characteristics variables are insignificant but negative. Thus, the results of Table 16 partly support the existence of the hypothesized mechanisms.

5.5. Economic consequences analysis: Do the differences in the background characteristics of the chairperson–CEO vertical dyad improve enterprise performance?

We consider that if the background characteristics of the chairperson-CEO vertical dyad align with social norms, then management agency costs will be reduced and company performance may correspondingly improve. We further test the relationship between differences in the background characteristics of the chairperson–CEO vertical dyad and company performance using return on equity (ROE) to indicate company performance. As reported in Table 17, in general, differences in the background characteristics of the chairperson–CEO vertical dyad significantly improve the enterprise performance, further verifying the conclusions of this study.

6. Conclusions

Based on the principal–agent and upper-echelons theories, we use a sample of A-share listed companies in China for the period from 2008 to 2017 to analyze the relationship between differences in the background characteristics of the chairperson–CEO vertical dyad and management agency costs, focusing on the three dimensions of age, education level and overseas (work experience or study) background. Compared to the CEO, due to the special cultural background of China, the differences in the background characteristics of the chairperson–CEO vertical dyad make the chairperson more authoritative to the CEO and lead the CEO to respect the chairperson more, thus making the chairperson's supervision task simpler and reducing agency costs. Meanwhile, the chairperson obtains more non-material emotional demand incentives in the situation where there are differences in vertical dyad background characteristics, which further helps reduce management agency costs. Our empirical research reveals the following results. (1) Differences in the background characteristics of the chairperson–CEO vertical dyad—including the chairperson being older than the CEO, having a higher education level than the CEO, and having an overseas background (study or work experience) that the CEO lacks—have a significantly negative impact on management agency costs. (2) Our results hold in response to a series of robustness tests. To address endogeneity problems, we use the one-period lagged independent variable, PSM and DID methods. Following the relevant literature, we calculate the excess perks, excess administrative expenses and inter-generational age gap as alternative measurements for the dependent and independent variables, respectively, in the main regression. In addition, we eliminate observations involving chairperson–CEO duality from the sample and rerun the regressions. These tests do not change our conclusions. (3) In further analysis, we exclude the alternative explanation of the impact of the chairperson's ability. Then, we discuss circumstances in which the chairperson–CEO vertical dyad linkage has the most significant effect in reducing management agency costs, which include when there is a new chairperson but the CEO does not change; when firms are state-owned; and when firms face fierce market competition. To further verify the theoretical and logical mechanism of our study, we explore the influence of Chinese traditional culture and find that the relationship between the differences in the background characteristics of the chairperson–CEO vertical dyad and management agency costs is stronger (weaker) for samples involving stronger (weaker) collectivism, having a chairperson or CEO with better (worse) background characteristics. (4) An analysis of economic consequences shows that the differences in the background characteristics of the chairperson–CEO vertical dyad help to improve enterprise performance.

Our study have significance for Chinese companies in indicating ways to rationally allocate the individual powers of the chairperson and CEO, optimize the management team, alleviate management agency costs and improve the corporate governance level. Enterprises should focus on the differences and relative strengths and weaknesses of the background characteristics of the chairperson and CEO within the vertical dyad, and should develop non-material incentives to systematically improve the configuration and optimization of the management team. When building the core leadership combination of the chairperson and CEO, the ages, educational

qualifications and overseas backgrounds of the candidates should be fully considered and should be made for these to conform to social norms to reduce management agency costs and thus improve the corporate value.

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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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Do anti-corruption campaigns affect IPO underpricing? Evidence from a central discipline inspection of the CSRC in China

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ABSTRACT

The system of central discipline inspections has become a key anti-corruption governance tool in China since 2013. This paper investigates the impact of a central discipline inspection of the China Securities Regulatory Commission (CSRC) on initial public offering (IPO) underpricing. We find that IPO firms listed during the inspection period exhibit greater IPO underpricing than those listed outside the inspection period. The reason is the increased focus of the CSRC on maintaining capital market stability, which makes it more inclined to approve IPO firms with lower issue prices during the inspection period compared with other periods. We also find that IPO firms listed during the inspection period have better short-term market performance but poorer long-term returns than those listed outside the inspection period. Moreover, the effect of the anti-corruption inspection on IPO underpricing is more pronounced for non-state-owned enterprises, firms with low-quality auditors and firms located in regions with high corruption. Overall, our paper enriches the literature on IPO underpricing and the economic consequences of the central discipline inspection system.

1. Introduction

Corruption consistently impairs long-term economic growth (Krueger, 1974; Shleifer and Vishny, 1993; Mauro, 1995; Zhou and Tao, 2009) and causes serious social problems (Manion, 2004). Due to China's

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immature legal system and insufficient regulations, it is estimated that close to 8 % of its gross national product is lost to corruption (Hu and Guo, 2001). Thus, corruption and anti-corruption measures are important research topics, particularly in China. China's anti-corruption campaigns began as early as April 1952, with the publication of the document *Regulations of the People's Republic of China on the Punishment of Corruption*. In 2012, new anti-corruption requirements were issued by the Communist Party of China (CPC), leading to significant anti-corruption achievements. One of the key measures is the system of central discipline inspections that aims to crack down on "tigers and flies," as corrupt officials are typically called.

The literature explores the economic consequences of anti-corruption inspections. One strand of the literature finds that the implementation of inspections has had significant positive effects on the national economy (Qu et al., 2018) and improved sustainable development (Wang et al., 2018). Another strand of studies focus on firm behaviors and document that inspections are effective in restricting earnings management, promoting innovation and improving operating performance (Zhong et al., 2016; Cao et al., 2018; Chen et al., 2020). In 2013, the Central Commission for Discipline Inspection (CCDI) started to dispatch central discipline inspection teams to government entities nationwide. Since then, the system of central discipline inspections has become increasingly critical in combating corruption. The CPC's focus on the capital market is indicated by its inspection of the China Securities Regulatory Commission (CSRC)[1] by the seventh central inspection team in October 2015.

As the gatekeeper of the capital market, the CSRC is responsible for examining the registration documents of initial public offering (IPO) applicants and regulating the IPO process to maintain capital market stability and protect investor interests. However, some studies show that corruption could occur during the IPO process (Du et al., 2013; Chen et al., 2014; Huang and Xie, 2016; Huang et al., 2021). This could lead IPO firms to raise their issue prices to compensate for rent extraction by officials, resulting in reduced IPO underpricing.[2] In this context, it is of practical significance to identify the impact of the central discipline inspection of the CSRC on its governance. Although the inspection period is only 2 months long, its effect is not negligible. We find that just over 60 firms obtain IPO approval during the inspection period and successfully go public. Using these firms as our sample, we explore the impact of this anti-corruption inspection on IPO underpricing.

Specifically, we choose IPO firms approved for listing between 31 October 2014 and 31 January 2016 as our sample. Fig. 1 presents the pass rate of IPO applicants from 2014 to 2016. The pass rate declines during the inspection period, which we take to indicate that the CSRC is more conservative in its IPO reviews during this period than during other times. Moreover, the CSRC is more motivated to boost the market performance of IPO firms after listing during the inspection period. Our empirical results indicate that the IPO firms listed during the inspection period experience higher levels of IPO underpricing than those listed outside the inspection period. We also find that the IPO firms listed during the inspection period have better short-term market performance but poorer long-term returns than other IPO firms listed outside the inspection period.

We then investigate the mechanisms leading to higher IPO underpricing under such anti-corruption campaigns. We find that the firm fundamentals, i.e., operating performance, of the IPO firms listed during the inspection period are not better than those of firms listed during other periods. Thus, the inspection does not lead to the CSRC being stricter in controlling firms' quality than during other periods. However, the issue prices of the IPO firms are significantly lower during the inspection period than outside the inspection period. We argue that the CSRC is more conservative in its review of IPO firms as a result of the presence of the inspection team and, to maintain capital market stability, the CSRC is more inclined to let IPO firms with lower issue prices go public. We document that greater IPO underpricing is mainly reflected in the secondary market. Moreover, we compare the impact of the anti-corruption inspection of the CSRC on different types of IPO firms, with variations in terms of firm ownership type (SOEs vs non-SOEs), quality of the selected audit firms (Big 4 vs non-Big 4) and their external environments (the degree of corruption). We find that the impact

[1] The CSRC is analogous to the Securities and Exchange Commission in the US.

[2] IPO underpricing means that the first-day trading price is significantly higher than the issue price. There is an extensive literature exploring IPO underpricing and providing various theories for its existence (Miller, 1977; Baron, 1982; Booth and Smith, 1986; Rock, 1986; Tinic, 1988; Benveniste and Spindt, 1989; Hanley, 1993; Ruud, 1993; Loughran and Ritter, 2002; Da et al., 2011; Green and Hwang, 2012).

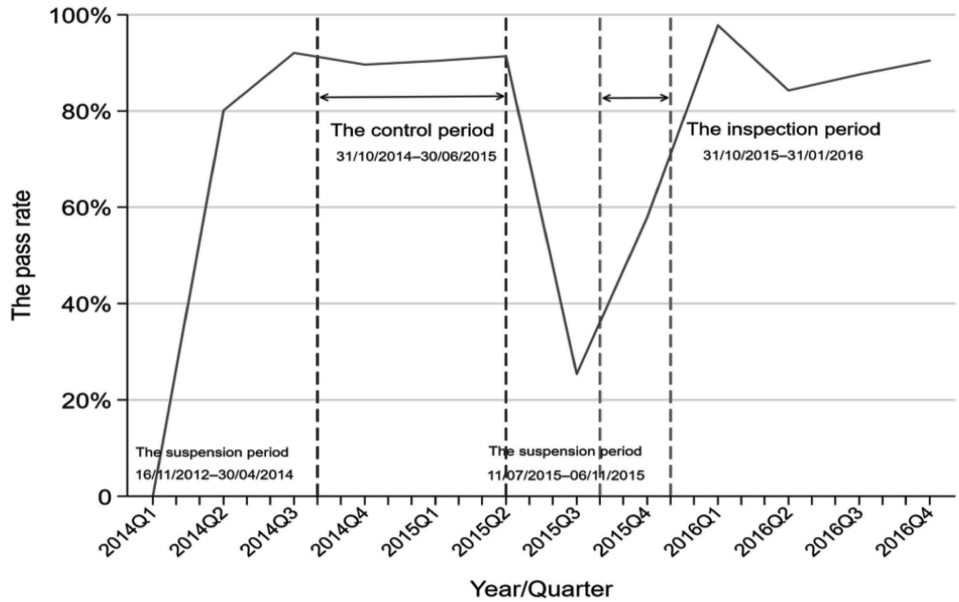


Fig. 1. The pass rate of IPO applicants from 2014 to 2016., *Notes*: The pass rate is calculated quarterly. The red and blue dotted lines represent the treated and control periods, respectively. The CSRC suspended all IPO activities between 16 November 2012 and 30 April 2014 and then again between 11 July 2015 and 6 November 2015.

of the inspection is more (less) pronounced for non-state-owned enterprises (SOEs) (vs non-SOEs), firms with low-quality (vs high-quality) auditors and firms located in regions with high (vs low) corruption.

Our study contributes to the literature in three ways. First, we extend the literature on the relationship between anti-corruption campaigns and the capital market. The literature investigates the economic consequences of China's anti-corruption campaigns on listed firms, including market performance (Kong et al., 2020; Wang et al., 2021), negative information release (Cao et al., 2018), financial reporting quality (Hope et al., 2020) and resource reallocation and innovation (Guo et al., 2021). Li et al. (2021) examine the impact of an anti-corruption campaign, i.e., central inspection team visits, on analyst earnings forecast optimism. They document higher analyst optimism during the visit periods than during non-visit periods. Using the similar setting of China's central discipline inspections, we examine the effect of the anti-corruption campaign within the CSRC on IPO underpricing.

Second, we contribute to the literature on the impacts of administrative intervention on the capital market (Wei et al., 2019; Tang and Song, 2020; Cong and Howell, 2021; Duchin et al., 2021; Hu and Qi, 2021). Most studies focus on direct intervention, such as IPO suspensions and the first-day daily limit system. Conversely, we analyze indirect intervention, i.e., the central discipline inspection system, and investigate its impact on the capital market. The anti-corruption campaign within the CSRC involves an inspection of the regulatory authority. The findings show that the CSRC's IPO review process is more conservative during the inspection period than outside the inspection period with the aim of preventing the emergence of market chaos.

Finally, we deepen our understanding of IPO underpricing. In its exploration of IPO underpricing, the literature focuses on information asymmetry (Beatty and Ritter, 1986; Shao et al., 2013), regulatory systems (Liu and Xiong, 2005; Tian, 2011; Song and Tang, 2019; Wei et al., 2019), social ties (Yu et al., 2013; Chen et al., 2017), market sentiment (Song et al., 2011; Li et al., 2014), geographical location (Nielsson and Wójcik, 2016; Yan and Wang, 2021) and firm behaviors (Huang et al., 2021). Based on China's anti-corruption campaigns, we enrich this literature by proposing a new factor that influences IPO underpricing in the case of the central discipline inspection of the CSRC.

The remainder of this study is organized as follows. In Section 2, we describe the institutional background concerning China's anti-corruption campaigns and IPOs. Section 3 develops our research hypotheses. In Section 4, we introduce the research design and the sample. Section 5 reports the empirical results and mechanism

analyses. Sections 6 and 7 provide further analyses and robustness checks, respectively. Finally, Section 8 concludes the study.

2. Institutional background

2.1. Anti-corruption governance and the system of central discipline inspections

The CPC attaches great importance to the goal of anti-corruption and building a clean government. China's anti-corruption campaigns officially began with the publication of the document *Regulations of the People's Republic of China on the Punishment of Corruption* in April 1952. Since then, every National Congress of the Communist Party of China (NCCPC) has announced new policies to improve the anti-corruption system. For example, the 15th NCCPC pronounced that the CPC would build a socialist country under the rule of law. In the fourth plenary session of the 16th CPC Central Committee in 2004, the *Decision of the CPC Central Committee on Strengthening the Party's Governing Capacity Construction* was announced, including the Sixteen-Word Policy, which reminds government officials to pay great attention to anti-corruption. In 2005, the CPC published an important guideline on preventing corruption, designed to enhance China's anti-corruption system. In 2008 and 2013, the government successively implemented its Four-Year Plan based on the targets of the 2005 guideline document, forming a strong basis for anti-corruption campaigns. Recently, the CPC has made further improvements with the aim of defeating corruption.

The third plenary session of the 18th CPC Central Committee suggested that the government promoted the modernization of China's governance system and capacity, which the CPC viewed as the goal of comprehensively deepening reform. The inspection system is one of the most important cornerstones of national governance in China; indeed, the government explicitly mentioned the inspection system when the People's Republic of China was founded. However, inspection teams were not established officially until 2003 and it was not until 2007 that the 17th NCCPC pronounced that the inspection system would be implemented in governments, provinces, autonomous regions and municipalities. Then, the CPC released the *Regulations of the CPC on Inspection Work (Trial Implementation)* and established a new inspection team in 2009. In 2012, the 18th NCCPC urged the government to establish a system to constrain officials' power and fully implement supervision through the inspection system. In 2013, central discipline inspection teams were deployed in each province for the first time. On average, inspection teams are deployed to government entities twice a year. The government has consistently improved the inspection system over time. For example, the CPC made important adjustments to the *Regulations of the CPC on Inspection Work (Trial Implementation)* in 2015 and 2017 and highlighted the inspection system. Overall, these regulations play an important role in upholding full and rigorous governance over the party.

2.2. The system of IPO pricing

The IPO pricing system in China could be divided into two phases around the publication of the *Notices on Several Issues Concerning the Trial Implementation of the IPO Inquiry System* by the CSRC in 2004. This document led to the establishment of what is known as the inquiry system in 2005. Before the establishment of the inquiry system, IPO firms tended to determine their issue price using some multiple of the price-to-earnings (P/E) ratio; for example, 15 × the P/E ratio. However, under the inquiry system, IPO applicants are required to obtain information on IPO pricing by asking institutional investors in the capital market.

The inquiry system was implemented to reduce information asymmetry and improve the efficiency of IPO pricing. Initially, although the CSRC did not set an official upper limit for issue prices, few IPO firms' P/E ratios were more than 30 times the average P/E ratio of their industry. This indicates that the government imposed controls on IPO pricing (Wang, 2013). In 2009, the CSRC issued the *Opinions on Further Reforming and Improving the IPO System*, which cancelled the upper price limit, meaning that issue prices were determined by the market. However, this led to frequent turmoil and chaos in the capital market, such as broken IPOs and the "three-high" phenomenon (i.e., high issue prices, P/E ratios and recruitment). To address these

problems, the CSRC published the document *Opinions on Further Deepening the Reform of the IPO System*[3] on 28 April 2012 and reset the upper limit on IPO pricing through supplementary disclosure provisions. The Shanghai and Shenzhen stock exchanges imposed restrictions on issue prices in December 2013. For example, the first-day daily limit system stipulated that the effective declared price could not be higher than 144 % or lower than 64 % of the issue price. In 2014, the CSRC set an upper limit of 23 times the P/E ratio for issue prices under the window guidance reform. Since then, the reform of the registration-based IPO system has been gradually implemented. In 2019, the CSRC issued the *Measures for the Administration of the Registration of IPO on STAR Market* leading to the reappearance of market-oriented pricing in the stock market.

3. Hypothesis development

The central discipline inspection system is not merely a strategic regulation to improve the CPC's internal governance but also a key effort to reduce corruption. The inspection system aims to deter and detect corruption by government officials. On average, the CCDI has dispatched inspection teams to government entities nationwide twice per year since 2013. As previously noted, on 31 October 2015, the seventh central inspection team was dispatched to the CSRC.

As the gatekeeper of the capital market, the major function of the CSRC is to examine the registration documents and quality of IPO applicants. However, the literature documents potential rent-seeking behaviors in the IPO approval process (Du et al., 2013; Chen et al., 2014; Huang and Xie, 2016; Huang et al., 2021). As these behaviors inevitably result in high rent-seeking costs for IPO applicants, one argument is that IPO applicants may seek high IPO offer prices to recoup these rent-seeking costs, leading to a reduction in IPO underpricing. Conversely, studies show that IPO pricing has an impact on post-IPO performance (Chen et al., 2014; Zhang et al., 2020b). The CSRC may have anticipated that the poor market performance of IPO firms listed during the inspection period would lead the inspection team to reinspect all aspects of the CSRC's routine work. Based on this discussion, we propose two possible mechanisms for the impact of the central discipline inspection of the CSRC on IPO underpricing.

