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ESG in China: A review of practice and research, and future research avenues

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ABSTRACT

This paper reviews the practice and research on environmental, social and governance (ESG) in China. It finds that (1) under China's top-down framework, ESG practices have grown substantially in ESG disclosure, ESG rating and ESG investing; and (2) ESG research has focused on corporate ESG disclosure and performance as well as ESG investing. Although the topics of the ESG studies reviewed in this paper are similar to those of ESG research in other countries, China's ESG research enriches international ESG research by showing two distinct characteristics, namely, the country's unique institutional context and the dominance of quantitative research methods. Future research can investigate ESG standards development and the impact of traditional Chinese ethics, modernization and internationalization on ESG in China.

1. Introduction

Traditional Chinese ethics offer a comprehensive guide to one's interactions with nature and society. It teaches respect for nature and emphasizes the deep connection between people and nature. The presiding idea in traditional Chinese ethics is to use nature wisely and seek a balance where both nature and human beings can thrive. Chinese philosophies such as Confucianism and Taoism attempt to find a balance between doing what is right and seeking profit. They hold that even when engaged in business, morality is important, and it can teach us how to gain wealth in a morally justifiable way. These ancient Chinese teachings encourage human beings to live in harmony with nature and society.

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Environmental, social and governance (ESG) has emerged over the past two decades as a crucial ethical construct in modern economies. The concept of ESG is aligned with traditional Chinese ethics, as they both encourage companies to seek a balanced relationship with nature and society. The concept of ESG was first introduced in 2004, when Kofi Annan, the then United Nations Secretary-General, initiated a discussion about how to promote ethical investment practices. As a result of this call to action, a group of 18 financial institutions from nine countries collaborated in 2005 on the influential report *Who Cares Wins: Connecting Financial Markets to a Changing World*. This report argued that financial institutions should consider ESG factors in their investment decisions; this marked the first formal presentation of the ESG concept. In 2006, the United Nations established the Principles for Responsible Investment (PRI), which was designed to help investors understand the impact of ESG on investment and encourage financial institutions to integrate ESG into their investment practices. The PRI defines ESG investing as a strategy that incorporates environmental, social and governance factors into investment decisions, an approach often referred to as sustainable, ethical, or impact investing (PRI, 2018). By the end of 2020, sustainable investment in the world's five major markets[1] had reached US$35.3 trillion in value (Global Sustainable Investment Alliance, 2021). As one of Asia's most vibrant green finance regions, China is a major player in the global ESG market. China has become the world's second-largest green bond market (Climate Bonds Initiative, 2022), and the total value of green loans from 21 Chinese major banks reached US$1.69 trillion by the end of 2020 (The State Council, 2021). China's efforts to develop a sustainable economy have gone a long way toward achieving the Sustainable Development Goals proposed by the United Nations. China's progress in ESG is a contemporary manifestation of the country's traditional ethics, while also being a way of pursuing high-quality economic development.

The widespread adoption of ESG has stimulated academic research in this area. The number of articles published per year on the Web of Science on the topic of "ESG" increased rapidly from 94 in 2015 to 1,410 in 2022. Meanwhile, the number of articles published per year on the topic of "ESG and China" increased from 3 in 2015 to 117 in 2022. Several literature reviews have summarized the development of global ESG research, but these have primarily focused on North America and Europe. Tsang et al. (2022) summarize the literature related to the determinants, characteristics, consequences and moderators of ESG disclosure. Gillan et al. (2021) review the literature on the factors and economic consequences of ESG at the corporate finance level. Brooks and Oikonomou (2018) and Huang et al. (2022) focus on the relationship between ESG and financial performance, while Grewal and Serafeim (2020) focus on measuring and managing corporate sustainability performance. Daugaard (2020) uses quantitative analysis to review the literature related to ESG investing systematically.

However, the scope of previous ESG literature reviews has been restricted to developed economies; none of these reviews considers the relevant literature from emerging markets, even though ESG in these markets is an indispensable part of global ESG development. In addition, previous literature reviews only assess ESG research along a single dimension, such as information disclosure, corporate behavior or ESG investing; this suggests that a comprehensive examination of ESG research is still urgently needed.

The two main contributions of this paper are as follows. First, this paper attempts to fills the research gap by offering a comprehensive review of ESG practice and research in China, the largest emerging economy. Specifically, we review studies on China's ESG (both in Chinese and English) and identify characteristics of ESG research in China including the utilization of the country's unique institutional context and the dominance of quantitative research methods. Second, this paper proposes three avenues for future research, namely, (1) the impact of the interaction between traditional Chinese ethics and the country's modernization on corporate ESG in China, (2) the impact of the internationalization of Chinese business on ESG in China, and (3) the development of China's ESG standards.

The remainder of this paper is structured as follows. Section 2 reviews the development of ESG practices in China from the perspectives of ESG disclosure, ESG rating and ESG investing. Section 3 describes the paper's methodology. Section 4 examines previous studies of ESG disclosure by Chinese companies. Section 5 summarizes research on corporate ESG performance from the perspectives of driving factors and economic con-

[1] These five markets are Europe, America, Canada, Australia and Japan (Global Sustainable Investment Alliance, 2021).

sequences. Section 6 reviews the research on ESG investing in China. Section 7 identifies the characteristics of ESG research in China. Section 8 outlines the paper's conclusions and proposes future research avenues on ESG in China.

2. Development of ESG practices in China

The development of ESG practices in China can be divided into three main stages, as shown in Fig. 1. The first stage began in 2001 when China joined the World Trade Organization (WTO) and integrated itself into the global economy. As a result, the concept of social responsibility was gradually embraced by Chinese companies. A significant turning point was reached in 2008, when the government made social responsibility reporting mandatory for particular companies (as discussed in detail in section 2.1). This led directly to a considerable increase in the number of listed companies publishing these reports. By 2011, over 500 A-share listed companies in China had issued social responsibility reports or sustainability reports (Chinese Association for Public Companies, 2022).

The second stage commenced after the 18th National Congress of the Communist Party of China (CPC) in 2012, and especially after the introduction at the Fifth Plenary Session of the 18th CPC Central Committee in 2015 of a new development philosophy emphasizing *innovation, coordination, green, openness and sharing*. During this stage, sustainable development became a national goal. This was marked by the issuance of *Guidelines for Establishing the Green Financial System* by the People's Bank of China and six other ministries in 2016, which increased the use of ESG ratings and green financial products in the Chinese market. Subsequently, Morgan Stanley Capital International (MSCI) partially included China A-shares in the MSCI Emerging Markets Index in 2018.

The third stage began in 2020, when the "dual carbon"[2] goal was announced as a national strategy, meaning that low-carbon transition became a priority. It is becoming more mainstream since ESG emphasizes environmental factors and is closely integrated with capital markets. This has in turn attracted attention from various sectors.

2.1. ESG disclosure practice

Sustainability reports serve as a measurement and disclosure mechanism for internal and external stakeholders, and are a tool by which an organization can achieve its sustainable development goals (GRI, 2016). In China, most companies voluntarily disclose ESG information.

China's ESG disclosure regulations differ between the capital markets in mainland China and in Hong Kong. In mainland China, ESG disclosure regulations were released as early as 2008, when the Shenzhen Stock Exchange required companies in the Shenzhen 100 Index to disclose social responsibility reports. The Shanghai Stock Exchange made it mandatory for companies in its Corporate Governance Index, companies that were listed both domestically and internationally, and financial companies to publish their social responsibility reports. Thereafter, sustainability disclosure transitioned from social responsibility reports to ESG reports. In June 2018, the China Securities Regulatory Commission (CSRC) issued the *Code of Corporate Governance Guidelines for Listed Companies*, formally establishing a framework for ESG disclosure. The CSRC revised its requirements for annual and semi-annual reports in 2021, requiring listed companies to disclose ESG information. In Hong Kong, the Hong Kong Stock Exchange (HKEX) introduced the *Environmental, Social, and Governance Reporting Guide* in 2012 and revised guidelines in 2016 and 2020, shifting disclosure requirements from voluntary to semi-mandatory and then to mandatory. The mandatory disclosure requirements in HKEX have driven the sustainability information disclosure of Chinese A-share listed companies (Fang and Guo, 2018).

These ESG disclosure regulations have greatly increased ESG disclosure and assurance in China. According to the Chinese Association for Public Companies (2022), an increasing number of companies are issuing

[2] At the General Debate of the 75th Session of the United Nations General Assembly on 22 September 2020, Chinese President Xi Jinping announced that China aimed to have CO_2 emissions peak before 2030 and achieve carbon neutrality before 2060; this is referred to as the "dual carbon" goal (https://www.xinhuanet.com/english/2020–09/23/c_139388764.htm).

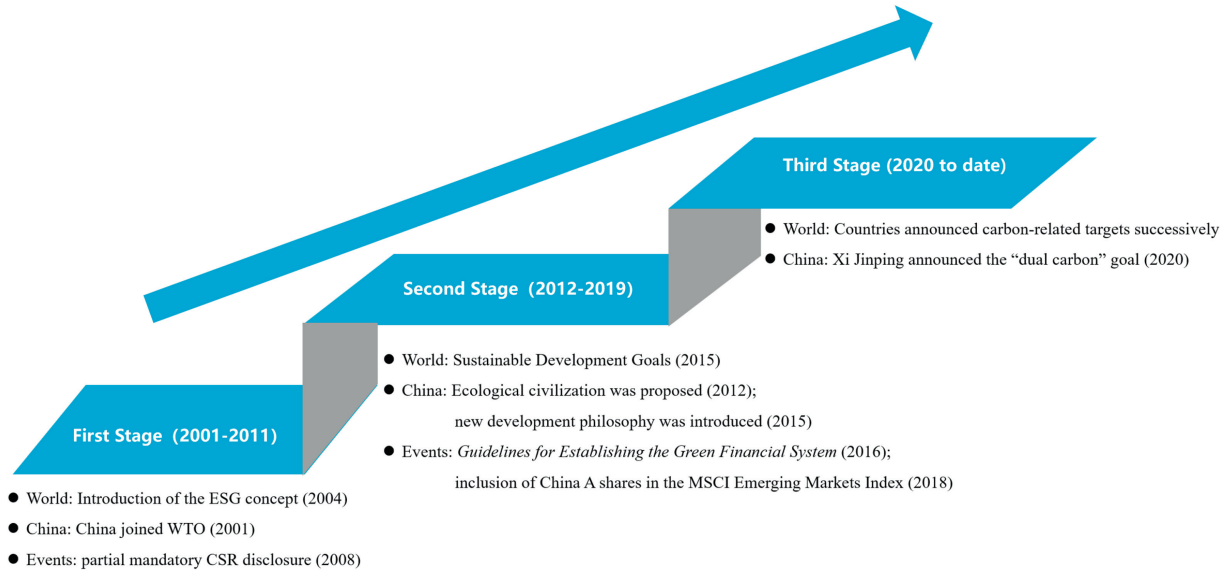

Fig. 1. Three stages of ESG practice in China.

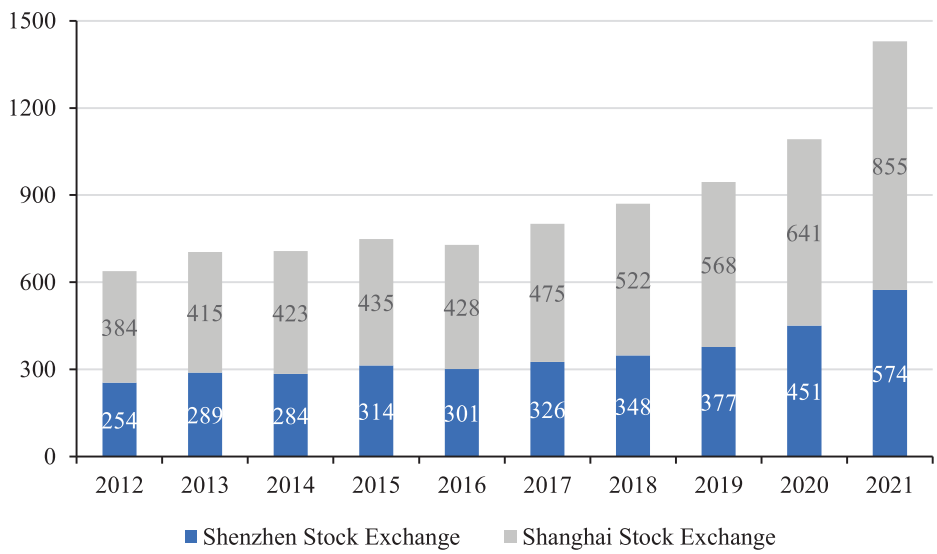

Fig. 2. Number of ESG reports disclosed by Chinese listed companies Data Source: Chinese Association for Public Companies (2022).

ESG or sustainability reports. Fig. 2[3] shows that the number of listed companies issuing ESG-related reports rose from 638 in 2012 to 1,429 in 2021. In 2021, 30% of listed companies issued ESG-related reports, of which 77% were social responsibility reports, 13% were ESG reports and 5% were sustainability reports, as shown in Fig. 3 (Chinese Association for Public Companies, 2022).[4] Furthermore, data from China Stock Market & Accounting Research (CSMAR) show that many listed companies voluntarily adopted the Global Reporting Initiative (GRI) Standards. This proportion rose from 20% in 2012 to 42% in 2021. In terms of ESG assur-

[3] This section only makes use of data from Chinese A-share listed companies in the last 10 years. The same applies below.
[4] Chinese listed companies publish ESG-related reports under a variety of titles, such as social responsibility reports, ESG reports and sustainability reports.