First, the CSRC may give priority to high-quality IPO applicants during the inspection period. To ensure thorough scrutiny and detection of corruption, the central discipline inspection within the CSRC involves all aspects of its routine work. Thus, the inspection team has both supervisory and deterrent effects on CSRC officers. Under such pressure, the CSRC would implement stricter reviews of IPO firm quality during the inspection period than outside the inspection period. Moreover, it is easier to detect officers who engage in irregular behaviors, including favoritism, during the inspection period because of the additional scrutiny compared with other times. Overall, any rent-seeking behaviors are likely to be effectively restrained during this period. Then, firm fundamentals, i.e., operating performance, become the most important factor in the IPO review process. Meanwhile, high-quality firms have an inherently higher probability of going through the IPO application process (Liu et al., 2013; Tu et al., 2013) than low-quality firms and, based on information asymmetry theory, high-quality firms use IPO underpricing to crowd out low-quality competitors from the capital market (Ibbotson, 1975; Allen and Faulhaber, 1989; Grinblatt and Hwang, 1989; Welch, 1989; Ritter and Welch, 2002). Therefore, during the inspection period, the CSRC is likely to tend to approve IPO applications with high-quality rather than low-quality firms, leading to higher levels of IPO underpricing.

Second, during the inspection period, the CSRC may tend to allow firms with low rather than high issue prices to pass the IPO approval process to prevent market turmoil. As noted, the *Opinions on Further Reforming and Improving the IPO System* was released in 2009, marking the start of market-oriented pricing. However, owing to frequent market turmoil, such as broken IPOs and the ''three-high'' phenomenon, the first-day daily limit system was imposed from December 2013. Since then, CSRC have gradually imposed controls on first-day trading prices. If the CSRC approves firms with high issue prices, it is more likely that market chaos will reappear, which may then arouse the attention of the central discipline inspection team. Thus, when the CSRC considers IPO applicants of similar quality, it may be more likely to approve firms with low rather than high issue prices for IPOs. Moreover, issuers and intermediaries, i.e., audit firms, may actively cater to what they perceive as the special demand of the CSRC for low issue prices during the inspection period. Overall, either the more conservative review process of the CSRC or the behaviors of issuers and intermediaries during the inspection period could lead to lower issue prices and higher levels of IPO underpricing.

Both explanations above predict that IPO firms listed during the inspection period will be associated with higher levels of IPO underpricing than those listed outside the inspection period. However, the underlying mechanisms are different. If the CSRC takes firm quality as the primary consideration in the IPO process, that is, if the first explanation above is the most relevant, we expect to find that the quality of firms approved to be listed during the inspection period is better than outside the inspection period. Therefore, we propose the following testable hypothesis:

H1. IPO firms listed during the inspection period exhibit higher levels of IPO underpricing than those listed outside the inspection period.

4. Research design

4.1. Data and sample

To identify all IPO firms approved for listing during the inspection period, we manually collect announcements from the CSRC website.[4] All capital market and company financial data are sourced from the China Securities Market and Accounting Research database. Our initial sample includes all A-share firms approved for IPOs from 31 October 2014 to 31 January 2016.[5] Then, we eliminate firms that belong to the banking, insurance or other financial industries, firms with more than 2 years between IPO approval and listing and firms with missing values. Our final sample consists of 300 listed firms approved for IPOs, including 61 firms approved for IPOs during the inspection period. Appendix A provides more detailed information on these 61 firms. We winsorize the continuous variables at the 1 % and 99 % levels to mitigate the effect of potential outliers.

4.2. Model and variables

To examine our hypothesis, we use the following baseline multiple regression model:

$$FDR10_i = \alpha_0 + \alpha_1 Inspection_i + Control_i + Industry + Month + \varepsilon_i \quad (1)$$

where *FDR10* is the difference between the mean closing price during the first 10 trading days and the offer price divided by the offer price. *Inspection* is a dummy variable that equals 1 if the firm obtains IPO approval during the inspection period and 0 otherwise. We include the following set of control variables: offer size (*OfferSize*), delay between IPO offer and listing day (*TimeLag*), private equity or venture capitalist involvement (*PVC*), audit quality (*Big4*), firm age (*Age*), issuance costs (*Cost*), firm size (*Size*), profitability (*ROE*), financial leverage (*Leverage*), cash holdings (*Cash*), state ownership status (*SOE*), CEO and chairperson duality (*Duality*) and firm location (*FinCenter*). The detailed variable definitions are provided in Appendix B. We also include industry and month fixed effects in Eq. (1). If H1 holds, α_1 should be positive and significant.

5. Empirical results

5.1. Univariate analysis

Recently, regulators have strengthened control over first-day trading prices, i.e., the first-day daily limit system. Thus, using first-day closing prices to compute *FDR* for IPOs in China may not be appropriate to reflect underpricing. Following Chung et al. (2005), we use the mean closing price during the first 10 trading days after an IPO to calculate IPO underpricing and denote it as *FDR10*. Following Chan et al. (2004), we calculate the market-adjusted first-day returns by subtracting the concurrent market returns of A-shares from *FDR10* and denote it as *AdjFDR10*.

[4] See https://www.csrc.gov.cn/.

[5] The inspection period is from 31 October to 29 December 2015. Considering the lagged effects, we choose firms approved for IPOs between 31 October 2015 and 31 January 2016 as the treated group.

Table 1 reports the univariate analysis results of the means and medians of the key variables. For *FDR10*, the means (medians) for IPO firms listed during the inspection and non-inspection periods are 1.287 (1.295) and 1.224 (1.295), respectively. There are positive and significant differences between the mean and median of the inspection period compared with the non-inspection period, indicating that IPO firms listed during the inspection period experience higher levels of IPO underpricing than other firms. Moreover, we obtain consistent results for *AdjFDR10*.

In addition to differences in IPO underpricing, we examine the differences between the treated and control groups for other dimensions. As shown in Table 1, IPO firms listed during the inspection period complete their IPO process faster and have lower costs than the control group (non-inspection period). Furthermore, we find that the treated firms do not have better operating performance in the year preceding the IPO compared with the control firms.

5.2. Baseline results

We present the results for Eq. (1) in Table 2. The dependent variables in Columns (1) and (2) are *FDR10* and *AdjFDR10*, respectively. In Column (1), the coefficient of *Inspection* is 0.055 and is significant at the 1 % level, suggesting that the mean *FDR10* in the treated group is 6 % higher than that of the control group. The

Table 1
Univariate analysis.

Variable	(1)	(2)	(3)
	Inspection	*Non-Inspection*	Mean and median differences
FDR10	1.287	1.224	0.063***
	[1.295]	[1.295]	[0.000**]
AdjFDR10	1.285	1.222	0.062***
	[1.292]	[1.284]	[0.008***]
OfferSize	0.490	0.527	–0.037
	[0.453]	[0.479]	[–0.027]
TimeLag	2.684	2.453	0.232***
	[2.639]	[2.398]	[0.241***]
PVC	0.705	0.699	0.006
	[1.000]	[1.000]	[0.000]
Big4	0.049	0.025	0.024
	[0.000]	[0.000]	[0.000]
Age	2.594	2.557	0.038
	[2.639]	[2.565]	[0.074]
Cost	8.277	8.354	–0.077
	[8.189]	[8.316]	[–0.128**]
Size	11.34	11.36	–0.0220
	[11.140]	[11.187]	[–0.047]
ROE	0.174	0.194	–0.020*
	[0.162]	[0.179]	[–0.016**]
Leverage	0.399	0.412	–0.013
	[0.444]	[0.395]	[0.048]
Cash	0.211	0.187	0.024
	[0.173]	[0.148]	[0.026]
SOE	0.148	0.084	0.064
	[0.000]	[0.000]	[0.000]
Duality	0.180	0.167	0.013
	[0.000]	[0.000]	[0.000]
FinCenter	0.213	0.251	–0.038
	[0.000]	[0.000]	[0.000]

Notes: This table presents the mean values, with the median values in brackets. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 2
The impact of the central discipline inspection of the CSRC on IPO underpricing.

Variable	(1)	(2)
	FDR10	*AdjFDR10*
Inspection	0.055***	0.051***
	(2.98)	(2.85)
OfferSize	–0.033	–0.029
	(–0.55)	(–0.50)
TimeLag	–0.045	–0.043
	(–1.07)	(–1.03)
PVC	0.007	0.009
	(0.43)	(0.57)
Big4	0.055*	0.055*
	(1.67)	(1.68)
Age	0.003	0.005
	(0.16)	(0.26)
Cost	–0.104***	–0.104***
	(–3.30)	(–3.31)
Size	–0.013	–0.012
	(–0.90)	(–0.84)
ROE	–0.004	–0.006
	(–0.02)	(–0.04)
Leverage	–0.024	–0.019
	(–0.39)	(–0.31)
Cash	0.039	0.043
	(0.80)	(0.89)
SOE	0.060***	0.059***
	(3.07)	(3.06)
Duality	–0.021	–0.021
	(–1.06)	(–1.04)
FinCenter	–0.006	–0.008
	(–0.39)	(–0.50)
Industry	YES	YES
Month	YES	YES
Constant	2.366***	2.345***
	(10.02)	(9.98)
N	300	300
Adjusted R^2	0.22	0.21

Notes: The *t*-statistics, calculated based on robust standard errors, are reported in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

results in Column (2) are also statistically and economically significant, which is consistent with the result above. Overall, the results in Table 2 support H1 that IPO firms listed during the inspection period experience higher levels of IPO underpricing.

The coefficients of the control variables carry the expected signs when they are significant, as shown in Table 2. For example, the coefficients of *Cost* are consistently negative and significant at the 1 % level, suggesting that IPOs that face high issue costs exhibit low levels of IPO underpricing because they impose high issue prices to recover their costs. The coefficients of *SOE* indicate that when the IPO firm is state-owned, it is more inclined to reduce its offer price to attract investors compared with non-SOEs.

5.3. Mechanism analysis

We further explore the mechanisms leading to higher IPO underpricing among IPO firms listed during the inspection period.

From the perspective of firm quality, we examine the *ROA* and *ROE* of the firms in our sample before and after their IPO. We present the results in Panels A and B of Table 3. Panel A reports the univariate analysis

Table 3
Test results of the mechanism analysis.

Panel A: Univariate tests

Variable	(1)	(2)	(3)
	Inspection	*Non-Inspection*	Mean and median differences
ROA_B1	0.106	0.115	–0.009
	[0.091]	[0.099]	[–0.008]
ROE_B1	0.174	0.190	–0.017*
	[0.162]	[0.178]	[–0.016**]
ROA_A1	0.060	0.063	–0.003
	[0.051]	[0.059]	[–0.008]
ROE_A1	0.089	0.091	–0.001
	[0.083]	[0.086]	[–0.003]
ROA_A2	0.056	0.060	–0.005
	[0.050]	[0.054]	[–0.004]
ROE_A2	0.084	0.089	–0.005
	[0.071]	[0.084]	[–0.013]
ROA_A3	0.051	0.053	–0.002
	[0.044]	[0.053]	[–0.009]
ROE_A3	0.071	0.078	–0.007
	[0.074]	[0.082]	[–0.008]
OfferPrice	11.420	14.200	–2.776***
	[10.500]	[12.870]	[–2.370***]

Panel B: Operating performance tests

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ROA_B1	*ROE_B1*	*ROA_A1*	*ROE_A1*	*ROA_A2*	*ROE_A2*	*ROA_A3*	*ROE_A3*
Inspection	0.002	–0.003	–0.004	0.004	–0.005	0.001	–0.006	–0.029
	(0.29)	(–0.31)	(–0.60)	(0.35)	(–0.78)	(0.08)	(–0.61)	(–1.52)
Controls	YES	YES	YES	YES	YES	YES	YES	YES
Industry	YES	YES	YES	YES	YES	YES	YES	YES
Month	YES	YES	YES	YES	YES	YES	YES	YES
Constant	0.012	–0.094	0.054	–0.011	0.046	0.019	0.047	–0.233
	(0.23)	(–1.13)	(0.86)	(–0.11)	(0.73)	(0.21)	(0.55)	(–1.49)
N	300	300	300	300	300	300	300	300
Adjusted R^2	0.77	0.59	0.21	0.02	0.19	0.04	0.09	–0.00

Panel C: Issue price tests

Variable	(1)
	OfferPrice
Inspection	–1.696**
	(–1.98)
Controls	YES
Industry	YES
Month	YES
Constant	–43.798***
	(–4.26)
N	300
Adjusted R^2	0.44

Notes: ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively. Panel A presents and compares the mean and median values, with the latter shown in brackets. Panels B and C report the regression results. The *t*-statistics, calculated based on robust standard errors, are reported in parentheses.

results for *ROA* and *ROE*. Interestingly, the *ROE* of IPO firms listed during the inspection period is significantly lower than the *ROE* in the year before their IPO. In the 3 years after their IPO, the differences in *ROA* and *ROE* are not significant. Meanwhile, Panel B of Table 3 shows the regression results, which suggest that

the operating performance of the treated firms is not significantly better than that of the control firms. The findings indicate that the CSRC does not take firm quality as its primary criterion for IPO approval during the inspection period. Therefore, these results do not support the firm quality mechanism.

The CSRC might be more concerned about capital market stability and avoiding market turmoil during the inspection period rather than firm quality when approving IPOs. If this is the case, we expect to find that during the inspection period, the CSRC is stricter in controlling the issue prices of IPO applicants than it is outside the inspection period. We take the issue price as the dependent variable empirically for two reasons (Zhou and Zhou, 2020). First, the China's IPO inquiry system is not equivalent to market-oriented pricing. During the sample period, the issue price limit of 23 times the P/E ratio ensures that extreme differences in issue prices do not emerge. Second, issue prices are determined by issuers and their lead underwriter, suggesting that these prices are closely related to the firms themselves. We present the univariate analysis and regression results in Panel A (the last line) and Panel C of Table 3, respectively. We find that the issue prices of IPO firms listed during the inspection period are significantly lower than those of firms listed outside the inspection period. Meanwhile, the coefficient of *Inspection* is –1.696 and is significant at the 5 % level, indicating that the average issue prices of IPO firms listed during the inspection period are 169.6 % lower than those of firms listed outside the inspection period. To ensure the robustness of these results, we construct two dependent additional variables, *OfferPrice_Share* (the issue price/actual number of shares issued) and *OfferPrice_Equity* (the issue price/equity). We re-estimate Eq. (1) using these two dependent variables and obtain the same results (untabulated).

Overall, the results of Table 3 show that the fundamentals of both groups are virtually the same. However, the issue prices of IPO firms listed during (outside) the inspection period are significantly lower (higher). Hence, during the inspection period, we argue that the CSRC is more concerned about capital market stability than at other times. This is reflected in a more conservative review process, resulting in stricter control of issue prices than outside the inspection period.

5.4. Post-IPO performance

To investigate the performance of firms listed after their IPO, we replace the dependent variable with *Performance* and re-estimate Eq. (1).

$$Performance_i = \alpha_0 + \alpha_1 Inspection_i + Control_i + Industry + Month + \varepsilon_i \quad (2)$$

where *Performance* denotes a firm's performance after its IPO. Following Huang et al. (2021), we use short-term excess returns (*CAR*) and long-term excess returns (*BHAR*) as proxies for market performance. The detailed variable definitions are presented in Appendix B.

5.4.1. Short-term market performance

We first examine short-term excess returns (*CAR*) at 5, 10, 30 and 60 days after an IPO. Panels A and B of Table 4 report the univariate analysis and regression results. The results in Panel A show that IPO firms listed during the inspection period have better short-term market performance than other IPO firms. Panel B indicates that the coefficients of *Inspection* are positive with an increasing trend and significant at the 1 % level. Fig. 2 confirms that the short-term market performance of IPO firms listed during the inspection period is significantly better than that of other IPO firms. Furthermore, the results are consistent with the argument in the literature that a lower issue price attracts investors and spurs a craze for stock speculation (Han and Wu, 2007).

5.4.2. Long-term market performance

We examine long-term excess returns (*BHAR*) at 6, 12 and 24 months after an IPO. The results are reported in Panels A and B of Table 5. The findings in Panel A show that the long-term market performance of IPO firms listed during the inspection period is significantly lower than that of firms listed outside the inspection period. In Panel B of Table 5, the coefficients of *Inspection* are negative and significant at the 1 % or 10 % level, consistent with the results of our univariate analysis.

Overall, IPO firms listed during the inspection period demonstrate better short-term market performance but poorer long-term returns than those listed outside the inspection period. The results support our mecha-

Table 4
Short-term market performance of firms approved for IPOs during the inspection period.

Panel A: Univariate analysis

Variable	(1)	(2)	(3)
	Inspection	*Non-Inspection*	Mean and median differences
CAR(1,5)	0.369	0.275	0.094***
	[0.383]	[0.273]	[0.110***]
CAR(1,10)	0.728	0.492	0.236***
	[0.765]	[0.504]	[0.262***]
CAR(1,30)	1.129	0.644	0.485***
	[1.100]	[0.581]	[0.519***]
CAR(1,60)	1.096	0.658	0.439***
	[1.081]	[0.615]	[0.467***]

Panel B: Regression results

Variable	(1)	(2)	(3)	(4)
	CAR_D (1,5)	*CAR_D (1,10)*	*CAR_D (1,30)*	*CAR_D (1,60)*
Inspection	0.120***	0.253***	0.509***	0.532***
	(10.87)	(9.47)	(7.34)	(9.04)
Controls	YES	YES	YES	YES
Industry	YES	YES	YES	YES
Month	YES	YES	YES	YES
Constant	0.994***	2.416***	5.065***	5.136***
	(7.13)	(8.38)	(11.45)	(10.57)
N	300	300	300	300
Adjusted R^2	0.42	0.48	0.57	0.50

Notes: ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively. Panel A presents and compares the mean and median values, with the latter shown in brackets. Panel B reports the regression results. The *t*-statistics, calculated based on robust standard errors, are reported in parentheses.

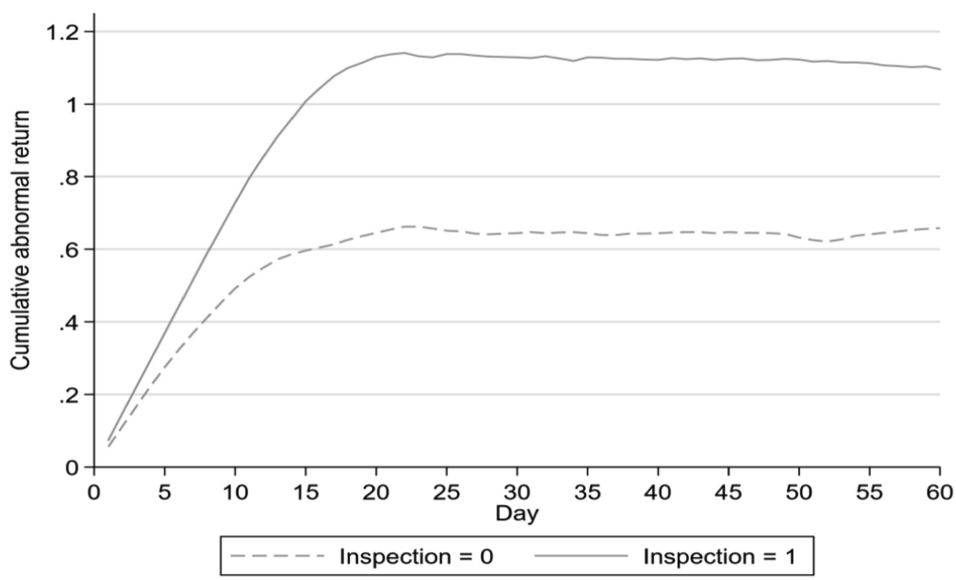


Fig. 2. Short-term market performance of firms approved for IPOs during the inspection period.