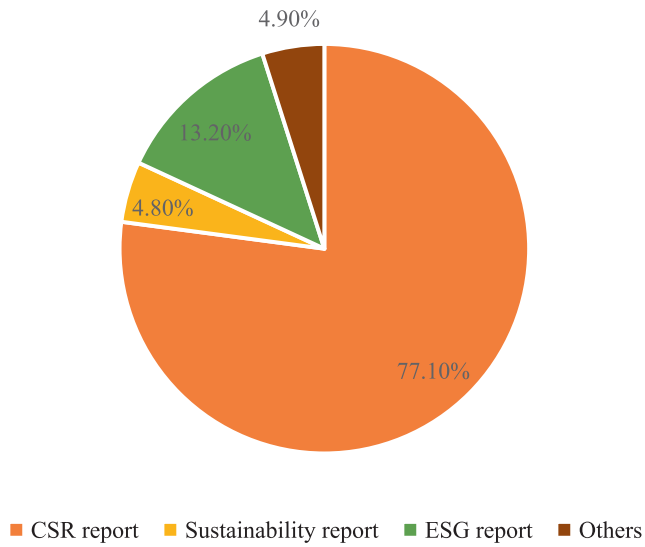

Fig. 3. Titles of ESG-related reports published by Chinese listed companies in 2021 Data Source: Chinese Association for Public Companies (2022).

ance, Fig. 4 shows that the proportion of listed companies purchasing ESG assurance services has steadily increased since 2019, although earlier years saw a downward trend. Various entities provide ESG assurance services, including public accounting firms, consulting institutions, industry associations (such as the China National Textile and Apparel Council) and experts.

2.2. ESG rating

ESG rating is a comparative assessment of companies or financial products in terms of strategies, disclosure or performance on specific ESG themes (European Commission, 2021). It is an effective tool that investors can use to measure a company's or financial product's sustainability.

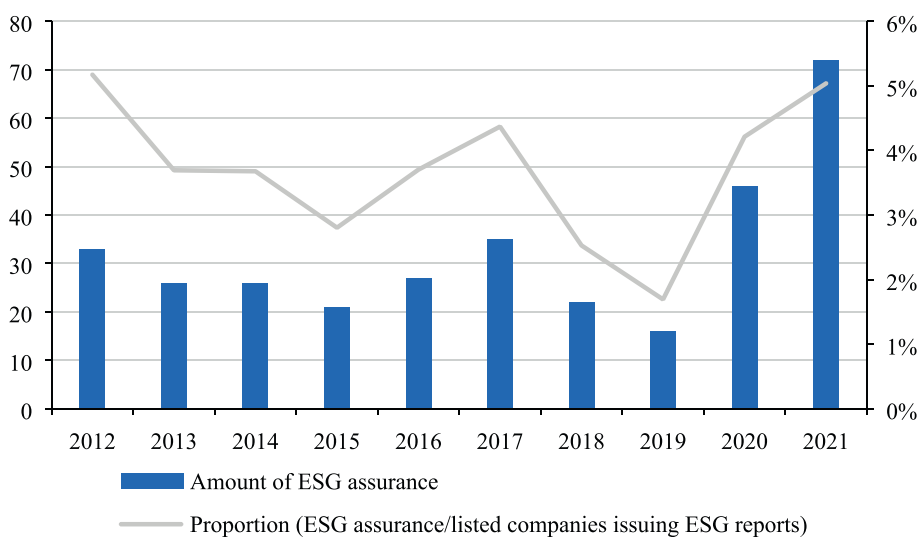

Fig. 4. Amount and proportion of ESG assurance disclosed by Chinese listed companies Data source: CSMAR database.

ESG rating was introduced relatively late in China. However, an increasing number of companies are covered by domestic and international rating agencies. In China, ESG rating agencies began to emerge in 2015, introducing evaluation systems and rating data. Leading ESG rating agencies include China Securities Index Co., Ltd., Beijing SynTao Green Finance Consulting Co., Ltd., Sino-Securities Index Information Service (Shanghai) Co., Ltd., Rankins Global (Beijing) Consulting Co., Ltd., etc. Globally, MSCI incorporated some Chinese companies into the MSCI Emerging Markets Index in 2018, which heightened Chinese companies' attention to ESG. Subsequently, both FTSE Russell and S&P Dow Jones included A-share companies in their indices, driving more international rating agencies to include Chinese companies in their rating scope. Table 1 provides a comparison of major ESG rating agencies.

The sources of ESG rating agencies primarily fall into four categories: company disclosure, media reports, alternative data and modeled data (Lee, 2021). Based on ESG news, media-sourced data are used to assess and model corporate ESG risks. Alternative data include weather maps, satellite data and an array of external databases. Modeled data rely on models to fill in gaps in corporate disclosure, such as forecasting emission trajectories based on emission reduction targets and historical records. While ESG data sources are fundamentally consistent, the rating methods used by different agencies vary because of divergences in scope, measures and weighting (Berg et al., 2022). Thus, there is no universal consensus on the ESG ratings of listed companies (Zhang and Yuan, 2022). Given this divergence, institutional investors are increasingly reassessing and adjusting their rating data to ensure consistency with their investment objectives. For instance, Southern Asset Management recently developed an ESG rating system and has used it to rate over 9,200 listed companies and bond issuers (Southern Asset Management, 2022). These rating results are integrated into the entire investment decision-making process, from pre-investment to post-investment.

2.3. ESG investing

Green finance is the primary manifestation of ESG investment in China. The People's Bank of China and six other ministries issued the *Guidelines for Establishing the Green Financial System* in 2016, which set out the basis for green finance. A subsequent series of policies have been released to guide and standardize green finance, which has continuously increased the scale of the green credit and bond market. Fig. 5 shows that green credit by major Chinese banks rose steadily from RMB 895 billion in 2012 to RMB 11,899 billion in 2021. Fig. 6 presents green bond in China from 2016 to 2021, which shows a significant surge in 2021.

ESG financial products include ESG funds, ESG indices and ESG banking wealth management products. Of these, ESG funds and ESG indices are the fastest-growing segments. As of June 2022, there were 374 publicly offered ESG funds in China, which exceeded 241.9 billion shares with a net total fund value of RMB 392.5 billion. These include 309 actively managed funds, focusing on low-carbon environmental protection, energy conservation, new energy and carbon neutrality, and 65 passive index funds that mainly track indices of environmental protection, new energy, photovoltaics, ecological protection and batteries. A total of 698 ESG indices were issued, including 274 core ESG indices and 424 broad ESG indices. (Zhang and Yuan, 2022).

There are seven main ESG investment strategies: ESG integration, negative screening, norms-based screening, positive screening, shareholder engagement, sustainability investment and impact investment. Among these, screening strategies are the main type of ESG investment strategy used by institutional investors in China. Screening strategies help institutional investors reduce investment risk (Alessandrini and Jondeau, 2021). Fig. 7, which presents data from the *China Fund Industry ESG Investment Special Survey Report* (Asset Management Association of China, 2020a, b), shows that 85% of the surveyed securities investors and 82% of the surveyed equity investors agreed that risk reduction is the main driving force for undertaking ESG/green investment.