Table 5
Long-term market performance of firms approved for IPOs during the inspection period.

Panel A: Univariate analysis			
Variable	(1)	(2)	(3)
	Inspection	*Non-Inspection*	Mean and median differences
BHAR_M(0,6)	1.986	2.047	–0.061
	[1.753]	[1.492]	[0.261]
BHAR_M(0,12)	0.919	1.651	–0.732***
	[0.775]	[1.311]	[–0.536***]
BHAR_M(0,24)	0.619	0.783	–0.163
	[0.371]	[0.548]	[–0.176]

Panel B: Regression results			
Variable	(1)	(2)	(3)
	BHAR_M (0,6)	*BHAR_M (0,12)*	*BHAR_M (0,24)*
Inspection	–0.134	–0.962***	–0.325*
	(–0.59)	(–5.24)	(–1.84)
Controls	YES	YES	YES
Industry	YES	YES	YES
Month	YES	YES	YES
Constant	17.395***	16.477***	9.462***
	(7.51)	(8.08)	(4.49)
N	300	300	300
Adjusted R^2	0.32	0.36	0.19

Notes: ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively. Panel A presents and compares the mean and median values, with the latter shown in brackets. Panel B reports the regression results. The *t*-statistics, calculated based on robust standard errors, are reported in parentheses.

nism analysis, indicating that the CSRC is driven by increased concerns to maintain capital market stability during the inspection period compared with the non-inspection period. Thus, the CSRC is more inclined to approve the IPO of firms with lower issue prices, resulting in lower issue prices for IPO firms. Owing to the speculative behavior of investors, who prefer low issue prices, the short-term market performance of these firms is high compared with that of IPO firms listed during the non-inspection period. However, during the inspection period, the CSRC does not prioritize the selection of firms that are truly high quality in terms of fundamentals because of its focus on capital market stability and low issue prices. Therefore, investors ultimately turn to other stocks, resulting in poorer long-term market performance of these firms compared with IPO firms listed outside the inspection period.

6. Further analysis

6.1. Market classification

In our baseline results, *FDR10* is the difference between the mean closing price during the first 10 trading days and the offer price divided by the offer price. However, short-term market performance in the secondary market includes the daily stock prices. Thus, we further examine whether higher IPO underpricing for firms listed during the inspection period is determined by the primary or secondary market.

On 13 December 2013, the Shanghai and Shenzhen stock exchanges stipulated that the first-day bidding prices of shares could not be higher (lower) than 144 % (64 %) of the issue price. Therefore, the first-day trading prices of all A-shares cannot truly represent IPO underpricing in the secondary market. Following Zhang et al. (2020a), we define underpricing in the primary market as an IPO's P/E ratio. Then, we re-estimate Eq. (1) and present the results in Table 6. The results show that the coefficient of *PE* is negative but not significant, indicating that higher IPO underpricing is not exhibited in the primary market. Moreover, *FDR10* partly rep-

Table 6
The impact of the central discipline inspection of the CSRC on IPO underpricing in the primary market.

Variable	(1)
	PE
Inspection	–0.355
	(–1.01)
Controls	YES
Industry	YES
Month	YES
Constant	15.299***
	(4.57)
N	300
Adjusted R^2	0.19

Notes: The *t*-statistics, calculated based on robust standard errors, are reported in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

resents IPO underpricing in the secondary market. Therefore, we argue that the impact of the inspection on IPO underpricing is reflected mainly in the secondary rather than the primary market.

6.2. Ownership type

As an important cornerstone of the national economy, SOEs may obtain more support than non-SOEs from the government and banks. In general, they tend to encounter less resistance in the IPO process than non-SOEs. Thus, we expect to find that the CSRC is stricter in controlling the issue prices of non-SOEs than SOEs during the inspection period. To further examine the impact of different ownership types on IPO underpricing during the inspection period, we divide *Inspection* into two variables (Liu and Ye, 2018; Chen et al., 2022; Xie et al., 2022): *Inspection_SOE* and *Inspection_NonSOE*. *Inspection_SOE* equals 1 if the IPO firms listed belong to the treated group and are SOEs and 0 otherwise. *Inspection_NonSOE* equals 1 if the IPO firms listed belong to the treated group and are non-SOEs and 0 otherwise.

We present the regression results in Table 7. In Columns (1) and (2), the coefficients of *Inspection_NonSOE* are positive and significant at the 1 % level. The impact of the inspection within the CSRC on IPO underpricing is more pronounced for non-SOEs than for SOEs. Therefore, we argue that the unique features of SOEs mean that the CSRC does not need to demand as much from them as from non-SOEs in terms of controlling issue prices. Non-SOEs are usually subject to greater resistance during the IPO approval process and stricter control of their issue prices compared with SOEs. Overall, the above results are consistent with our baseline regressions.

6.3. Audit firms

Since the implementation of the approval system, audit firms hired by IPO applicants have played a crucial role in the IPO process in China. The duty of audit firms is to inspect the documents of an IPO application and reply to inquiries from regulators. The quality of the responses is decisive for the IPO review process. In this section, we examine the impact of different audit firms on IPO underpricing during the inspection period.

Information is crucial in the capital market. The ability of audit firms, as auditors of financial information, plays an important role in audit quality. In addition, studies demonstrate that the quality of audit firms could affect the IPO process (Lu et al., 2020), where high quality is generally indicated by an audit firm being one of the Big 4 accounting firms. Hence, we expect to find that the CSRC is stricter (less strict) in controlling the issue prices of firms that employ non-Big 4 (Big 4) audit firms. We divide *Inspection* into two variables, *Inspection_Big4* and *Inspection_NonBig4*. *Inspection_Big4* equals 1 if the IPO firms listed belong to the treated group and employ Big 4 accounting firms and 0 otherwise. *Inspection_NonBig4* equals 1 if the IPO firms listed belong to the treated group and employ non-Big 4 accounting firms and 0 otherwise. As shown in Table 8, the coef-

Table 7
Further analysis based on ownership type.

Variable	(1)	(2)
	FDR10	*AdjFDR10*
Inspection_NonSOE	0.061***	0.057***
	(3.22)	(3.11)
Inspection_SOE	–0.001	–0.006
	(–0.03)	(–0.22)
Controls	YES	YES
Industry	YES	YES
Month	YES	YES
Constant	2.365***	2.343***
	(10.07)	(10.03)
N	300	300
Adjusted R^2	0.22	0.21

Notes: The *t*-statistics, calculated based on robust standard errors, are reported in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

ficients of *Inspection_NonBig4* are positive and significant at the 1 % level, but the coefficients of *Inspection_Big4* are not significant. These results suggest that for IPO firms that employ non-Big 4 (Big 4) accounting firms, the impact of the inspection period on IPO underpricing is more (less) pronounced.

Overall, during the inspection period, the CSRC implements stricter controls for firms that employ low-quality (i.e., non-Big 4) audit firms. Conversely, we expect the CSRC to have confidence in the abilities of high-quality auditors and expect Big 4 audit firms to ensure that IPO applicants go public successfully and that they control stock prices properly. Hence, the CSRC's regulation of these firms is not as strict as for firms with non-Big 4 auditors. Moreover, the results further support H1, that the IPO firms listed exhibit higher IPO underpricing during the inspection period than those listed outside the inspection period.

6.4. External environment

The level of regional corruption affects the manipulative behaviors of local firms (Wan and Chen, 2010) and studies suggest that firms located in regions with high corruption experience greater IPO underpricing than those in regions with low corruption (Wang and Song, 2021). Hence, we expect to find that the CSRC is stricter (less strict) in controlling the issue prices of firms located in regions with high (low) corruption. We use the median number of corruption cases in the region where the IPO applicant is located to construct the dummy

Table 8
Further analysis based on audit firms.

Variable	(1)	(2)
	FDR10	*AdjFDR10*
Inspection_NonBig4	0.056***	0.051***
	(2.98)	(2.86)
Inspection_Big4	0.045	0.036
	(0.61)	(0.50)
Controls	YES	YES
Industry	YES	YES
Month	YES	YES
Constant	2.365***	2.343***
	(10.04)	(9.99)
N	300	300
Adjusted R^2	0.21	0.21

Notes: The *t*-statistics calculated based on robust standard errors are reported in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 9
Further analysis based on the external environment.

Variable	(1)	(2)
	FDR10	*AdjFDR10*
Inspection_Corruption	0.060***	0.055***
	(3.23)	(3.03)
Inspection_NonCorruption	0.042	0.039
	(1.48)	(1.45)
Controls	YES	YES
Industry	YES	YES
Month	YES	YES
Constant	2.373***	2.350***
	(9.92)	(9.90)
N	300	300
Adjusted R^2	0.21	0.21

Notes: The *t*-statistics calculated based on robust standard errors are reported in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 10
Analysis results using alternative measures of the dependent variable.

Panel A: Univariate tests

Variable	(1)	(2)	(3)
	Inspection	*Non-Inspection*	Mean and median differences
FDR20	2.694	2.114	0.580***
	[2.879]	[2.079]	[0.800***]
FDR30	3.667	2.677	0.990***
	[3.747]	[2.312]	[1.435***]
AdjFDR20	1.285	1.222	0.063***
	[1.292]	[1.283]	[0.009***]
AdjFDR30	3.665	2.675	0.990***
	[3.745]	[2.310]	[1.435***]

Panel B: Regression results

Variable	(1)	(2)	(3)	(4)
	FDR20	*FDR30*	*AdjFDR20*	*AdjFDR30*
Inspection	0.514***	0.904***	0.511***	0.902***
	(3.87)	(3.31)	(3.89)	(3.31)
Controls	YES	YES	YES	YES
Industry	YES	YES	YES	YES
Month	YES	YES	YES	YES
Constant	8.306***	14.435***	8.305***	14.428***
	(9.31)	(8.66)	(9.34)	(8.67)
N	300	300	300	300
Adjusted R^2	0.52	0.51	0.53	0.51

Notes: ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively. Panel A presents and compares the mean and median values, with the latter shown in brackets. Panel B reports the regression results. The *t*-statistics, calculated based on robust standard errors, are reported in parentheses.

variable *Corruption*. It equals 1 if the number of corruption cases in the IPO applicant's region is greater than the median and 0 otherwise. We collect data from the China Procuratorial Yearbooks. Specifically, we divide *Inspection* into two variables: *Inspection_Corruption* and *Inspection_NonCorruption*. *Inspection_Corruption* equals 1 if the IPO firms listed belong to the treated group and are located in regions with high corruption

Table 11
Regression results using matched samples.

Panel A: 1:1 matching of approximate *Size* and *EPS* within the same Industry

Variable	(1)	(2)
	FDR10	*AdjFDR10*
Inspection	0.127***	0.112***
	(3.14)	(3.00)
Controls	YES	YES
Industry	YES	YES
Month	YES	YES
Constant	2.400***	2.347***
	(5.72)	(5.88)
N	120	120
Adjusted R^2	0.37	0.35

Panel B: Covariate balance after propensity score matching (PSM)

Variable	*Inspection*		*Non-Inspection*		MeanDiff	p-value
	N	Mean	N	Mean		
OfferSize	61	0.469	61	0.488	–0.019	0.656
TimeLag	61	2.667	61	2.687	–0.020	0.623
PVC	61	0.721	61	0.705	0.016	0.843
Big4	61	0.049	61	0.049	0.000	1.000
Age	61	2.571	61	2.594	–0.024	0.747
Cost	61	8.275	61	8.279	–0.004	0.954
Size	61	11.340	61	11.340	–0.002	0.990
ROE	61	0.167	61	0.173	–0.007	0.571
Leverage	61	0.409	61	0.399	0.010	0.753
Cash	61	0.208	61	0.211	–0.003	0.927
SOE	61	0.115	61	0.148	–0.033	0.595
Duality	61	0.180	61	0.180	0.000	1.000
FinCenter	61	0.213	61	0.213	0.000	1.000

Panel C: Regression results using the PSM matched sample

Variable	(1)	(2)
	FDR10	*AdjFDR10*
Inspection	0.049**	0.046*
	(2.06)	(1.96)
Controls	YES	YES
Industry	YES	YES
Month	YES	YES
Constant	1.847***	1.859***
	(5.76)	(5.94)
N	122	122
Adjusted R^2	0.32	0.34

Notes: The *t*-statistics, calculated based on robust standard errors, are reported in parentheses. ***, ** and

and 0 otherwise. *Inspection_NonCorruption* equals 1 if the IPO firms listed belong to the treated group and are located in regions with low corruption and 0 otherwise.

Table 9 presents the regression results. The coefficients of *Inspection_Corruption* in Columns (1) and (2) are positive and significant at the 1 % level. However, the coefficients of *Inspection_NonCorruption* are not significant. These results are in accordance with our expectations and indicate that the CSRC is more concerned about the quality of firms located in regions with high corruption than those in regions with low corruption. Therefore, the CSRC is stricter in controlling the former firms' issue prices to prevent the emergence of market chaos, i.e., broken IPOs, during the inspection period than outside the inspection period.

Table 12
The impact of IPO suspensions on IPO underpricing.

Panel A: Regression results based on the 2008–2009 IPO suspension		
Variable	(1)	(2)
	FDR10	*AdjFDR10*
Suspension1	0.098	0.095
	(0.47)	(0.46)
Controls	YES	YES
Industry	YES	YES
Month	YES	YES
Constant	2.270*	2.269*
	(1.96)	(1.96)
N	105	105
Adjusted R^2	0.28	0.27
Panel B: Regression results based on the 2012–2014 IPO suspension		
Variable	(1)	(2)
	FDR10	*AdjFDR10*
Suspension2	0.019	0.018
	(0.16)	(0.15)
Controls	YES	YES
Industry	YES	YES
Month	YES	YES
Constant	4.063***	4.052***
	(4.31)	(4.30)
N	94	94
Adjusted R^2	0.77	0.77

Notes: The *t*-statistics, calculated based on robust standard errors, are reported in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

7. Robustness tests

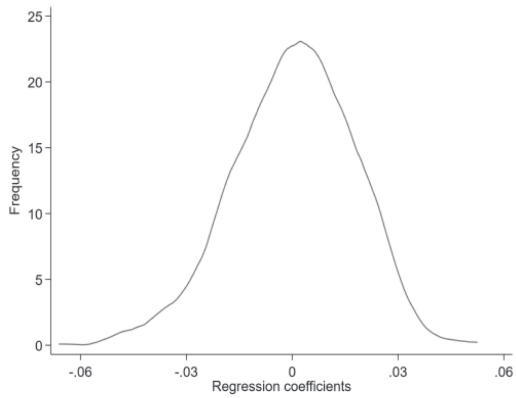
7.1. Alternative measures of the dependent variable

Since 2001, the CSRC has only allowed daily stock swings of 10 % in either direction. In 2013, the Shanghai and Shenzhen stock exchanges implemented the first-day daily limit system. Thus, the CSRC has continuously imposed regulatory limits on daily trading prices. Following Chan et al. (2004) and Chung et al. (2005), we use the mean closing price during the first 20 or 30 trading days after an IPO to calculate IPO underpricing (*FDR20* and *FDR30*, respectively). Meanwhile, we examine the market-adjusted first-day returns, *AdjFDR20* and *AdjFDR30*, by subtracting the concurrent market returns of A-shares from *FDR20* and *FDR30*. We re-estimate Eq. (1) and Table 10 shows the univariate analysis and regression results. As shown in Panel A of Table 10, IPO firms listed during the inspection period exhibit higher IPO underpricing than those listed outside the inspection period. Panel B of Table 10 shows that the coefficients of *Inspection* are positive and significant at the 1 % level, further supporting our baseline regression results.

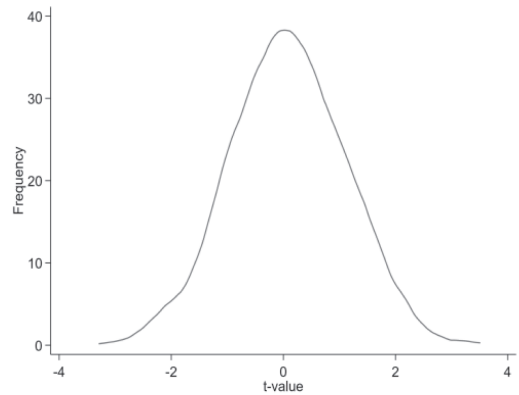
7.2. Matched samples

To further address possible endogeneity, we construct a 1:1 matched sample using firm size, earnings per share (EPS) and industry. We match book assets and EPS because the CSRC takes firm size and historical profitability as primary criteria. Using the matched group,[6] we re-estimate Eq. (1). As shown in Panel A of

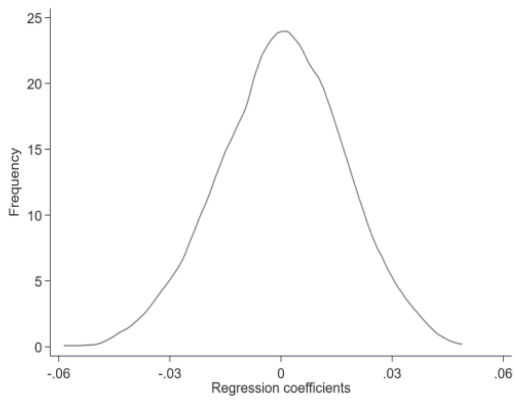
[6] One firm from our sample is dropped because there are no counterparts in the same industry and year.



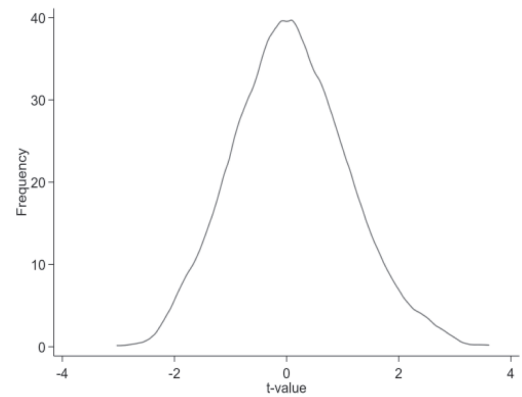
A. Regression coefficients (*FDR10*)



B. t-values (*FDR10*)



C. Regression coefficients (*AdjFDR10*)



D. t-values (*AdjFDR10*)

Fig. 3. Placebo test.