3. Methodology

Following prior studies (Linnenluecke et al., 2020; Fan et al., 2021; Tsang et al., 2022), this paper systematically reviews and summarizes the literature on ESG in China. The literature reviewed in this paper concentrates on the concept of ESG as a whole. This paper does not review research on CSR or on individual ESG components. The data sources are twofold: English literature and Chinese literature.

Table 1
Comparison of ESG rating agencies.

Rating agency	Data sources	Indicator rating structure	Rating scheme	Update frequency
Bloomberg	1. Listed companies' websites, announcements, sustainability reports, etc. 2. News and public opinion3. Other public data	3 pillars, 120 issues	0–100	Annually
FTSE Russell	1. Listed companies' websites, announcements, sustainability reports, etc. 2. Regulatory authorities 3. News and public opinion4. Industry associations	3 pillars, 14 issues, 300+ data points	0–5	Monthly
MSCI	1. Listed companies' websites, announcements, sustainability reports, etc. 2. Regulatory authorities 3. News and public opinion 4. Industry associations5. Corporate communication channels	3 pillars, 10 issues, 37 sub-issues	7 levels, from low to high: CCC, B, BB, BBB, A, AA, AAA	Annually
Refinitiv	1. Listed companies' websites, announcements, sustainability reports, etc. 2. Regulatory authorities 3. News and public opinion4. Industry associations	3 pillars, 10 issues, 186 sub-issues, 500+ data points	12 levels, from low to high: D−, D, D+, C−, C, C+, B−, B, B+, A−, A, A+	Weekly
RepRisk AG	1. Regulatory authorities 2. News and public opinion3. Industry associations	3 pillars, 28 issues, 73 sub-issues	10 risk levels, from high to low: D, C, CC, CCC, B, BB, BBB, A, AA, AAA	Monthly
China Securities Index Co., Ltd., CSI	1. Listed companies' websites, announcements, sustainability reports, corporate charters, etc. 2. Regulatory authorities 3. News and public opinion4. Specific data in CSI	3 pillars, 14 issues, 22+ sub-issues, 100+ data points	10 levels, from low to high: D, C, CC, CCC, B, BB, BBB, A, AA, AAA	Monthly
Beijing SynTao Green Finance Consulting Co., Ltd., SynTao	1. Listed companies' websites, announcements, sustainability reports, etc.2. News and public opinion	3 pillars, 14 issues, 200+ data points	10 levels, from low to high: D, C−, C, C+, B−, B, B+, A-, A, A+	Quarterly
Sino-Securities Index Information Service (Shanghai) Co., Ltd., Huazheng	1. Listed companies' websites, announcements, sustainability reports, corporate charters, etc. 2. Regulatory authorities3. News and public opinion	3 pillars, 14 issues, 26 sub-issues, 130+ data points	9 levels, from low to high: C, CC, CCC, B, BB, BBB, A, AA, AAA	Quarterly
Rankins Global (Beijing) Consulting Co., Ltd., RKS	1. Listed companies' websites, announcements, sustainability reports, etc. 2. Regulatory authorities 3. News and public opinion4. Social organization surveys	3 pillars, 26 issues, 100+ data points	7 levels, from low to high: CCC, B, BB, BBB, A, AA, AAA	Annually

(*continued on next page*)

Table 1 (*continued*)

Rating agency	Data sources	Indicator rating structure	Rating scheme	Update frequency
China Alliance of Social Value Investment, CASVI	1. Listed companies' websites, announcements, sustainability reports, corporate charters, etc. 2. Regulatory authorities3. News and public opinion	3 pillars, 9 issues, 27 sub-issues, 55+ data points	10 levels, from low to high: D, C, CC, CCC, B, BB, BBB, A, AA, AAA	Semiannually
Wind Information Technology Co., Ltd., Wind	1. Listed companies' websites, announcements, sustainability reports, etc. 2. Regulatory authorities 3. News and public opinion4. Industry associations	3 pillars, 27 issues, 300+ data points	7 levels, from low to high: CCC, B, BB, BBB, A, AA, AAA	Monthly
MioTech Information Technology (Shanghai) Co., Limited, MioTech	1. Listed companies' websites, announcements, sustainability reports, corporate charters, etc. 2. Regulatory authorities3. News and public opinion	3 pillars, 19 issues, 700+ sub-issues, 1,000+ data points	12 levels, from low to high: D, DD, DDD, C, CC, CCC, B, BB, BBB, A, AA, AAA	Quarterly

Data source: Zhang and Yuan (2021).

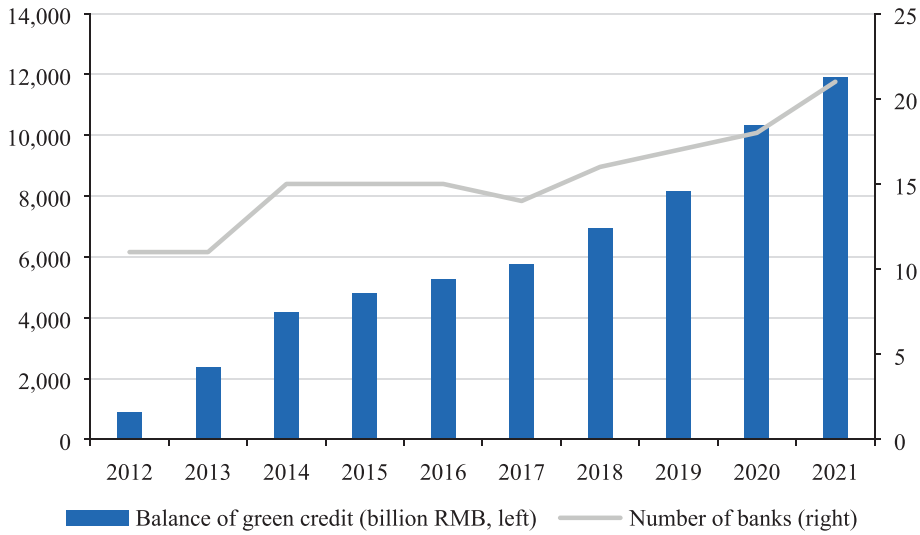

Fig. 5. Balance of green credit by major Chinese banks Data source: CSMAR database.