Table 11, the coefficients of *FDR10* and *AdjFDR10* are positive and significant at the 1 % level, consistent with our baseline regression results.

Moreover, we construct a 1:1 matched sample using propensity score matching (PSM). Specifically, we take a set of variables in Eq. (1) as the matched variables. We use a logit model to calculate the propensity scores to select the control group and then re-estimate Eq. (1). Panel B of Table 11 reports the differences in the matched variables after PSM and indicates that there are no significant differences between the treated and control groups. The results in Panel C of Table 11 show that IPO underpricing is higher for IPO firms listed during the inspection period than outside the inspection period, consistent with our baseline regression results.

7.3. Intervention of IPO suspension

A concern of the CSRC is that too many IPOs may have negative impacts on market liquidity and stock prices. Hence, as an extreme form of IPO market regulation, when these concerns are high, the CSRC suspends all IPO activities beyond the application submission step. Since the establishment of the Shanghai and Shenzhen stock exchanges, there have been nine IPO suspensions in China. In addition, these suspensions all started and ended without pronouncements. After an IPO suspension, the demand for new stock market shares may increase significantly and there could be a simultaneous influence on IPO underpricing. Moreover,

studies suggest that IPO suspensions influence firm behavior regarding corporate innovation, social responsibility and internal governance (Cong and Howell, 2021; Li et al., 2022; Pan et al., 2022). Thus, IPO suspensions may affect IPO underpricing. To address this concern, following Cong and Howell (2021), we use two IPO suspensions to test the robustness of our results: the first is from September 2008 to June 2009 and the second is from October 2012 to April 2014.

We choose firms with IPOs up to 3 months before (after) the IPO suspensions in 2008 and 2012 as the control (treated) group to examine this issue empirically. Then, we introduce two dummy variables, *Suspension1* and *Suspension2*. *Suspension1* equals 1 if IPO firms go public between July 2009 and September 2009 and 0 otherwise. *Suspension2* equals 1 if IPO firms go public between May 2014 and July 2014 and 0 otherwise. We re-estimate Eq. (1) using the two variables. Panels A and B of Table 12 report the corresponding regression results. The coefficients of *Suspension1* and *Suspension2* are positive but not significant. Overall, we conclude that our findings are robust to the inclusion of IPO suspensions in our analysis.

7.4. Placebo test

Another concern is that our baseline regressions may be randomly caused by a time trend. To address this problem, we conduct a placebo test by randomly selecting firms from the sample as the treated group. Then, we repeat the random process 1,000 times. Fig. 3 presents the distribution of the estimates of the 1,000 runs, which is clearly centered on 0, suggesting no effect in the randomly constructed sample. Therefore, these results further support our baseline results.

8. Conclusions

Using the unique setting of China's central discipline inspection of the CSRC in 2015, we examine the impacts of anti-corruption campaigns on IPO underpricing. Our study has three main findings. First, IPO firms listed during the inspection period are associated with significantly higher IPO underpricing than those listed outside the inspection period. Under the deterrent effect of China's anti-corruption campaigns, the CSRC's key concern becomes capital market stability, leading it to take low issue prices, rather than firm quality, as its primary consideration during the inspection period. Second, the short-term market performance of IPO firms listed during the inspection period is significantly better than that of other IPO firms, but their long-term performance is poorer. Finally, we find that the effect of the inspection within the CSRC on IPO underpricing is mainly exhibited in the secondary market rather than the primary market. Moreover, the effect of China's anti-corruption campaigns on IPO underpricing is more (less) pronounced for non-SOES (SOEs), firms with low-quality (high-quality) auditors and those located in regions with high (low) corruption.

Our study has two important implications. First, investors should pay attention to the consequences of anti-corruption campaigns and make rational investments. The long-term returns of IPO firms listed during the inspection period are poorer than those of other IPO firms, indicating that the operating performance of these firms is not better than those of other IPO firms. Thus, investors should focus on firm fundamentals and rationally analyze the relationship between a firm's issue price and its operating performance. Second, the government should improve the anti-corruption system and consider its unexpected effects on the inspected subjects. For example, to prevent market turmoil during the inspection period, the CSRC attaches greater importance to the issue prices of IPO applicants than to firm quality. This focus, without attempts to solve the root causes, does not promote the development of China's capital market. Indeed, it may distort the market and harm investor interests.

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Appendix A. Firms approved to conduct IPOs during the inspection period

Stock code	Passing date (day/month/year)	Listing date (day/month/year)	Industry
601,020	25/11/2015	16/03/2016	Mining
603,726	25/11/2015	21/04/2016	Manufacturing
603,029	18/11/2015	27/04/2016	Manufacturing
603,822	02/12/2015	28/04/2016	Manufacturing
603,101	09/12/2015	06/05/2016	Wholesale & retail trade
002,796	27/11/2015	10/05/2016	Manufacturing
603,779	02/12/2015	16/05/2016	Manufacturing
603,959	02/12/2015	17/05/2016	Construction
603,339	09/12/2015	19/05/2016	Manufacturing
002,798	11/12/2015	25/05/2016	Manufacturing
300,513	20/11/2015	30/05/2016	Information technology
002,800	25/12/2015	30/05/2016	Transport & storage
300,516	27/11/2015	02/06/2016	Manufacturing
603,737	16/12/2015	03/06/2016	Manufacturing
603,131	16/12/2015	07/06/2016	Manufacturing
300,515	27/11/2015	08/06/2016	Manufacturing
002,799	18/12/2015	08/06/2016	Manufacturing
601,127	23/12/2015	15/06/2016	Manufacturing
002,801	30/12/2015	22/06/2016	Manufacturing
300,519	04/12/2015	24/06/2016	Manufacturing
300,518	11/12/2015	24/06/2016	Information technology
603,909	23/12/2015	28/06/2016	Scientific research & technical service
002,802	30/12/2015	29/06/2016	Manufacturing
603,958	08/01/2016	29/06/2016	Manufacturing
603,016	06/01/2016	01/07/2016	Manufacturing
300,521	11/12/2015	05/07/2016	Manufacturing
300,522	18/12/2015	05/07/2016	Manufacturing
601,966	13/01/2016	06/07/2016	Manufacturing
002,805	22/01/2016	07/07/2016	Manufacturing
300,520	25/12/2015	08/07/2016	Information technology
603,069	20/01/2016	12/07/2016	Transport & storage
300,517	04/12/2015	19/07/2016	Construction
300,523	18/12/2015	26/07/2016	Information technology
002,806	18/01/2016	26/07/2016	Manufacturing
300,525	29/01/2016	26/07/2016	Information technology
603,322	27/01/2016	28/07/2016	Information technology
603,663	20/01/2016	01/08/2016	Manufacturing
300,529	08/01/2016	02/08/2016	Manufacturing
300,526	15/01/2016	02/08/2016	Manufacturing
300,527	25/12/2015	05/08/2016	Manufacturing
300,528	30/12/2015	08/08/2016	Communication & cultural industry
601,811	06/01/2016	08/08/2016	Communication & cultural industry
300,531	22/01/2016	09/08/2016	Manufacturing
300,530	29/01/2016	09/08/2016	Manufacturing
603,569	27/01/2016	10/08/2016	Social service
300,535	29/01/2016	12/08/2016	Manufacturing

600,936	27/01/2016	15/08/2016	Information technology
601,595	30/12/2015	17/08/2016	Communication & cultural industry
300,533	15/01/2016	18/08/2016	Information technology
300,532	29/01/2016	18/08/2016	Information technology
300,538	27/01/2016	26/08/2016	Wholesale & retail trade
002,810	29/01/2016	26/08/2016	Manufacturing
603,007	29/01/2016/	26/08/2016	Construction
603,843	27/01/2016	05/09/2016	Construction
601,163	06/01/2016	09/09/2016	Manufacturing
603,067	20/01/2016	13/09/2016	Manufacturing
300,541	29/01/2016	13/09/2016	Information technology
603,189	27/01/2016	14/09/2016	Information technology
300,559	25/12/2015	01/11/2016	Information technology
601,882	20/01/2016	07/11/2016	Manufacturing
300,572	22/01/2016	06/12/2016	Manufacturing

Appendix B. Variable definitions

Variable	Definition
FDR10(20/30)	Difference between the mean closing price during the first 10 (20/30) trading days and the offer price divided by the offer price.
AdjFDR10(20/30)	Market-adjusted first-day returns (*FDR10(20/30)*). Market returns are market returns for A-shares.
CAR-D(1,d)	Cumulative market-adjusted stock returns from the day after the IPO (1) to day *d*.
BHAR_M(0, m)	Cumulative market-adjusted stock returns from the month of the IPO (*0*) to month *m* (excluding the first day).
ROA(B/A, y)	Mean *ROA* in *y* years before (after) the IPO. *ROA* equals the ratio of earnings to total assets in the fiscal year.
ROE(B/A, y)	Mean *ROE* in *y* years before (after) the IPO. *ROE* equals the ratio of earnings to total equity in the fiscal year.
Inspection	A dummy variable that equals 1 if the firm obtains IPO approval between 31 October 2015 and 31 January 2016 and 0 if the firm obtains IPO approval between 31 October 2014 and 30 June 2015.
Suspension1	A dummy variable that equals 1 if the firm goes public between July 2009 and September 2009 and 0 if the firm goes public between June 2008 and August 2008.
Suspention2	A dummy variable that equals 1 if the firm goes public between May 2014 and July 2014 and 0 if the firm goes public between May 2012 and July 2012.
Inspection_(Non) SOE	A dummy variable that equals 1 if the IPO firms listed belong to the treated group and are (not) state-owned firms and 0 otherwise.
Inspection_(Non) Big4	A dummy variable that equals 1 if the IPO firms listed belong to the treated group and employ (non–) Big 4 audit firms and 0 otherwise.
Inspection_(Non) Corruption	A dummy variable that equals 1 if the IPO firms listed belong to the treated group and are located in regions with high (low) corruption and 0 otherwise.
OfferPrice	Issue price of listed firms.
OfferPrice_Share	Issue price/actual number of shares issued.
OfferPrice_Equity	Issue price/equity.
OfferSize	Ratio of the dollar amount of IPO proceeds to total assets.

TimeLag	Natural logarithm of 1 plus the number of days between disclosing the IPO prospectus and the listing day.
Age	Natural logarithm of 1 plus the age of the firm in the IPO year.
Cost	Natural logarithm of total issuance costs.
Big4	A dummy variable that equals 1 if the firm is audited by a Big 4 accounting firm and 0 otherwise.
Size	Natural logarithm of total assets in the pre-IPO year.
ROE	Return on equity in the pre-IPO year.
Cash	Ratio of cash assets to total assets in the pre-IPO year.
SOE	A dummy variable equals 1 if the firm is state-owned in the IPO year and 0 otherwise.
Duality	A dummy variable that equals 1 if the chair of the board is also the CEO and 0 otherwise.
PVC	A dummy variable that equals 1 if the firm has private equity or venture capital investors and 0 otherwise.
Leverage	Leverage ratio, measured as total debt over assets in the pre-IPO year.
Fincenter	A dummy variable that equals 1 if the firm is located in a financial center (i.e., Beijing, Shanghai and Shenzhen) and 0 otherwise.
Month	A dummy variable set according to the month.
Industry	A dummy variable set according to the industry classification of the CSRC in 2012.

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Confucian culture and corporate bond pricing

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ABSTRACT

We investigate the effect of Confucian culture on corporate bond pricing. Using the birthplace data of 56,759 *Jinshi* in the Ming and Qing dynasties to construct a proxy of Confucian culture, we find a significantly negative relation between Confucian culture and bond pricing: the stronger the Confucian atmosphere of the corporate headquarters' location, the higher the bond rating and the lower the credit spread. This conclusion still holds after using the distance to the nearest ancient printing office as an instrumental variable and a series of robustness tests. The mechanism test shows that Confucian culture can improve the pricing efficiency of corporate bonds by fostering investors' trust, alleviating principal–agent problems and restraining bad corporate behaviors. Moreover, the impact of Confucian culture on corporate bond pricing is greater for firms located in regions with weak legal and other formal institutional constraints and for unlisted companies. Our study complements the literature on culture and bond pricing, and provides policy insights from traditional Chinese wisdom for improving the efficiency of financial markets.

1. Introduction

In recent years, policy makers have lauded the role of Chinese traditional culture in economic and social development. In the 19th National Congress of the Communist Party of China, the General Secretary of the CPC Central Committee, Xi Jinping, pointed out that "Culture is the soul of a country and a nation; without cultural prosperity, there will be no great rejuvenation of the Chinese nation." Since the 18th CPC National Congress, Xi Jinping has emphasized cultural pride on multiple occasions. He has stated "We must maintain pride in our path, theories, systems and, most fundamentally, our culture." The General Offices of

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the CPC Central Committee and the State Council promulgated the *Opinions on Implementing the Project for Inheriting and Developing the Glories of Traditional Chinese Culture* in 2017. Since then, the comprehensive revival of traditional culture has become a national strategic issue and policy in China.

It is not only government departments that have emphasized traditional culture. The role of traditional culture in market activities has also been of interest to scholars. Previous studies show that culture affects cognition, interaction and strategic choice among economic entities (DiMaggio, 1997) by shaping individual preferences and values (Guiso et al., 2006); culture is thus a fundamental factor in economic growth (Zhao and Lin, 2017). China is a transitional market economy with an imperfect legal system (Allen et al., 2005). Its traditional culture goes back thousands of years, and acts as a substitute for the formal system more recently transplanted from Western countries; thus, China's traditional culture exerts a profound influence on its economy (Chen et al., 2013; Dai et al., 2016).

Among aspects of Chinese traditional culture, Confucianism has the most far-reaching influence (Xu and Li, 2020), and examining economic and financial issues from the perspective of Confucian culture has become popular in the field of finance. Previous studies investigate the impact of Confucian culture on agency costs, risk taking, enterprise innovation, on-the-job consumption and other economic activities (Gu, 2015; Jin et al., 2017; Xu and Li, 2019; Pan et al., 2020; Pan et al., 2021). However, there are still some gaps in the literature. Previous studies mainly focus on the impact of Confucian culture on corporate behavior, with the exception of Xu et al. (2020), who examine its impact on stock price crash risk; there are few studies of how Confucian culture affects asset pricing. Previous research also focuses on the stock market, rather than the bond market. Building on the literature, this paper explores the impact of Confucian culture on bond pricing.

We first obtain the birthplace data of 56,759 *Jinshi* in the Ming and Qing dynasties and match the longitude and latitude of these birthplaces with contemporary administrative divisions. In this way, we obtain the number of *Jinshi* in the Ming and Qing dynasties in prefecture-level cities and use this as a proxy index of Confucian culture. The benchmark regression result shows that the stronger the Confucian atmosphere of a firm's location, the higher the bond rating and the lower the credit spread. This conclusion holds when the distance to the nearest ancient printing office is used as an instrumental variable in regressions and other robustness tests are carried out. The mechanism test shows that Confucian culture improves the pricing efficiency of corporate bonds by fostering investors' trust, reducing principal–agent problems and restraining bad corporate behavior. Furthermore, the impact of Confucian culture on corporate bond pricing is greater for firms located in regions with weak legal and other formal institutional constraints and for unlisted companies.

Compared with previous studies, this paper makes the following contributions. First, it expands the scope of research on the intersection of Confucian culture and finance. The Chinese bond market has developed into the second largest bond market in the world. By the end of 2020, the stock volume of the bond market exceeded 113.87 trillion yuan, while the total market value of Chinese A-share listed companies was 79.72 trillion yuan.[1] However, most previous studies of Confucian culture and finance are still limited to the stock market, focusing on the impact of Confucian culture on corporate financial behavior and governance decisions (Gu, 2015; Jin et al., 2017; Xu and Li, 2020; Pan et al., 2020). From the perspective of bond rating and credit spread, this paper provides new evidence from the bond market for understanding the influence of Confucian culture on economy and finance.

Second, this paper extends the research on bond pricing. Previous studies mainly focus on "hard information" including bond terms (Chen and Li, 2013; Shi et al., 2016), auditing (Chen and Li, 2014), underwriting (Wang and Gao, 2017; Lin et al., 2019), rating payment models (Wu et al., 2020), ownership (Lin et al., 2020) and multiple credit ratings (Chen et al., 2021), and pay less attention to "soft information". Regarding Confucian culture as a kind of soft information, this paper embeds regional values and social norms into enterprise management and governance and confirms that local Confucian culture does reduce the bond financing cost (higher bond rating, lower credit spread), providing a new perspective on bond pricing.

Finally, this research has practical significance. China's economic system is still imperfect, and informal institutions such as culture, customs and religion still play an important role in the economy (Allen et al.,

[1] Source: https://www.xinhuanet.com/fortune/2020–10/11/c_1126592602.htm; https://finance.sina.com.cn/roll/2021–01-01/doc-iiznezxt0016277.shtml.

2005; Chen et al., 2013). This study shows that Confucian culture has had a positive impact on the bond market, with a scale exceeding 100 trillion yuan, which provides support for the CPC Central Committee's policies, post-18th CPC National Congress, of promoting cultural pride and preserving Chinese traditional culture. It also suggests how bond market regulators can promote the development of the bond market.

The remainder of the paper proceeds as follows. Section 2 presents the theoretical analysis and research hypothesis. Section 3 describes our research design. Section 4 reports the empirical results. Section 5 provides further analysis, and Section 6 concludes the paper.

2. Theoretical analysis and hypothesis

2.1. Soft information, informal institutions and debt financing costs

In research on financial markets and intermediation, scholars often use "soft information" and "hard information" to distinguish types of information about enterprises. "Soft information" refers to qualitative information that is difficult to summarize using numerical data, while "hard information" is easy to quantify (Bertomeu and Marinovic, 2016; Liberti and Petersen, 2019). Because it is difficult to quantify and collect soft information, the literature in this area is mostly limited to theoretical discussion, rather than empirical studies. In addition, because soft information is often specific to persons and relationships, it is difficult to transfer within an enterprise or between enterprises. Scholars have accordingly become especially interested in soft information (Bertomeu and Marinovic, 2016). Some studies find that financial market participants and intermediaries consider not only hard information such as financial statements but soft information when they price corporate debt financing (Butler and Cornaggia, 2012; Kraft, 2015; Botsch and Vanasco, 2019).

Some studies find that rating agencies and banks extract and process enterprises' soft information and use it to price debts. Butler and Cornaggia (2012) find that when bond rating agencies charge higher fees, they rely less on publicly available hard information, which means that rating fees include the cost of assessing the soft information of issuers. Kraft (2015) focuses on Moody's rating process, in which adjustments are made to corporate financial reports before ratings are given. As Moody uses a relatively rigorous assessment methodology, these adjustments tend to be downward. The author divides these adjustments into hard information and soft information adjustments according to whether they can be quantified or not, and empirically finds that soft information adjustments significantly improve the credit spread of the underlying bonds, which means that rating agencies deal with soft information effectively. Botsch and Vanasco (2019) investigate the process of obtaining soft information in relational transactions. They find that after it establishes a loan relationship with an enterprise, a bank can gradually obtain soft information about the enterprise that cannot be observed by the external market, and subsequently approve and price the enterprise's loan application more effectively. Generally, the common point of these studies lies in indirectly inferring that soft information plays a role in the pricing process through incomplete correlation between bond pricing outcome variables, such as credit rating and credit spread, and hard information such as enterprise financial data.

Second, with the development of informal institution research in recent years, a few scholars try to bring social capital, religion and other informal institutional factors that are traditionally considered to be difficult to measure into the category of soft information, and directly test whether soft information has a pricing function in debt financing. Hasan et al. (2017) use the percent of eligible voters who voted in presidential elections and the county-level response rate to the Census Bureau's decennial census as an indicator of social capital. They find that higher regional social capital is associated with lower corporate bank loan spread, indicating that the soft information of social capital is helpful for determining the loan price. Similarly, Jiang et al. (2018) use the proportion of religious believers among the population in the county where a company's headquarters is located as an indicator of regional religious belief intensity. They find that religion, as a kind of soft information, improves the credit rating of enterprises and reduces the credit spread and the interest rate of bank loans. In addition, Li et al. (2018) find that social capital helps to reduce the price of municipal bonds in the secondary market, which means that the capital market also considers the soft information of social capital in pricing municipal bonds. Finally, taking the Chinese bond market as a research context, Yang et al. (2019) investigate the role of trust (a form of social capital) in bond pricing, and find that the higher

the trust index of the province where an enterprise is located, the higher the credit rating of the bonds issued by the enterprise, and the lower the credit spread.

As we can see, the pricing role of soft information in debt financing is indirectly inferred and directly tested by a number of empirical studies. However, these studies still have some shortcomings. The scope of soft information is relatively broad, and the types of soft information investigated in the literature are quite limited. For example, soft information at the regional or national level conceptually covers factors related to informal institutions, including religion, culture, customs and social capital; however, the papers cited above only discuss religion and social capital, and Hasan et al. (2017) and Jiang et al. (2018) do not distinguish between types of religious faith. In addition, relatively few studies focus on emerging economies. Considering that emerging economies often have imperfect market mechanisms, low levels of financial development and poor information transparency, soft information related to informal institutions may play a more important role than in developed economies (Allen et al., 2005; Chen et al., 2013). Therefore, in an emerging economy, research on soft information and bond pricing from the perspective of informal institutions has unique advantages.

Based on the above analysis, this paper examines whether the informal institution of Confucian culture acts at the regional level as useful soft information, which in turn has an impact on bond pricing. It is worth mentioning that, unlike Hasan et al. (2017) and Jiang et al. (2018), who focus on religion, this paper investigates the effect of traditional Chinese Confucianism, mainly based on the particularities of Chinese culture. Religion has had a relatively weak influence on China's society, politics and economy, in contrast to Europe and the United States (Weber and Gerth, 1953; Yang, 1967).[2] Additionally, since Emperor Wu of the Han Dynasty declared "Dismiss the hundred schools, revere only the Confucians" more than 2,000 years ago, Confucianism has been regarded as the orthodoxy by the Chinese ruling class and has had a decisive influence on the development of Chinese history and society (Feng and Tu, 1985; Du, 2012). It has deep roots in Chinese society, and it is the common, daily ethos of both the general populace and the elite (Xu, 2014). Therefore, it may be more meaningful to examine the role of Confucianism in the modern bond market, given its thousands of years of history.

2.2. Confucian culture and corporate bond pricing

Based on an in-depth interpretation of Confucian classic literature, this paper argues that Confucian culture, as an important form of soft information, can convey positive signals about willingness to repay debts and governance quality to external investors, which can induce creditors to conduct a more optimistic assessment of the company's default risk than hard information such as financial reports would indicate, thus reducing the risk premium level required by creditors, improving the debt rating of enterprises and reducing financing costs.

First, a stronger Confucian culture in the enterprise's location may mean that its managers are more willing to pay debts, thereby reducing the risk premium required by investors. Confucianism attaches great importance to honesty, which is mentioned many times in the Confucian classics: for example, "I do not know how a man without truthfulness is to get on,"[3] "What has been said cannot be unsaid,"[4] "Sincerity is the way of heaven. Making oneself sincere is the way of man."[5] The Confucian valorization of honesty has a far-reaching influence on Chinese borrowing and lending. "It is only right and proper to pay off debts," "Out of debt, out of danger," "Nothing can be accomplished without integrity"—all of these sayings reflect people's averseness to losing credit, which makes them unlikely to default. Therefore, when the Confucian honesty principle extends to enterprise managers' handling of the loan relationship, it will be embodied in

[2] According to one view, Confucianism, Buddhism and Taoism have absorbed and influenced each other in China, resulting in a fusion (Brook, 1993). However, Confucianism is not considered a religion in China. Both Buddhism and Taoism have supernatural deities (namely, Buddha and Taoist deities), but Confucianism does not (Rosker, 2017). Religion emphasizes the performance of rituals, while Confucianism does not. Buddhists and Taoists traditionally visit religious sites (such as temples) to perform strict religious rituals (Conroy and Emerson, 2004).

[3] *Analects of Confucius*: *Wei Zheng.*

[4] *Analects of Confucius: Yanyuan.* The original text is "Your words show you to be a superior man, but four horses cannot overtake the tongue.".

[5] *Mencius: Li Lou Shang.*

a commitment to repaying debts on schedule to creditors. In the bond market, bond investors should evaluate not only the solvency of bond issuers but also the willingness of bond issuers to repay debts. Companies that are deeply influenced by Confucian culture are more likely to pay their debts faithfully, so investors are more willing to trust them, thus reducing the risk compensation required.

Second, a stronger Confucian culture in the location of the enterprise may mean better corporate governance and fewer principal–agent problems, thus reducing the risk premium demanded by investors. Due to the different order of claims to cash flow, there is a natural conflict of interest between creditors and shareholders, so the interests of creditors may be damaged by certain corporate behaviors (Jensen and Meckling, 1976; Myers, 1977). Black (1976), for example, points out that an enterprise may make itself unable to repay its debts by paying dividends to its shareholders, knowing that it is going to be insolvent. Studies by Jiang et al. (2010) and Chu (2018) based on the perspective of dual holders of stocks and bonds also confirm that principal–agent conflicts increase the debt financing costs of enterprises. Therefore, because they require compensation for risk, creditors take the agency problem into consideration when pricing bonds. As an implicit constraint mechanism, Confucian culture can inhibit the potential encroachment of creditors' interests by management and major shareholders, thus reducing the cost of bond financing. First, Confucian culture respects the ethos of "The superior man comprehends righteousness; the small man comprehends profit,"[6] which has caused the Chinese people to value "righteousness before profit" in their daily life for thousands of years. Specific to corporate operations and management, "Taking what one has no right to is contrary to righteousness,"[7] so it is obviously "unrighteous" for the management or major shareholders of the company to encroach on the interests of creditors to seek benefits for themselves by paying excess dividends, over-investing in high-risk projects or transferring company assets. "Riches and honors acquired by unrighteousness are to me as a floating cloud."[8] Therefore, in areas with stronger Confucian culture, it is less likely that the practice of encroaching on creditors' interests out of self-interest will be engaged in by management and controllers, and more likely that it will be condemned by outsiders. Second, Confucian culture emphasizes the ethical norm of "faithfulness." Confucius pointed out in the *Book of Rites* that "The scholar does not consider gold and jade to be precious treasures, but loyalty and good faith." Ceng Zi famously said "I examine myself three times a day," which includes inquiring "whether, in transacting business for others, I may have been not faithful; whether, in intercourse with friends, I may have been not sincere." It can be seen that the Confucian ethics of "loyalty" determines the code of conduct when individuals accept the trust of others; that is, on the one hand, they should be conscientious and dedicated to what they have been entrusted with, and on the other hand, they should give timely and truthful feedback to the other party: "being trusted by others and being loyal to others," as the folk proverb says. In terms of corporate governance and operation, the Confucian ethic of "faithfulness" requires the management and controllers to abide by the obligations of diligence and loyalty, and to focus on maximizing the company's overall value as the decision-making criterion. Therefore, under the influence of the Confucian ethos of "faithfulness", there are fewer principal–agent problems and better corporate governance. With the reduction of agency problems, bond investors will reduce the risk compensation they require.

Third, a stronger Confucian culture in the location of the enterprise may mean that its business behavior and information disclosure are more stable, which makes the risk of negative events lower, thus reducing its bond financing cost. A large number of studies show that negative events such as financial fraud, environmental pollution and product defects seriously damage enterprises' reputation and have negative consequences in the capital market, such as stock price declines, rating downgrades and debt contract tightening (Wang et al., 2010; Zhu, 2020). Many ethical norms in Confucian culture can restrain bad behaviors in enterprise management and information disclosure. For example, Confucian culture attaches importance to honesty; Confucian businessmen believe in the principle of "no faith, no prosperity," and regard honesty as their creed. When the Confucian principle of honesty extends to the business behavior of enterprises, they will avoid cheating consumers, investors, tax authorities and other stakeholders, and try to fulfill promises on time. Obviously, negative behaviors such as financial fraud and spreading misinformation are attempts to deceive stakeholders,

[6] *Analects of Confucius: Li Ren.*
[7] *Mencius: Jin Xin Shang.*
[8] *Analects of Confucius: Shu Er.*

which do not conform to the concept of honest management. Therefore, the concept of honesty emphasized by Confucianism can reduce the bad behavior of enterprises. As another example, Confucian culture emphasizes prudence in words and deeds. In the *Analects*, Confucius frequently emphasized that individuals need to be cautious in their words: "He who aims to be a man of complete virtue in his food does not seek to gratify his appetite, nor in his dwelling place does he seek the appliances of ease; he is earnest in what he is doing, and careful in his speech,"[9] "The firm, the enduring, the simple and the modest are near to virtue,"[10] "The superior man wishes to be slow in his speech and earnest in his conduct."[11] Similarly, cautiousness is another major principle of Confucian ethics. For example, Confucius warned his disciples "He who will unarmed attack a tiger, or cross a river without a boat, dying without any regret, I would not have act with me. My associate must be the man who proceeds to action full of solicitude, who is fond of adjusting his plans, and then carries them into execution." That is, you should work with people who behave cautiously rather than radically. In addition, there are many expressions of the doctrine of the Mean in the Confucian classics, such as "To go beyond is as wrong as to fall short,"[12] "Sincerely hold fast the due Mean,"[13] "Take hold of their two extremes, determine the Mean, and employ it in his government of the people."[14] In modern enterprises, managers are prone to negative behaviors such as violating laws and regulations because of overconfidence or eagerness to dispose of business difficulties (Shi and Yang, 2021). In Confucian culture, the requirement of personal caution in words and deeds reminds managers to avoid risks, thus reducing the occurrence of negative events. Furthermore, Confucian culture values social responsibility. Confucian culture emphasizes self-denial and serving the public, putting the common interests of the collective above personal interests. For example, *The Book of Rites: Li Yun* states "When the Great Way is practiced, the world is for the public," and *The Book of Rites: Fang Ji* states "The superior man exalts others and abases himself." *Rizhilu: Zheng Shi* holds that "Rise and fall of a nation rests with every-one of its citizens," while *Mencius: Jing Xin Shang* directs "Serve the world if you are rich, otherwise serve yourself." Influenced by the Confucian principle of social responsibility, enterprise managers will heed the rights and interests of stakeholders such as consumers, investors and the public during the decision-making process, and will thus avoid negative actions such as infringement on consumer rights and interests, financial fraud and polluting due to pursuing the enterprise's short-term interests. Therefore, under the influence of Confucian culture, corporate behavior may be more stable and the risk of negative events may be lower, thus reducing corporate bond financing cost.

Based on the above analysis, we put forward hypothesis H1:

H1: The stronger the Confucian cultural atmosphere where the enterprise is located, the higher the bond rating and the lower the credit spread.

3. Research design

3.1. Sample selection and data source

Our primary source for corporate and bond issuance data, including enterprise bonds, corporate bonds and medium-term notes, from 2008 to 2020 is the Wind database. We remove financial firms, insolvent firms and observations with missing financial data, and ultimately obtain 18,393 bond issuance samples. The *Jinshi* data come from the Chinese Biographical Database (CBDB) of Harvard University, and the urban data come from the CEIC database on China's economy. We winsorize the data at the 1 % level to deal with possible outliers.

3.2. Variable definition

(1) Bond pricing.

[9] *Analects of Confucius: Xue Er.*
[10] *Analects of Confucius: Zi Lu.*
[11] *Analects of Confucius: Li Ren.*
[12] *Analects of Confucius: Xian Jin.*
[13] *Analects of Confucius: Yao Yue.*
[14] *The Doctrine of Mean.*

The variable of interest in this paper is bond pricing. Following Jiang et al. (2018) and Yang and Pan (2019), we use bond rating (*Rating*) and credit spread (*Spread*) as alternative variables for bond pricing. The bond rating at the time of issuance has 4 grades: AAA, AA+, AA and AA-. We assign numeric values for each rating from high to low, with 4 for AAA, 3 for AA+, 2 for AA and 1 for AA-. The higher the bond rating, the lower the bond financing cost. The credit spread (*Spread*) at the time of issuance is equal to the difference between the yield of a corporate bond and the yield of the nearest maturity-matched Treasury bond. The higher the credit spread, the higher the bond financing cost.

(2) Confucian culture.

The independent variable of main interest is Confucian culture. Referring to Pan et al. (2020), the logarithm of the number of *Jinshi* in the Ming and Qing Dynasties (*Lognumjs*) in the prefectural city where the bond issuing firm is located is taken as the proxy indicator of Confucian culture. We select *Jinshi* as a proxy variable for the following reasons. First, Douglas North, the pioneer of new institutional economics and Nobel laureate, pointed out that "culture is transmitted from generation to generation by education and imitation," and the role of education lies in "instilling a set of values repeatedly" (North, 1981). Moreover, an influential article by Guiso et al. (2006) defines culture as "customs, traditions and values that can be passed down from generation to generation and are relatively stable among ethnic, religious or social groups." Therefore, data based on Confucian education closely match the definition of culture in the mainstream literature. The literature on Confucian culture, economy and finance thus adopts the number of Confucian temples or schools as an index of Confucian culture (Gu, 2015; Jin et al., 2017, Xu and Li, 2020). Second, although existing Confucian temples are often used as the proxy variable of Confucian culture in the early literature, there are serious discrepancies in the data on Confucian temples. According to "Research on Confucius Temples in the World" (Kong and Kong, 2011), since the Ming Dynasty, there have been 1,460 Confucian temples in the Chinese mainland; by contrast, Du (2015, 2016) use 52 Confucian temples listed as national heritage sites, and Jin et al. (2017) use a hand-collected list of 359 existing Confucian temples; thus, all of these studies have limited coverage. Finally, the ancient records and modern historical and archaeological research are very detailed, so we have nearly complete information on *Jinshi*. There were 56,759 *Jinshi* in the Ming and Qing Dynasties, and the variation of their number among prefecture-level cities was much higher than the difference in geographical distribution of Confucian temples, so this data set could greatly improve empirical estimation and reduce bias.

The Chinese Biographical Database (CBDB), operated and maintained by the Fairbank Center for Chinese Studies of Harvard University and the Harvard-Yenching Institute, provides information on the place of origin of the successful candidates in the imperial examinations of past dynasties. We extract a total of 56,759 *Jinshi* in the Ming and Qing Dynasties, and map the latitude and longitude of their birthplaces to contemporary Chinese administrative divisions using the GIS software ArcGIS to obtain the number of *Jinshi* from prefecture-level cities in the Ming and Qing Dynasties, then combine this mapping with the data on prefecture-level cities where corporate headquarters are located, thus obtaining the indicators of Confucian cultural atmosphere in prefecture-level cities where corporate headquarters are located.

(3) Control variables.

Following Yang and Pan (2019), we select relevant control variables at the firm level, regional level and bond level. The firm-level variables are firm size (*Size*), profitability (*Roa*), debt level (*Lev*), cash holding level (*Cash*), *Growth*, *Tangibility*, interest coverage ratio (*Intcov*), whether the auditors are from the top four international companies (*Big4*), whether it is a state-owned enterprise (*SOE*) and whether it is a public company (*Public*). The economic variables at the regional level are per capita GDP of the city where the enterprise is located, whether the city is the provincial capital (*Capcity*) and the education development level of the city where the enterprise is located (*Edu*). The bond-level control variables are the size of the bond issuance (*Amount*), bond maturity (*Maturity*) and related bond terms, including whether the bond is callable, puttable or guaranteed. Finally, we control the bond type, industry fixed effect and year fixed effect, and perform heteroscedasticity adjustment on the regression standard error. See Table 1 for specific definitions.

3.3. Model specification

To test the influence of Confucian culture on bond pricing, we construct a multiple regression model (1):

Table 1
Variable definitions.

Variable	Definition
Rating	Bond rating grades are assigned numeric values from high to low, with 4 for AAA, 3 for AA+, 2 for AA and 1 for AA-
Spread	The difference between the yield of a corporate bond and the yield of the nearest maturity-matched Treasury bond
Lognumjs	Logarithm of the number of *Jinshi* in the Ming and Qing Dynasties in the city where the firm is located
Size	Logarithm of total assets
Roa	Net profit divided by total assets
Lev	Total liabilities divided by total assets
Cash	Cash and short-term investments to assets
Growth	Growth rate of sales revenue
Tangibility	Fixed assets divided by total assets
Intcov	Earnings before interest and tax divided by interest expenses
*Big*4	An indicator equal to 1 if the audit firm is a Big 4 auditing firm and 0 otherwise
SOE	An indicator equal to 1 for state-owned enterprises and 0 otherwise
Public	An indicator equal to 1 if the firm is a listed firm and 0 otherwise
Gdp	Logarithm of GDP per capita at the location of the enterprise
Capcity	An indicator equal to 1 if the firm is located in a provincial capital city and 0 otherwise
Edu	Average years of education at the location of the enterprise
Amount	Logarithm of the bond issuance scale
Maturity	Duration of bond issue
Call	Equal to 1 if the bond is callable and 0 otherwise
Put	Equal to 1 if the bond is puttable and 0 otherwise
Guarantee	Equal to 1 if the bond is guaranteed and 0 otherwise
Bondtype	Bond type dummy variable
Industry	Industry dummy variable
Year	Year dummy variable

$$\begin{aligned} Rating/Spread = {} & \beta_0 + \beta_1 Lognumjs + \beta_2 Size + \beta_3 Roa + \beta_4 Lev + \beta_5 Cash + \beta_6 Growth + \beta_7 Tangibility \\ & + \beta_8 Intcov + \beta_9 Big4 + \beta_{10} SOE + \beta_{11} Public + \beta_{12} Gdp + \beta_{13} Capcity + \beta_{14} Edu \\ & + \beta_{15} Amount + \beta_{16} Maturity + \beta_{17} Call + \beta_{18} Put + \beta_{19} Guarantee + \sum Bondtype \\ & + \sum Year + \sum Industry + \varepsilon \end{aligned} \quad (1)$$

When the dependent variable is *Rating*, we use an *Ologit* regression model, as *Rating* is a multi-valued ordered discrete variable; when the dependent variable is *Spread*, we use *OLS* regression.