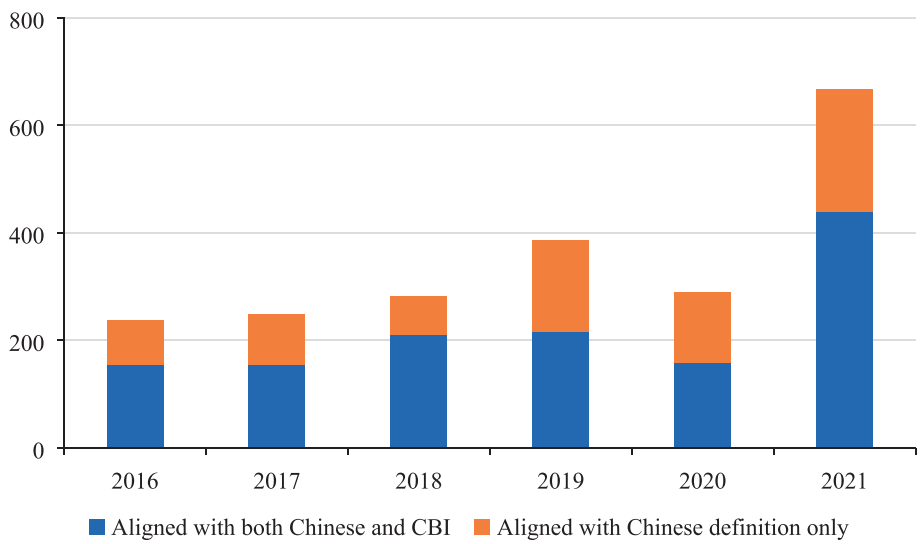

Fig. 6. Volume of green bond issuance in China (in billions of RMB) Data Source: Climate Bonds Initiative (2022).

3.1. The English literature

Following the methodology of Khlif and Chalmers (2015) and Daugaard (2020), a search of the English-language literature is performed on various databases such as EBSCO, Scopus, Emerald, Web of Science and Wiley. The search query is constructed as "Topics=(ESG OR Environment* Social* Govern*) AND (China OR Chinese)". The following filtering is applied: English-language studies published in journals listed in either JCR Q1, ABDC A/A*, or ABS 3 and above are included; the journal category is restricted to the fields of economics or management; and the theme is limited to ESG in China.

Ultimately, we obtain 44 English articles. Fig. 8 shows the distribution of the English literature across journals. The 44 articles were published between 2014 and 2023, as shown in Fig. 9 (including several articles published online). Fig. 10 analyzes the keywords used in the English literature; it demonstrates that ESG

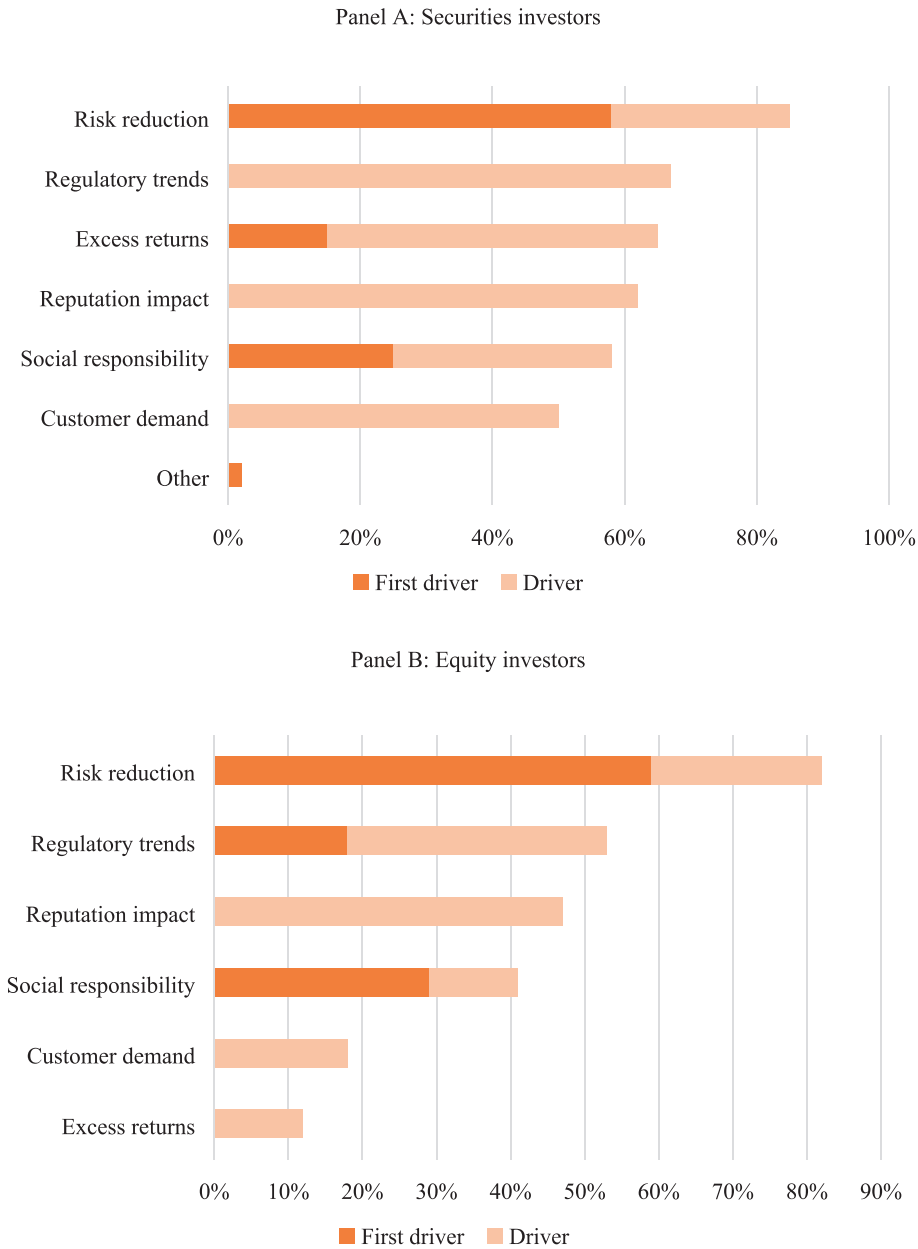

Fig. 7. Drivers motivating institutional investors to engage in ESG/green investment Data Source: Asset Management Association of China (2020a; 2020b).

performance, stock market and impact are popular topics. Furthermore, the majority (96%) of ESG-related articles adopt quantitative research methods, while interviews (2%) and case studies (2%) are rarely used.

3.2. The Chinese literature

The Chinese articles analyzed in this paper are sourced from the China National Knowledge Infrastructure (CNKI) database. The search keywords "ESG" or "environmental, social, and governance" (in Chinese) are used to find Chinese articles published up to 31 December 2022. The following filters are applied: Chinese articles published in journals listed in the Chinese Social Sciences Citation Index (CSSCI) are included; the journal category is restricted to the fields of economics or management; and the theme is limited to ESG in China.

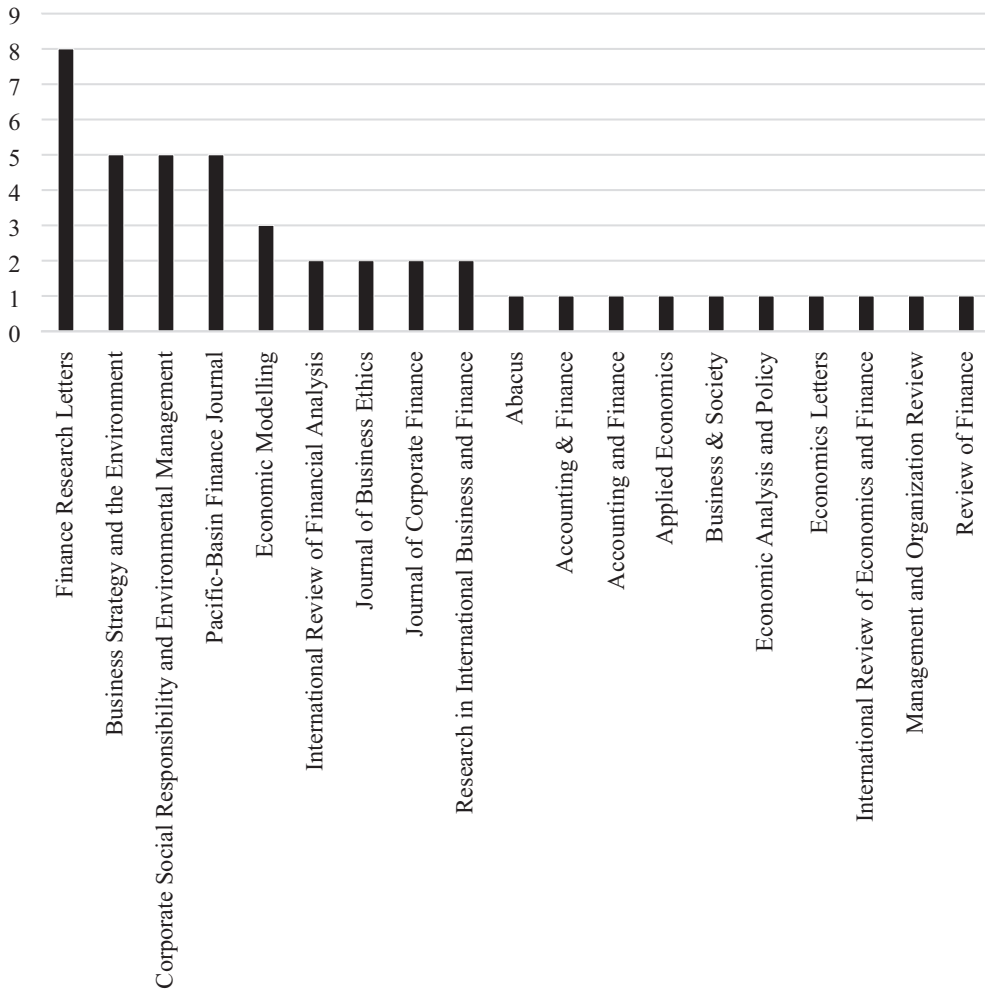

Fig. 8. The distribution of the English literature across journals.

Through this filtering process, a total of 38 relevant Chinese articles are obtained. The distribution of these articles among journals is depicted in Fig. 11. The timeline shows that these articles were primarily published between 2019 and 2023 (including several articles published online). Fig. 12 depicts the rapid growth of the Chinese ESG literature. The most frequent keywords in the Chinese ESG literature include ESG, financing constraints, sustainable development and green innovation, as shown in Fig. 13. A review of the research methods shows that all Chinese articles use archival data.

4. Research on corporate ESG disclosure in China[5]

4.1. Drivers of corporate ESG disclosure

Corporate ESG disclosure is a branch of non-financial information disclosure. The literature focuses on how companies respond to international stakeholders and compile ESG reports. Companies with international business attract attention from various international stakeholders, such as investors, customers and governments. In turn, these international stakeholders' requirements for ESG reporting and practices can induce companies to publish sustainability reports (Parsa et al., 2018).

[5] Appendix A lists the research on corporate ESG disclosure in China.

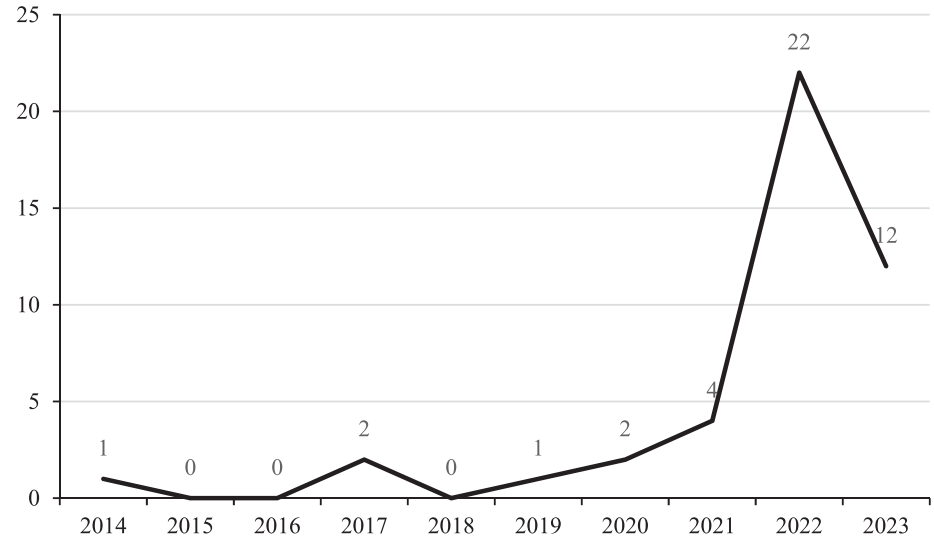

Fig. 9. The English literature from 2014 to 2023.