4. Empirical results

4.1. Descriptive statistics

Fig. 1 shows the distribution of the number of *Jinshi* in each prefecture-level city in China during the sample period, that is, the intensity of Confucian culture in each region. The average number of *Jinshi* in prefecture-level cities across the country is 86.33, indicating a strong level of Confucian culture in China. However, due to the vast territory of China, there are significant differences in the level of Confucian culture among prefecture-level cities. The darker the color in Fig. 1, the more *Jinshi* there are in the prefecture-level city and the stronger the Confucian culture. It can be seen that the prefecture-level cities with a large number of *Jinshi* are mainly distributed in North China and East China, which are deeply influenced by the traditional Confucian culture; however, the number of *Jinshi* in Southwest and Northwest China is small, indicating that the degree of Confucian culture is relatively low.

Table 2 reports the summary statistics for the main variables used in our analysis. As is shown in Panel A, *Rating* at the time of issuance is AAA at the highest and AA- at the lowest, with a median of AA. The maximum value of *Spread* is 4.935, the minimum value is 0.501, the mean value is 2.192 and the standard deviation is 1.084, which indicates great differences in the default risk of different corporate bonds. The minimum value

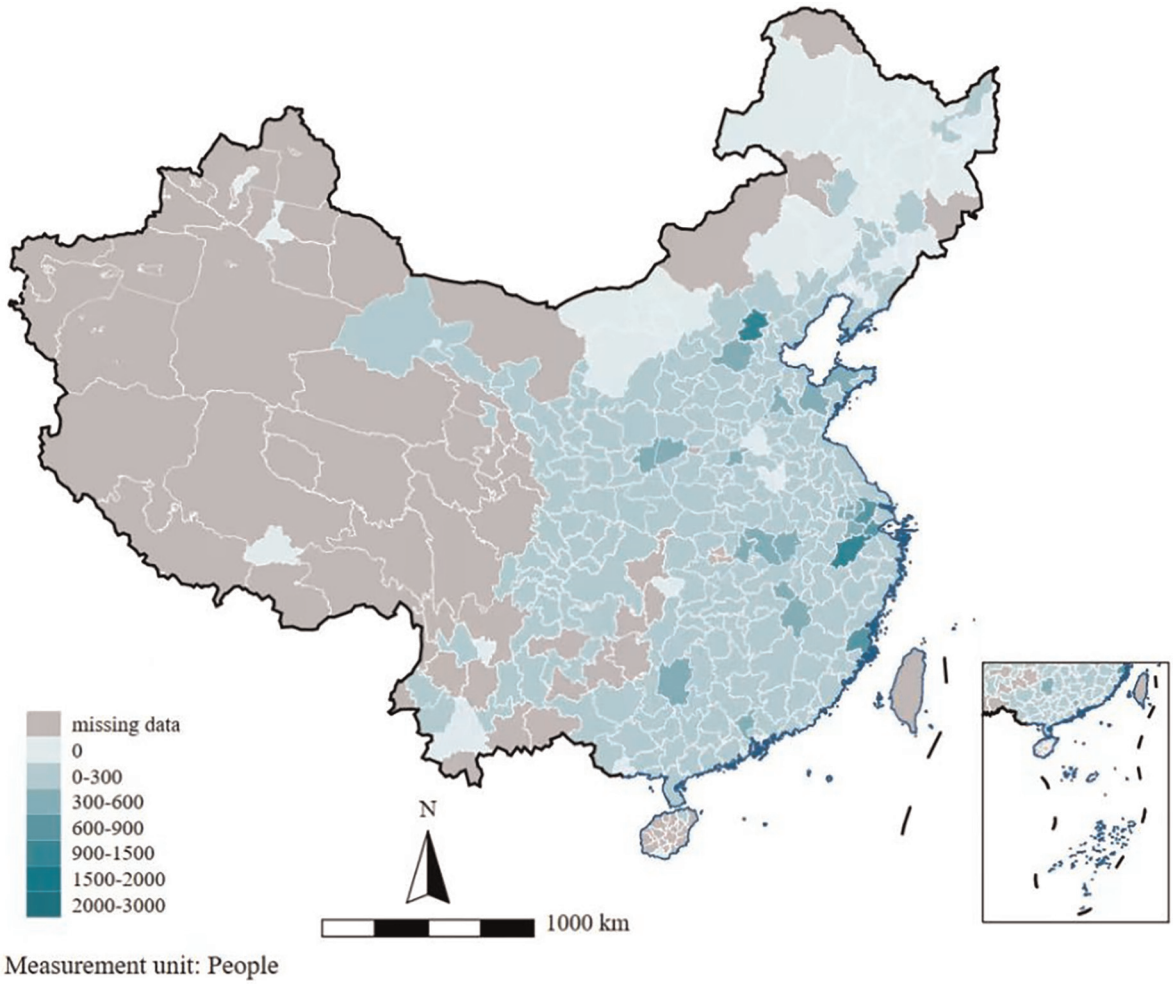

Fig. 1. Distribution map of the number of *Jinshi* in prefecture-level cities.

of Confucian culture (*Lognumjs*) for the location of the enterprise is 0, the maximum value is 6.855, the average value is 4.799 and the standard deviation is 1.862, which indicates great differences in Confucian atmosphere between different regions. We find that 87.7 % of the observations involve state-owned enterprises, which indicates that state-owned enterprises have certain advantages in bond market financing. In addition, 13.6 % of the observations are listed companies, while 86.4 % are unlisted companies, which indicates that China's bond market is an important financing channel for unlisted companies. The mean value of the logarithmic size of bonds is 2.388, the average bond maturity is 5.101 years, 9.2 % of bonds have a call option, 43.4 % of bonds have a put option and 14 % of bonds are guaranteed. The summary statistical results of other variables are shown in Table 2, and will not be repeated here.

Panel B compares the bond pricing between the two groups of samples with high and low Confucian culture. The results of the inter-group mean T-test and Wilcoxon test show that firms located in regions with high Confucian cultural atmosphere have significantly higher bond ratings and significantly lower credit spreads, which provides preliminary support for our hypothesis.

4.2. Test of the impact of Confucian culture on bond pricing

In Table 3, we test the impact of Confucian culture on *Rating* and *Spread* to verify the role of Confucian culture in bond pricing. Column (1) of Table 3 reports the results of *Ologit* regressions where the dependent

Table 2
Summary statistics.

Panel A: Summary statistics for main variables

Variable	N	Mean	Sd	Min	p25	p50	p75	Max
Rating	18,393	3.139	0.857	1.000	2.000	3.000	4.000	4.000
Spread	18,393	2.192	1.084	0.501	1.328	1.988	2.914	4.935
Lognumjs	18,393	4.799	1.862	0.000	3.871	5.352	5.814	6.855
Size	18,393	24.623	1.419	22.023	23.523	24.459	25.619	28.194
Roa	18,393	0.019	0.020	−0.010	0.006	0.013	0.025	0.107
Lev	18,393	0.590	0.153	0.167	0.493	0.615	0.698	0.859
Cash	18,393	0.108	0.068	0.009	0.057	0.096	0.142	0.353
Growth	18,393	0.224	0.485	−0.520	0.013	0.119	0.291	3.114
Tangibility	18,393	0.166	0.189	0.000	0.019	0.086	0.257	0.751
Intcov	18,393	10.156	31.965	−3.124	1.135	2.519	6.195	260.802
Big4	18,393	0.071	0.257	0.000	0.000	0.000	0.000	1.000
SOE	18,393	0.877	0.329	0.000	1.000	1.000	1.000	1.000
Public	18,393	0.136	0.343	0.000	0.000	0.000	0.000	1.000
GDP	18,393	9.659	4.452	2.099	5.966	9.141	12.898	20.349
Capacity	18,393	0.616	0.486	0.000	0.000	1.000	1.000	1.000
Edu	18,393	9.996	1.105	7.820	8.980	9.930	10.930	11.710
Amount	18,393	2.388	0.648	0.262	1.902	2.398	2.773	5.707
Maturity	18,393	5.101	2.086	1.000	3.000	5.000	7.000	20.000
Call	18,393	0.092	0.289	0.000	0.000	0.000	0.000	1.000
Put	18,393	0.434	0.496	0.000	0.000	0.000	1.000	1.000
Guarantee	18,393	0.140	0.347	0.000	0.000	0.000	0.000	1.000

Panel B: Univariate mean difference test

	High Confucian culture	Low Confucian culture	T-test	Wilcoxon Z
Rating	3.261	2.940	0.321***	24.962***
Spread	2.019	2.477	−0.458***	− 28.156***

variable is *Rating*. We find that the Confucian culture variable, *Lognumjs*, has a significantly positive association with *Rating*, indicating that the stronger the Confucian culture in a firm's location, the higher the bond issuance rating. The odds ratio is 1.051; that is, for every additional unit of Confucian culture, the possibility of upgrading the bond rating of the local enterprise by one grade is 1.051 times that of the original. Column (2) of Table 3 reports the results of *OLS* panel regressions where the dependent variable is credit spread for a given corporate bond issue. We find that *Lognumjs* has a significantly negative association with *Spread*; that is, the stronger the Confucian culture in the firm's location, the lower the bond spread. The specific economic significance is that when Confucian culture increases by one standard deviation, corporate bond spreads in the region decrease by about 20.56 % (0.0242 × 1.862/2.192). Overall, the regression results support the hypothesis that Confucian culture plays an economically desirable role in bond pricing; that is, Confucian culture can significantly reduce the corporate bond financing cost. Hypothesis 1 is thus supported.

4.3. Robustness test

Although we control the relevant variables at the firm level, urban level and bond level, there may still be the problem of omitted variables; that is, there may be relevant variables that are not only related to the number of *Jinshi* in ancient times, but also to the corporate bond financing cost because they influence contemporary economic and social development. Therefore, we further address the potential endogeneity problems by using an instrumental variable method.

In the era of the imperial examination, it was far from enough for candidates to learn the Four Books and Five Classics to achieve good results. Candidates also needed to refer to annotations of the Four Books and Five Classics and current affairs articles published by the government (Chen et al., 2020). During the Ming and Qing Dynasties, there were 19 government-run bookstores in China, which undertook more than 80 % of the book publishing and printing work. Referring to Chen et al. (2020), we use the geographical distance between the location of the enterprise and the ancient printing bureau as an instrumental variable for 2SLS regression.

Table 3
Confucian culture and bond pricing.

	(1)	(2)
	Rating	Spread
Lognumjs	0.0496***	−0.0242***
	(4.79)	(-7.83)
Size	1.9224***	−0.0751***
	(57.47)	(-10.04)
Roa	23.1740***	−5.5872***
	(17.94)	(-16.45)
Lev	−3.1198***	0.4060***
	(-17.42)	(9.07)
Cash	1.2829***	−0.9183***
	(4.02)	(-10.22)
Growth	−0.1129***	0.0008
	(-2.95)	(0.07)
Tangibility	1.7779***	−0.2497***
	(10.92)	(-7.04)
Intcov	−0.0017***	0.0001
	(-3.45)	(0.59)
Big4	0.9695***	−0.0854***
	(9.85)	(-3.86)
SOE	1.7364***	−1.0100***
	(24.27)	(-42.42)
Public	0.3192***	−0.0717***
	(4.70)	(-3.81)
GDP	0.0630***	−0.0554***
	(9.81)	(-27.08)
Capcity	0.5251***	−0.0911***
	(9.71)	(-5.33)
Edu	0.2331***	0.0666***
	(7.25)	(6.91)
Amount	0.6096***	−0.0508***
	(14.68)	(-4.73)
Maturity	0.1435***	−0.0231***
	(9.14)	(-7.10)
Call	0.5033***	0.5656***
	(7.64)	(28.86)
Put	−0.8428***	−0.0509***
	(-14.36)	(-2.91)
Guarantee	3.9061***	0.2984***
	(45.37)	(14.78)
_cons		5.9135***
		(33.34)
Bondtype	Yes	Yes
Rating		Yes
Industry	Yes	Yes
Year	Yes	Yes
R^2	0.4834	0.5902
N	18,393	18,393

Note: (1) the *t*-statistics adjusted for heteroscedasticity are in parentheses; (2) ***, ** and * indicate significance at the 0.01, 0.05 and 0.10 levels, respectively.

Because the geographical distance from a place to the printing office would have greatly affected the difficulty and economic cost of obtaining books for local examinees (Du and Du, 2001), the geographical distance between the location of an enterprise and the printing office is strongly correlated with the number of *Jinshi* in the region, which meets the correlation requirements of instrumental variables. At the same time, because these government-run printing offices were mainly distributed in bamboo-producing areas, and went bankrupt and closed with the introduction of Western printing technology in modern times (Chen et al., 2020), the geo-

graphical distance between the location of enterprises and the printing office has nothing to do with the level of regional economic and social development in modern times, and cannot be related to the bond financing cost of contemporary enterprises, so it meets the exogeneity requirements of instrumental variables.

Table 4 reports the results of the instrumental variable regressions. Column (1) of Table 4 shows the results of one-stage regression, which show that the Confucian culture variable, *Lognumjs*, has a significantly positive

Table 4
Instrumental variable regression.

	(1)	(2)	(3)
	Lognumjs	Rating	Spread
Lognumjs		0.0474**	−0.0395***
		(2.05)	(-8.18)
Distance	−0.4645***		
	(-81.95)		
Size	0.0465***	0.3671***	−0.0827***
	(4.00)	(66.66)	(-11.14)
Roa	−0.3685	4.3140***	−5.4043***
	(-0.52)	(15.22)	(-15.47)
Lev	0.1781*	−0.3963***	0.4576***
	(1.88)	(-10.06)	(9.86)
Cash	0.0678	0.5330***	−0.8865***
	(0.38)	(7.52)	(-9.63)
Growth	−0.0952***	−0.0139	0.0088
	(-4.08)	(-1.42)	(0.75)
Tangibility	0.2244***	0.2212***	−0.2487***
	(3.38)	(7.26)	(-7.05)
Intcov	0.0008**	−0.0005***	0.0000
	(2.41)	(-3.85)	(0.06)
Big4	−0.3580***	0.1390***	−0.1002***
	(-6.45)	(6.00)	(-4.46)
SOE	0.1105***	0.3466***	−0.9951***
	(2.59)	(18.94)	(-40.54)
Public	−0.1526***	0.0750***	−0.0721***
	(-3.82)	(5.08)	(-3.77)
GDP	−0.0347***	0.0106***	−0.0528***
	(-8.18)	(5.94)	(-25.40)
Capcity	0.5607***	0.1639***	−0.0783***
	(16.57)	(7.88)	(-4.44)
Edu	−0.0627***	0.0232**	0.0624***
	(-3.46)	(2.15)	(6.27)
Amount	0.0010	−0.0007**	0.0002
	(1.47)	(-1.97)	(0.48)
Maturity	0.0085	0.0185***	−0.0223***
	(1.44)	(6.71)	(-6.86)
Call	−0.0797**	0.0861***	0.5680***
	(-2.14)	(6.60)	(28.88)
Put	0.0385	−0.0896***	−0.0589***
	(1.38)	(-7.40)	(-3.33)
Guarantee	0.0611*	0.8340***	0.3064***
	(1.83)	(51.39)	(14.28)
_cons	5.6914***	−6.5450***	6.0599***
	(20.33)	(-57.10)	(33.25)
Bondtype		Yes	Yes
Rating			Yes
Industry	Yes	Yes	Yes
Year	Yes	Yes	Yes
R^2	0.4607	0.6296	0.5830
N	17,168	17,168	17,168

Note: (1) The *t*-statistics adjusted for heteroscedasticity are in parentheses; (2) ***, ** and * indicate significance at the 0.01, 0.05 and 0.10 levels, respectively.

association with the instrumental variable (*Distance*), indicating that the number of *Jinshi* was smaller in places further away from the printing office, presumably because it was more difficult to obtain books. Columns (2)–(3) of Table 4 are two-stage regression results. *Lognumjs* has a significantly positive association with *Rating* and negative association with *Spread*. This shows that the influence of Confucian culture on bond pricing is robust to the use of instrumental variables. Specifically, regions with higher Confucian culture have higher corporate bond issuance ratings and lower credit spreads. Our results thus pass the weak instrumental variable test. This shows that the empirical results are still robust after using instrumental variable regression.[15]

In addition, we use different indicators of Confucian culture to test the robustness of our results. Following Gu (2015) and Jin et al. (2017), the numbers of Confucian schools and Confucian temples in various parts of China in the middle and late Qing Dynasty (1796–1840) are used as alternative indicators of Confucian culture to test the impact of Confucian culture on bond pricing. The results are shown in columns (1)–(4) of Table 5, and the conclusion is still robust. In addition, following the research design of Jin et al. (2017), we obtain the birthplace information of the chairmen of the listed companies from the CSMAR database,[16] and merge it with the *Jinshi* data, to obtain the index of the number of *Jinshi* in the birthplace of the chairman, and measure the degree to which the company is influenced by Confucian culture. The regression results are shown in columns (5)–(6) of Table 5, and the results remain robust. Finally, Jiang et al. (2018) show that religious culture significantly affects bond pricing. To rule out this explanation, we further control the influence of religion. We use the number of religious sites in the province where the enterprise is located to measure the intensity of religious influence. The results are shown in columns (7)–(8) of Table 5. The results show that after controlling the influence of religion, Confucian culture still has a significant impact on bond pricing.

Considering the unique ethnic culture in ethnic minority areas, we remove the samples of enterprises located in the Xinjiang, Tibet, Qinghai and Inner Mongolia Autonomous regions and re-run the regression. The results are shown in Table 6, and remain robust.

Finally, we conduct a placebo test. We estimate Model (1) with the number of *Jinshi* randomly assigned to each bond-annual observation. The baseline results will not hold if we still identify a positive relationship between Confucian culture and bond pricing. We repeat the placebo test 1,000 times and depict the virtual distribution of the *t*-values of *Lognumjs* in Fig. 2. The figure shows that the virtual regression coefficients are not significantly different from 0, indicating that there is no virtual treatment effect, thus validating our main results.