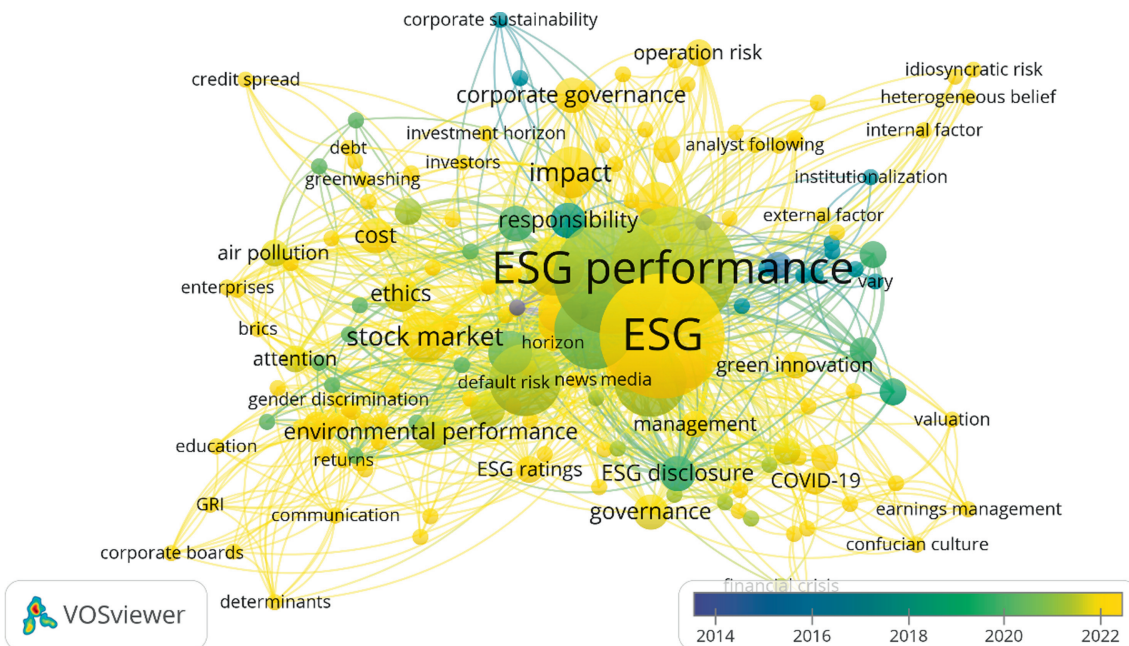

Fig. 10. Co-occurrence network of keywords in the English literature.

Marquis et al. (2017) use China Ocean Shipping (COSCO) as a case study to examine how foreign stakeholders drive Chinese companies to adjust their ESG practices and publish sustainability reports. Regarding GRI standards, COSCO identifies key sustainability issues, defines the report's boundaries and establishes an ESG database compatible with international standards. Based on these initiatives, COSCO develops a guide for future sustainability reports. Nevertheless, Yang et al. (2021) find that when Chinese companies apply GRI standards in response to international stakeholders' concerns, they do not gain a competitive advantage in international markets compared with those in the domestic market. They argue that when Chinese companies enter foreign markets, they face more intensive social and environmental regulatory requirements from vari-

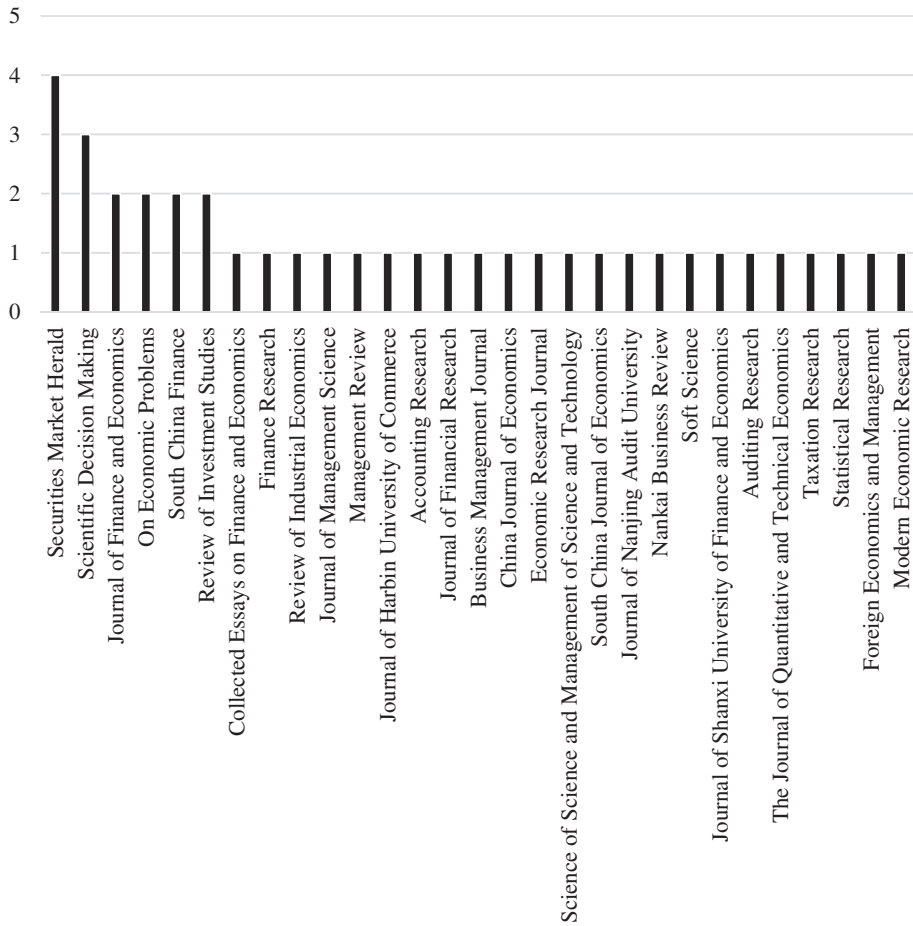

Fig. 11. The distribution of the Chinese literature across journals.

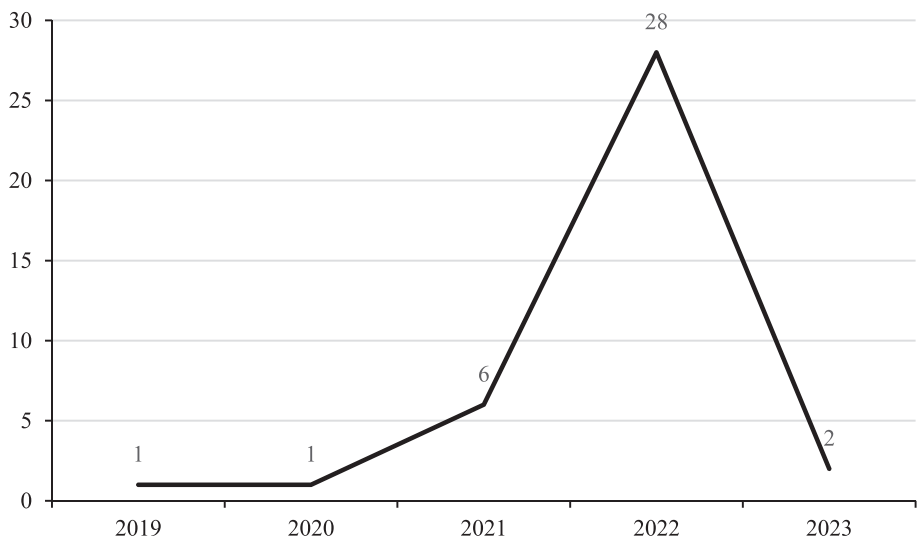

Fig. 12. The Chinese literature from 2019 to 2023.