4.4. Test of the mechanism of Confucian culture's effect on bond pricing

The theoretical analysis above shows that, as a kind of cultural soft information, Confucian culture can convey the signal that enterprises value integrity in the capital market, so that investors have more positive expectations of the willingness of enterprises to repay debt, and thus reduce the required risk premium. To test this logic, we use a mediation effect regression. We obtain data from the 2013 Chinese General Social Survey to measure the level of trust in each region. In response to the question "Generally speaking, do you agree or disagree that most people in this society can be trusted?", respondents give a score from 1 to 5; the higher the value, the more they agree. We take the average score of respondents in each province as the index of trust,

[15] In addition, to increase the reliability of the instrumental variable in this paper and make it more exogenous, we also exclude the research samples with printing offices in cities where the enterprises are located and conduct the test again. If the enterprise and the printing office are not located in the same city, then the cultural and economic factors that influenced the location of the printing office in the past are unlikely to influence the bond pricing of enterprises in other cities in contemporary times. In other words, we geographically cut off the influence of the historical cultural environment, economic development level and other relevant factors on contemporary corporate bond pricing, and obtain a relatively exogenous instrumental variable by subdividing the sample. The results are still robust after re-testing.

[16] We also control the management characteristics of listed firms, i.e., the age of the chairman and overseas experience, because the older the chairman is, the longer and deeper the influence of Confucian culture is likely to be, which in turn affects bond pricing; however, if the chairman has an overseas background (including overseas employment and overseas study), the influence of traditional Chinese Confucian culture may be weakened, which will affect bond pricing. Our empirical results are still robust after further controlling management characteristics.

Table 5
Confucian culture and bond pricing test using alternative variables.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Rating	Spread	Rating	Spread	Rating	Spread	Rating	Spread
Shuyuan	0.0078***	−0.0029***						
	(8.33)	(-10.78)						
Wenmiao			0.0157***	−0.0014*				
			(6.01)	(-1.75)				
ChairmanJS					0.0716*	−0.0147*		
					(1.68)	(-1.67)		
Lognumjs							0.0417***	−0.0252***
							(3.77)	(-7.30)
Religion							−0.0000***	−0.0000
							(-2.98)	(-0.26)
Size	1.9565***	−0.1001***	1.9502***	−0.2723***	2.7791***	−0.0083	1.9391***	−0.2698***
	(56.83)	(-13.30)	(58.31)	(-41.04)	(18.54)	(-0.34)	(57.99)	(-40.48)
Roa	23.6891***	−5.4299***	23.1454***	−7.5580***	10.5404***	−4.8596***	23.1304***	−7.6098***
	(17.53)	(-15.44)	(17.84)	(-20.70)	(3.15)	(-6.01)	(17.90)	(-20.83)
Lev	−3.0404***	0.4514***	−3.1388***	0.6370***	−9.8827***	0.8652***	−3.1456***	0.6444***
	(-16.56)	(9.70)	(-17.60)	(13.16)	(-10.90)	(4.84)	(-17.59)	(13.33)
Cash	1.2022***	−0.8738***	1.3121***	−1.1719***	−5.5347***	0.4475	1.2636***	−1.1795***
	(3.65)	(-9.40)	(4.12)	(-12.07)	(-5.32)	(1.57)	(3.96)	(-12.16)
Growth	−0.1220***	−0.0001	−0.1231***	0.0124	−0.2859	0.0889	−0.1118***	0.0091
	(-3.11)	(-0.01)	(-3.22)	(1.03)	(-1.31)	(1.27)	(-2.92)	(0.76)
Tangibility	1.8299***	−0.2918***	1.7292***	−0.3554***	0.1697	−0.2829**	1.7822***	−0.3557***
	(10.95)	(-8.16)	(10.55)	(-9.38)	(0.26)	(-2.36)	(10.93)	(-9.43)
Intcov	−0.0016***	0.0002	−0.0016***	0.0003	0.0018	−0.0034***	−0.0017***	0.0003
	(-3.30)	(1.14)	(-3.33)	(1.47)	(0.53)	(-3.32)	(-3.55)	(1.57)
Big4	0.7439***	−0.0418*	0.9134***	−0.1224***	0.1077	−0.0734	0.9588***	−0.1397***
	(7.06)	(-1.73)	(9.29)	(-5.12)	(0.47)	(-1.63)	(9.72)	(-5.83)
SOE	1.7224***	−1.0231***	1.7691***	−1.2010***	1.7011***	−0.8939***	1.7408***	−1.1940***
	(22.65)	(-39.77)	(24.59)	(-47.63)	(9.40)	(-16.55)	(24.33)	(-47.42)
Public	0.3032***	−0.0808***	0.2982***	−0.1027***			0.3178***	−0.1075***
	(4.24)	(-4.10)	(4.37)	(-5.05)			(4.68)	(-5.29)
GDP	0.0481***	−0.0557***	0.0660***	−0.0610***	0.0507**	−0.0589***	0.0609***	−0.0608***
	(6.45)	(–23.52)	(10.24)	(-27.19)	(2.05)	(-8.48)	(9.38)	(-27.45)
Capcity	0.3588***	−0.0329*	0.5963***	−0.1891***	1.0282***	−0.0113	0.5320***	−0.1753***
	(6.27)	(-1.78)	(11.01)	(-10.47)	(4.30)	(-0.17)	(9.85)	(-9.69)
Edu	0.3238***	0.0306***	0.2207***	0.0465***	−0.0042***	0.0006	0.2383***	0.0557***
	(9.24)	(2.84)	(6.88)	(4.46)	(-2.74)	(1.63)	(7.32)	(5.33)
Amount	0.0456***	−0.0002	0.0466***	0.0002	0.0684***	0.0004	0.0465***	0.0003
	(12.08)	(-0.67)	(12.79)	(0.50)	(5.24)	(0.35)	(12.76)	(0.83)
Maturity	0.1379***	−0.0193***	0.1443***	−0.0337***	0.2272***	−0.0536***	0.1422***	−0.0328***
	(8.52)	(-5.88)	(9.09)	(-9.94)	(2.61)	(-4.58)	(8.98)	(-9.67)
Call	0.5102***	0.5811***	0.5141***	0.5215***	0.1083	0.2849***	0.5135***	0.5199***
	(7.58)	(29.02)	(7.78)	(26.08)	(0.46)	(5.51)	(7.79)	(25.93)
Put	−0.8325***	−0.0685***	−0.8332***	−0.0089	−0.6375***	−0.0845*	−0.8391***	−0.0084
	(-13.88)	(-3.87)	(-14.20)	(-0.47)	(-2.81)	(-1.83)	(-14.32)	(-0.45)
Guarantee	3.8611***	0.2815***	3.8968***	−0.1157***	4.2381***	0.5404***	3.8924***	−0.1131***
	(44.25)	(13.63)	(45.55)	(-5.98)	(10.27)	(7.77)	(45.39)	(-5.85)
_cons		6.7264***		10.0046***		4.6696***		9.9273***
		(35.62)		(61.51)		(8.16)		(61.45)
Bondtype	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rating		Yes		Yes		Yes		Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.4806	0.5916	0.4832	0.5357	0.5749	0.6224	0.4831	0.5371
N	17,410	17,410	18,393	18,393	1831	1831	18,393	18,393

Note: (1) The *t*-statistics adjusted for heteroscedasticity are in parentheses; (2) ***, ** and * indicate significance at the 0.01, 0.05 and 0.10 levels, respectively.

Table 6
Confucian culture and corporate bond pricing (removing ethnic minority observations).

	(1)	(2)
	Rating	Spread
Lognumjs	0.0393***	−0.0192***
	(3.65)	(-6.09)
Size	1.9312***	−0.0764***
	(57.35)	(-10.24)
Roa	23.1687***	−5.4025***
	(17.67)	(-15.83)
Lev	−3.1346***	0.4219***
	(-17.39)	(9.43)
Cash	1.3749***	−0.9014***
	(4.29)	(-10.05)
Growth	−0.1267***	0.0011
	(-3.31)	(0.10)
Tangibility	1.8383***	−0.2601***
	(11.01)	(-7.27)
Intcov	−0.0017***	0.0001
	(-3.49)	(0.67)
Big4	0.9443***	−0.0749***
	(9.57)	(-3.38)
SOE	1.7035***	−1.0039***
	(23.60)	(-41.89)
Public	0.3065***	−0.0754***
	(4.48)	(-3.99)
GDP	0.0734***	−0.0588***
	(10.95)	(-28.73)
Capcity	0.5387***	−0.0882***
	(9.94)	(-5.15)
Edu	0.2066***	0.0726***
	(6.36)	(7.53)
Amount	0.6197***	−0.0534***
	(14.85)	(-4.95)
Maturity	0.1426***	−0.0231***
	(9.04)	(-7.11)
Call	0.5111***	0.5620***
	(7.71)	(28.63)
Put	−0.8371***	−0.0548***
	(-14.22)	(-3.13)
Guarantee	3.9284***	0.2966***
	(45.20)	(14.70)
_cons		5.9015***
		(33.23)
Bondtype	Yes	Yes
Rating		Yes
Industry	Yes	Yes
Year	Yes	Yes
R^2	0.4844	0.5910
N	18,252	18,252

Note: (1) The *t*-statistics adjusted for heteroscedasticity are in parentheses; (2) ***, ** and * indicate significance at the 0.01, 0.05 and 0.10 levels, respectively.

and use path analysis to test the mechanism. The results are shown in Table 7. Column (1) of Table 7 shows that the stronger the Confucian atmosphere, the higher the trust level of the region; Columns (2)–(3) show that the stronger the Confucian atmosphere, the higher the corporate bond rating and the lower the credit spread. A Sobel test indicates a mediating effect with trust as the mediating variable, indicating that Confucian culture influences corporate bond pricing by improving the level of trust. This result also suggests that Confucian culture is a source of trust.

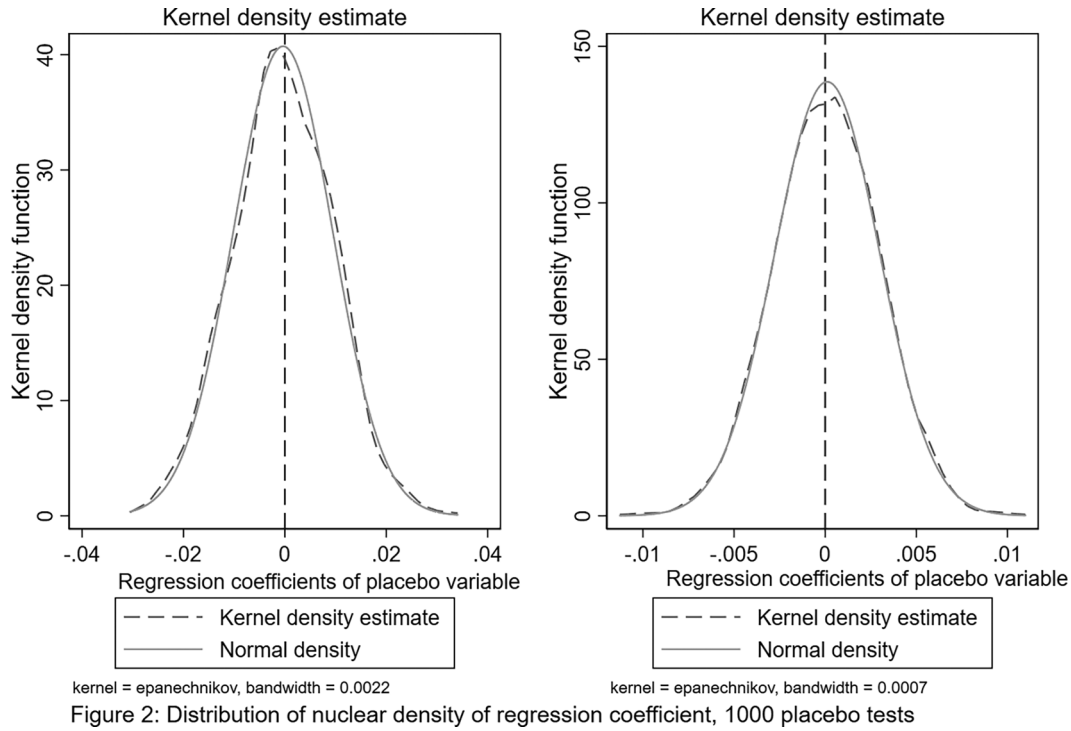

Figure 2: Distribution of nuclear density of regression coefficient, 1000 placebo tests

Fig. 2. *Distribution of nuclear density of regression coefficient,1000 placebo tests Note*: (1) The left panel shows the placebo test results for *Rating* (corresponding to column 1 of the baseline regression in Table 3) and the right panel shows the placebo test results for *Spread* (corresponding to column 2 of the baseline regression in Table 3). (2) The dashed line is the kernel density function of the regression coefficient of the placebo variable (virtual *Lognumjs*), and the solid line is the kernel density function of the standard normal distribution.

Second, Confucian culture may also imply a smaller principal–agent problem, which in turn affects bond pricing. Investors pay attention to the fundamentals (financial and non-financial information) of the issuer. If the agency problem is serious, this indicates that the corporate governance of the issuer is problematic. Accordingly, investors will demand a risk premium. Following Dai et al. (2016), we use the ratio of administrative expenses to total revenue (*Agency Cost*) as a proxy for the agency problem. The larger the agency cost, the worse the corporate governance. The path analysis method is used to analyze the mediation effect; the results are shown in Table 8. Column (1) shows that the stronger the Confucian culture where the enterprise is located, the smaller the agency problem and the better the corporate governance; Columns (2)–(3) show that the stronger the Confucian culture, the higher the bond rating and the lower the credit spread. A Sobel test shows that there is an intermediary effect with *Agency Cost* as the intermediary variable, which shows that Confucian culture affects the pricing of corporate bonds by reducing the agency problem and improving corporate governance.

Third, Confucian culture may inhibit the bad behavior of enterprises and thus affect bond pricing. Previous studies show that enterprises' misconduct, such as financial fraud, harms the interests of shareholders or stakeholders, such as creditors, customers and suppliers (Caton et al., 2011; Zhang et al., 2018). However, Confucian culture may inhibit such bad behavior and thus affect bond pricing. Therefore, we build a mediating effect model and test it from the perspectives of earnings management and violation. We use the modified Jones model to calculate the earnings management level (*DA*) and construct a violation dummy variable (*Violate*; only listed companies have this data), and adapt the path analysis method to conduct the mechanism test; the results are shown in Table 9. Column (1) shows that the stronger the Confucian culture, the lower the earnings management level. Columns (2) and (3) show that the stronger the Confucian culture, the higher the corporate bond rating and the lower the credit spread. A Sobel test shows that there is a mediating effect with earnings management as the mediating variable, which means that Confucian culture reduces corporate bond pricing by inhibiting corporate earnings management behavior. Column (4) shows that the stronger the Con-

Table 7
Test of trust mechanism.

	(1)	(2)	(3)
	Trust	Rating	Spread
Lognumjs	0.0177***	0.0206*	−0.0205***
	(30.83)	(1.81)	(-6.24)
Trust		0.8195***	−0.1626***
		(7.69)	(-5.10)
Size	0.0127***	1.9685***	−0.0969***
	(8.12)	(57.96)	(-13.32)
Roa	0.4916***	22.7732***	−5.5586***
	(6.07)	(17.38)	(-16.28)
Lev	−0.0263**	−3.1308***	0.4320***
	(-2.16)	(-17.25)	(9.53)
Cash	0.0108	1.3648***	−0.9936***
	(0.46)	(4.23)	(-11.11)
Growth	−0.0072**	−0.1017***	−0.0023
	(-2.47)	(-2.59)	(-0.20)
Tangibility	−0.0085	1.7875***	−0.2520***
	(-0.78)	(10.85)	(-7.11)
Intcov	−0.0001	−0.0016***	0.0001
	(-1.27)	(-3.35)	(0.61)
Big4	0.0122**	0.9371***	−0.0980***
	(2.55)	(9.32)	(-4.47)
SOE	0.0012	1.7438***	−1.0232***
	(0.26)	(23.86)	(-42.40)
Public	0.0176***	0.3078***	−0.0788***
	(4.27)	(4.42)	(-4.16)
GDP	−0.0025***	0.0606***	−0.0550***
	(-5.06)	(9.21)	(-26.81)
Capcity	−0.0656***	0.5645***	−0.0995***
	(-16.14)	(10.40)	(-5.80)
Edu	0.0736***	0.2105***	0.0747***
	(30.05)	(6.20)	(7.34)
Amount	0.0006***	0.0451***	0.0004
	(6.79)	(12.27)	(1.06)
Maturity	0.0038***	0.1383***	−0.0213***
	(5.08)	(8.57)	(-6.55)
Call	0.0137***	0.4910***	0.5695***
	(3.00)	(7.32)	(29.11)
Put	−0.0104***	−0.8359***	−0.0559***
	(-2.93)	(-14.12)	(-3.19)
Guarantee	0.0049	3.9098***	0.2937***
	(1.14)	(45.39)	(14.49)
_cons	1.4654***		6.6960***
	(37.78)		(36.64)
Bondtype		Yes	Yes
Rating			Yes
Industry	Yes	Yes	Yes
Year	Yes	Yes	Yes
R^2	0.2099	0.4870	0.5939
N	18,130	18,130	18,130
Sobel		2.022**	−5.322***

Note: (1) The *t*-statistics adjusted for heteroscedasticity are in parentheses; (2) ***, ** and * indicate significance at the 0.01, 0.05 and 0.10 levels, respectively.

fucian culture, the lower the probability of violation. Columns (5) and (6) show that the stronger the Confucian culture, the higher the corporate bond rating and the lower the credit spread. A Sobel test shows there is a mediating effect with *Violate* as the mediating variable, indicating that Confucian culture reduces corporate bond pricing by inhibiting corporate violation.

Table 8
Test of the agency problem mechanism.

	(1)	(2)	(3)
	Agency Cost	Rating	Spread
Lognumjs	−0.0011***	0.0512***	−0.0240***
	(-4.09)	(4.95)	(-7.79)
Agency Cost		−0.0160**	0.0198***
		(-1.99)	(13.95)
Size	−0.0085***	1.9411***	−0.0922***
	(-15.82)	(58.05)	(-12.62)
Roa	−0.4496***	23.2093***	−5.6184***
	(-16.48)	(17.97)	(-16.57)
Lev	−0.0491***	−3.1598***	0.4524***
	(-10.89)	(-17.69)	(10.01)
Cash	0.0667***	1.2872***	−0.9242***
	(7.42)	(4.04)	(-10.27)
Growth	−0.0072***	−0.1156***	0.0022
	(-5.98)	(-3.02)	(0.19)
Tangibility	−0.0206***	1.7832***	−0.2518***
	(-5.34)	(10.93)	(-7.10)
Intcov	−0.0001***	−0.0017***	0.0001
	(-5.72)	(-3.54)	(0.57)
Big4	0.0047***	0.9652***	−0.0901***
	(2.86)	(9.78)	(-4.08)
SOE	0.0022	1.7462***	−1.0167***
	(1.45)	(24.36)	(-42.66)
Public	−0.0037***	0.3186***	−0.0752***
	(-2.97)	(4.69)	(-4.00)
GDP	0.0011***	0.0630***	−0.0556***
	(6.64)	(9.82)	(-27.19)
Capcity	0.0042***	0.5223***	−0.0897***
	(3.07)	(9.69)	(-5.25)
Edu	0.0005	0.2268***	0.0649***
	(0.68)	(7.06)	(6.73)
Amount	−0.0001***	0.0469***	0.0002
	(-2.66)	(12.90)	(0.57)
Maturity	0.0010***	0.1427***	−0.0228***
	(3.55)	(9.01)	(-7.01)
Call	−0.0032**	0.5167***	0.5636***
	(-2.38)	(7.85)	(28.84)
Put	0.0024**	−0.8419***	−0.0569***
	(2.00)	(-14.39)	(-3.25)
Guarantee	−0.0121***	3.8969***	0.3016***
	(-8.02)	(45.43)	(14.91)
_cons	0.3165***		6.2471***
	(21.38)		(34.69)
Bondtype		Yes	Yes
Rating			Yes
Industry	Yes	Yes	Yes
Year	Yes	Yes	Yes
R^2	0.1668	0.4830	0.5900
N	18,389	18,389	18,389
Sobel		2.271**	−2.483**

Note: (1) The *t*-statistics adjusted for heteroscedasticity are in parentheses; (2) ***, ** and * indicate significance at the 0.01, 0.05 and 0.10 levels, respectively.

Table 9
Test of the mechanism of Confucian culture inhibiting misconduct.

	(1)	(2)	(3)	(4)	(5)	(6)
	DA	Rating	Spread	Violate	Rating	Spread
Lognumjs	−0.0167***	0.0521***	−0.0249***	−0.0077**	0.0740**	−0.0217***
	(-8.68)	(5.05)	(-7.57)	(-2.47)	(2.32)	(-2.62)
DA		−0.9741***	0.1102**			
		(-5.65)	(2.27)			
Violate					−0.4089**	0.1617**
					(-2.00)	(2.52)
Size	−0.0025**	1.9378***	−0.2691***	−0.0336***	2.5492***	−0.0190
	(-2.55)	(57.95)	(-40.57)	(-4.04)	(17.74)	(-0.80)
Roa	−0.2163***	23.1128***	−7.5729***	−0.6636*	17.5468***	−6.1414***
	(-3.94)	(17.86)	(-20.75)	(-1.92)	(5.46)	(-8.05)
Lev	−0.0098	−3.1681***	0.6469***	0.0450	−7.3897***	0.5303***
	(-1.18)	(-17.69)	(13.38)	(0.62)	(-9.15)	(3.37)
Cash	0.0470***	1.3773***	−1.1830***	0.0209	−2.4346**	0.0755
	(3.12)	(4.32)	(-12.21)	(0.18)	(-2.38)	(0.29)
Growth	0.0020	−0.1102***	0.0085	0.0147	−0.4149***	0.1220**
	(0.92)	(-2.87)	(0.71)	(0.69)	(-2.64)	(2.32)
Tangibility	0.0446***	1.8106***	−0.3602***	−0.0804	0.6793	−0.0521
	(7.14)	(11.13)	(-9.54)	(-1.40)	(1.23)	(-0.44)
Intcov	0.0001*	−0.0017***	0.0003*	0.0001	0.0007	−0.0011*
	(1.88)	(-3.49)	(1.65)	(0.38)	(0.28)	(-1.80)
Big4	−0.0107***	0.9632***	−0.1394***	−0.0141	0.6625***	−0.0582
	(-3.96)	(9.74)	(-5.81)	(-0.98)	(3.27)	(-1.34)
SOE	0.0099***	1.7514***	−1.1939***	−0.0558***	1.5688***	−0.8207***
	(3.44)	(24.45)	(-47.42)	(-2.96)	(9.77)	(-17.46)
Public	−0.0120***	0.3107***	−0.1068***			
	(-5.00)	(4.57)	(-5.25)			
GDP	0.0169***	0.0628***	−0.0607***	−0.0049*	0.0880***	−0.0527***
	(2.60)	(9.79)	(-27.67)	(-1.85)	(3.97)	(-7.26)
Capcity	−0.0068	0.5142***	−0.1747***	0.0257	0.8823***	−0.1421**
	(-1.29)	(9.54)	(-9.65)	(0.99)	(4.52)	(-2.26)
Edu	0.0062	0.2226***	0.0557***	−0.0009	−0.0063***	0.1187***
	(1.56)	(6.93)	(5.38)	(-0.07)	(-3.11)	(3.57)
Amount	0.0003***	0.0484***	0.0003	0.0003	0.0605***	−0.0003
	(4.74)	(13.23)	(0.77)	(0.87)	(5.19)	(-0.31)
Maturity	0.0013***	0.1426***	−0.0328***	0.0081*	0.2422***	−0.0438***
	(2.84)	(9.02)	(-9.69)	(1.80)	(3.28)	(-3.85)
Call	0.0048**	0.5164***	0.5197***	−0.0059	0.3963*	0.4210***
	(2.14)	(7.88)	(25.94)	(-0.33)	(1.80)	(7.71)
Put	0.0103***	−0.8409***	−0.0085	0.0110	−0.3604*	−0.0598
	(4.89)	(-14.40)	(-0.46)	(0.68)	(-1.68)	(-1.25)
Guarantee	0.0034	3.9055***	−0.1131***	−0.0185	4.5408***	0.4697***
	(1.11)	(45.29)	(-5.85)	(-0.78)	(12.01)	(7.39)
_cons	0.1235***		9.9063***	0.9980***		3.9092***
	(5.41)		(61.53)	(4.10)		(7.15)
Bondtype		Yes	Yes		Yes	Yes
Rating			Yes			Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.0445	0.4838	0.5373	0.1288	0.5486	0.6302
N	18,379	18,379	18,379	1817	1817	1817
Sobel		3.122***	−2.77**		2.475**	−2.08**

Note: (1) The *t*-statistics adjusted for heteroscedasticity are in parentheses; (2) ***, ** and * indicate significance at the 0.01, 0.05 and 0.10 levels, respectively.

Table 10
Heterogeneity test.

	(1)	(2)	(3)	(4)
	Rating	Spread	Rating	Spread
Lognumjs	0.1537***	−0.0475***	0.0623***	−0.0325***
	(6.89)	(-6.57)	(5.46)	(-9.23)
Lognumjs*Law	−0.0136***	0.0037***		
	(-6.36)	(5.70)		
Law	0.0902***	−0.0344***		
	(7.92)	(-9.43)		
Lognumjs*Public			−0.0564**	0.0358***
			(-2.08)	(5.00)
Public	0.3175***	−0.0781***	0.5742***	−0.2455***
	(4.66)	(-4.16)	(4.14)	(-6.10)
Size	1.9441***	−0.0890***	1.9399***	−0.0921***
	(58.03)	(-12.25)	(58.03)	(-12.62)
Roa	23.0593***	−5.4958***	23.2914***	−5.6823***
	(17.86)	(-16.24)	(18.03)	(-16.75)
Lev	−3.1847***	0.4546***	−3.1554***	0.4499***
	(-17.82)	(10.13)	(-17.66)	(9.96)
Cash	1.2223***	−0.9146***	1.3043***	−0.9183***
	(3.83)	(-10.21)	(4.09)	(-10.20)
Growth	−0.1096***	−0.0027	−0.1140***	0.0011
	(-2.85)	(-0.24)	(-2.98)	(0.09)
Tangibility	1.8797***	−0.2949***	1.7759***	−0.2477***
	(11.52)	(-8.30)	(10.91)	(-6.99)
Intcov	−0.0017***	0.0001	−0.0017***	0.0001
	(-3.54)	(0.60)	(-3.54)	(0.61)
Big4	0.8972***	−0.0680***	0.9675***	−0.1023***
	(9.05)	(-3.06)	(9.82)	(-4.54)
SOE	1.7447***	−1.0112***	1.7501***	−1.0228***
	(24.32)	(-42.52)	(24.41)	(-42.68)
GDP	0.0443***	−0.0423***	0.0610***	−0.0543***
	(5.80)	(-18.04)	(9.47)	(-26.21)
Capcity	0.5590***	−0.1249***	0.5160***	−0.0846***
	(10.15)	(-7.10)	(9.55)	(-4.92)
Edu	0.2785***	0.0469***	0.2296***	0.0622***
	(8.47)	(4.80)	(7.16)	(6.42)
Amount	0.0469***	0.0005	0.0471***	0.0001
	(12.87)	(1.20)	(12.96)	(0.40)
Maturity	0.1450***	−0.0240***	0.1419***	−0.0226***
	(9.13)	(-7.43)	(8.97)	(-6.96)
Call	0.5210***	0.5598***	0.5173***	0.5628***
	(7.88)	(28.68)	(7.87)	(28.78)
Put	−0.8293***	−0.0600***	−0.8393***	−0.0568***
	(-14.15)	(-3.44)	(-14.34)	(-3.25)
Guarantee	3.8914***	0.3053***	3.8950***	0.3011***
	(45.37)	(15.18)	(45.41)	(14.89)
_cons		6.4956***		6.2958***
		(35.11)		(34.90)
Bondtype	Yes	Yes	Yes	Yes
Rating		Yes		Yes
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
R^2	0.4831	0.5903	0.4831	0.5903
N	18,393	18,393	18,393	18,393

Note: (1) The *t*-statistics adjusted for heteroscedasticity are in parentheses; (2) ***, ** and * indicate significance at the 0.01, 0.05 and 0.10 levels, respectively.

Table 11
Influence of Confucian culture on other bond characteristics.

	(1)	(2)	(3)	(4)	(5)
	Default	Default_ratio	Amount	Maturity	Guarantee
Lognumjs	−0.0887**	−0.0040*	0.1868***	0.0300***	0.0505***
	(-2.55)	(-1.78)	(4.55)	(5.48)	(2.74)
Size	0.3461***	0.0140**	6.6121***	0.2228***	−1.9417***
	(3.44)	(2.40)	(28.78)	(12.48)	(-34.57)
Roa	9.3613**	0.3133	31.0645***	−0.6675	−19.2710***
	(2.53)	(0.86)	(4.81)	(-1.01)	(-8.48)
Lev	2.5529***	0.1120***	−21.8423***	−0.4815***	4.4157***
	(3.43)	(3.43)	(-18.42)	(-5.01)	(15.41)
Cash	5.0688***	0.5144***	−0.5764	0.5987***	−1.9075***
	(5.15)	(4.93)	(-0.47)	(3.46)	(-3.55)
Growth	0.2634**	0.0209***	−0.4538***	−0.0248	0.0616
	(2.21)	(2.93)	(-3.91)	(-1.08)	(1.07)
Tangibility	−0.4846	−0.0181	1.5669**	0.3239***	−1.2267***
	(-0.80)	(-0.62)	(2.26)	(2.97)	(-4.78)
Intcov	−0.0084**	−0.0003***	0.0072**	−0.0001	0.0014*
	(-2.06)	(-2.71)	(2.33)	(-0.38)	(1.84)
Big4	−0.6904**	−0.0631***	2.0359***	−0.1077**	−0.0997
	(-2.46)	(-3.49)	(4.25)	(-2.34)	(-0.68)
SOE	−2.8334***	−0.3054***	1.6471***	0.5639***	−1.0352***
	(-12.46)	(-10.63)	(6.50)	(16.92)	(-8.57)
Public	−0.0341	−0.0034	1.3063***	−0.0757**	0.0446
	(-0.20)	(-0.19)	(4.58)	(-2.28)	(0.43)
GDP	−0.2258***	−0.0170***	0.0374	0.0026	−0.0178
	(-7.17)	(-9.79)	(1.57)	(0.71)	(-1.61)
Capcity	0.1632	−0.0079	−0.4265**	0.0091	−0.5671***
	(0.70)	(-0.70)	(-2.35)	(0.31)	(-6.40)
Edu	0.6362***	0.0566***	1.2073***	−0.0367**	−0.0844
	(5.40)	(7.70)	(10.03)	(-1.97)	(-1.56)
Amount	0.3407**	0.0662***		−0.0009	−0.0044
	(2.39)	(5.69)		(-0.69)	(-0.65)
Maturity	0.0382	−0.0015	−0.0501		0.1391***
	(0.88)	(-0.72)	(-0.68)		(6.66)
Call	0.2543	0.0191	−1.2292***	−0.4387***	−0.1452
	(0.90)	(1.28)	(-4.77)	(-14.46)	(-1.02)
Put	0.5428**	0.0488***	1.6770***	1.3705***	−0.1237
	(2.40)	(3.29)	(5.73)	(33.29)	(-1.23)
Guarantee	0.1728	0.0412**	1.7141***	0.2241***	
	(0.66)	(2.48)	(6.04)	(4.91)	
_cons	−20.7389***	−0.7067***	−1.6e + 02***	−2.8835***	38.6480***
	(-7.85)	(-4.55)	(-28.93)	(-6.51)	(27.51)
Bondtype	Yes	Yes	Yes	Yes	Yes
Rating	Yes	Yes	Yes	Yes	
Industry	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes
R^2	0.3726	0.0727	0.4012	0.5105	0.4827
N	17,969	18,391	18,393	18,393	18,393

Note: (1) The *t*-statistics adjusted for heteroscedasticity are in parentheses; (2) ***, ** and * indicate significance at the 0.01, 0.05 and 0.10 levels, respectively.

5. Further research

5.1. Heterogeneity test

Culture, as an informal institution, may be a supplement or a substitute to formal institutions (Chen et al., 2013). We further investigate the impact of Confucian culture on bond pricing under different legal systems.

The legal system index (*Law*) in the Chinese marketization index compiled by Fan (2011) is used as an indicator to measure different legal environments. Columns (1)–(2) of Table 10 show that *Law* has a significantly negative moderating effect on the relationship between Confucian culture and bond pricing, which indicates that the legal system environment and Confucian culture may be substitutes. In regions with strong legal and other formal institutional constraints, Confucian culture plays a smaller role. However, in regions with weak legal and other formal institutional constraints, Confucian culture can make up for the lack of formal institutions and play a greater role in bond pricing.

In addition, whether bond issuers are listed or not may also affect the influence of Confucian culture on bond pricing. The reason is that unlisted companies disclose relevant information only when issuing bonds, while the information disclosure of listed companies is much more complete. Therefore, investors and rating agencies can obtain less information on unlisted companies, and need to rely more on soft information such as corporate culture for evaluation. We use the cross term of the bond issuer's listing dummy (*Public*) and Confucian culture to test for heterogeneity, and the results are shown in columns (3)–(4) of Table 10. We find that the listing dummy variable, *Public*, has a significantly negative moderating effect on the relationship between Confucian culture and bond pricing, which indicates that Confucian culture plays a particularly significant role in bond pricing in unlisted firms. This shows that unlike listed firms, which need to disclose financial reports regularly, unlisted firms have less available public information and a worse information environment. Accordingly, soft information such as Confucian culture plays a more significant role in bond pricing in unlisted firms.

5.2. The impact of Confucian culture on bond default risk and other bond characteristics

To fully understand the influence of Confucian culture on bond pricing, in this section, we shift our focus to other factors related to bond pricing and investigate whether Confucian culture has an impact on them. First, we examine the influence of Confucian culture on bond default risk. Bond market participants such as rating agencies and bond investors are most concerned about the risk of bond default. If Confucian culture plays an active role in bond pricing, then we expect that the stronger the Confucian culture, the lower the probability of bond default. To test the influence of Confucian culture on bond default, we use a bond default dummy variable (*Default*), which is set to 1 when the bond is defaulted on and 0 otherwise, and a variable for bond default degree (*Default_ratio*), which is equal to the balance of bonds on the default date divided by the amount of bonds issued. The results are shown in columns (1)–(2) of Table 11. We find that the Confucian culture variable, *Lognumjs*, is significantly negatively correlated with *Default* and *Default_ratio*, which indicates that the stronger the Confucian culture, the lower the probability and degree of bond default. This result further reveals how Confucian culture plays an active role in bond pricing.

Second, we expand the scope of investigation to the influence of Confucian culture on other bond characteristics, including bond size, maturity and guarantee terms. Columns (3)–(5) of Table 11 report that the stronger the Confucian culture where the enterprise is located, the larger the scale of bonds issued, the longer the maturity and the greater the probability of providing guarantees. We also use the path analysis method to investigate whether Confucian culture affects the guarantee terms and thus the bond pricing. The results do not support this view. This shows that Confucian culture can not only reduce the bond financing cost but also help firms obtain bond financing on a larger scale and with a longer term. However, firms with a strong Confucian culture are also more cautious in issuing bonds, and are more likely to provide guarantees for their bonds to avoid "breaking promises" due to default.

6. Conclusion

This paper investigates the role of traditional Confucian culture in bond pricing. Using the number of *Jinshi* during the Ming and Qing Dynasties in the corporate headquarters' location as a measure of Confucian culture, we find that Confucian culture improves corporate bond rating and reduces credit spreads. This conclusion holds even when we use the distance to the nearest ancient printing office as an instrumental variable in regressions and other robustness tests. The mechanism test shows that Confucian culture improves the pricing efficiency of corporate bonds by fostering investors' trust, reducing agency problems and restraining bad cor-

porate behaviors. The heterogeneity test shows that the influence of Confucian culture on corporate bond pricing is stronger in regions with weak legal and other formal institutional constraints and in unlisted companies.

Based on the above research findings, this paper draws the following policy implications. First, regulators should explore the inherent value of traditional Confucian culture. Compared with developed Western countries, the Chinese bond market started late, and the market pricing mechanism is not perfect. In these circumstances, we should take advantage of China's culture and traditions such as Confucianism, promoting them and allowing them to play a greater role in bond market pricing. Second, managers should promote their enterprises' development by developing a strong corporate culture. Corporate culture is a core source of an enterprise's competitive advantage and can even determine its fate. This paper confirms that a healthy regional culture helps enterprises obtain more favorable terms when issuing bonds, and shows that Confucian culture is vital for building a strong cultural atmosphere within enterprises. Finally, Confucian culture can be included in the investment analysis framework used by investors and intermediaries in the bond market. Investors can analyze and identify enterprises with more investment prospects, based on the dimensions of regional culture, corporate culture and management culture, so as to create better investment returns and promote market efficiency.

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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