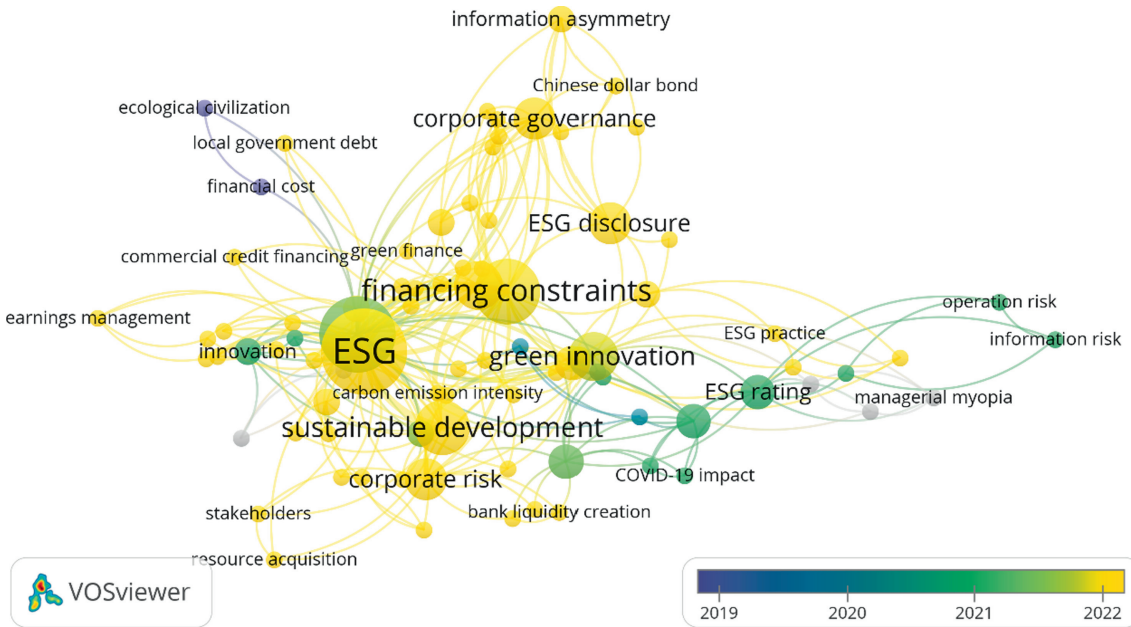

Fig. 13. Co-occurrence network of keywords in the Chinese literature.

ous stakeholders, such as host country governments, foreign customers and non-governmental organizations. Compliance with GRI standards alone does not guarantee support from international stakeholders.

4.2. Economic consequences of corporate ESG disclosure

Research on the economic consequences of ESG disclosure among Chinese companies primarily concentrates on its impact on corporate operational activities and capital market performance. Overall, previous studies show that ESG disclosure has a positive effect on corporate operations and reduces information asymmetry in the capital market.

Concerning the impact on corporate operational activities, Chen and Xie (2022) find, based on the first release of ESG ratings by Bloomberg, that ESG disclosure has a positive effect on corporate performance, especially in companies with ESG investors, longer established companies, those receiving more media attention and those with higher agency costs. Yang et al. (2021) examine the first application of GRI standards and document that companies that apply GRI standards achieve better than expected performance. Li et al. (2022c) discover that ESG disclosure can significantly alleviate corporate financing constraints, and that positive news plays a moderating role. Li et al. (2022b) find a U-shaped relationship between ESG disclosure and the green innovation of heavily polluting companies. When the degree of ESG disclosure is low, the costs of information production and transmission outweigh its positive effects, thus decreasing the degree of corporate green innovation. However, when the degree of ESG disclosure is high, the positive effects can offset the negative effects resulting from costs.

Concerning corporate capital market performance, Xi and Wang (2022) find that ESG disclosure can mitigate stock price crash risk by reducing information asymmetry and minimizing investor emotions. He et al. (2022b) confirm that ESG disclosure provides additional non-financial information that reduces information asymmetry, significantly lowering companies' idiosyncratic risk. This effect is primarily concentrated in companies that are subject to mandatory ESG disclosure.

In the bond market, Wu et al. (2022) find that when Chinese dollar bonds disclose ESG information (i.e., as rated by Bloomberg), the bond issuance spread decreases by an average of 59 basis points. The higher the ESG disclosure scores, the smaller the issuance spread of Chinese dollar bonds. Zhang and Liu (2022) suggest that

companies with relatively high ESG disclosure scores reduce information asymmetry between bond issuers and investors, significantly decreasing the value at risk of corporate bonds.

4.3. Quality of ESG disclosure

Sun et al. (2022) discuss the quality of corporate ESG disclosure from the perspectives of readability and conciseness. They suggest that GRI-compliant ESG reports are lengthier than other ESG reports, because GRI-compliant ESG reports typically contain more information to fulfill the demands of various stakeholders. Moreover, compared with other ESG reports, GRI-compliant ESG reports generally have lower readability, due to a lack of integration between non-financial and financial information.

5. Research on corporate ESG performance in China

5.1. Driving factors of corporate ESG performance

The driving factors are of two types: external factors, such as regulations, government behaviors and market power, and internal factors, such as ownership structure, corporate governance and digitalization. Appendix B lists the research on the drivers of corporate ESG performance in China.

5.1.1. External factors

The Chinese government adopts a top-down approach in addressing environmental issues, by means of environmental regulations. Investigations into the influence of regulatory policies on ESG performance reflect the top-down institutional framework in China. Specifically, these studies help us trace the chain of effects from institutions at the country level to ESG performance at the company level.

Previous studies explore the impact of low-carbon and environmental policies on corporate ESG performance. For instance, the National Development and Reform Commission launched low-carbon city pilot programs in 2010, 2012 and 2017. These pilot programs requires the government involved to develop policies to promote low-carbon development and accelerate the creation of a low-carbon industrial system. Wang and Wang (2022) discuss the impact of this policy on high-quality development (as measured by ESG) and find a positive relationship between them. Wang et al. (2021) suggest that China's environmental protection tax enhances corporate ESG performance, primarily by encouraging green innovation to improve environmental performance. Wang et al. (2022b) find that central environmental protection inspection enhances corporate ESG performance, by reinforcing corporate environmental compliance, strengthening connections between companies and stakeholders, and alleviating agency conflicts between managers and shareholders. Shu and Tan (2023) focus on the need for the low-carbon transformation of Chinese companies in the context of the "dual carbon" goal, exploring the relationship between carbon control policy risk and corporate ESG performance. They argue that regulations for carbon emissions could cause high-carbon companies to face extra compliance costs, leaving insufficient funds to support ESG activities. They accordingly discover a negative correlation between carbon control policy risk and corporate ESG performance, particularly in companies that are non-state-owned, insensitive to green innovation, in carbon-sensitive industries or located in regions with strict environmental regulations.

In addition to environmental regulations, government behaviors also have an impact on corporate ESG performance. Zhang and Deng (2022) explore the crowding-out effect of government debt on corporate ESG performance. They find that government debt crowds out credit resources, increasing corporate financing costs and diminishing financial support for green governance. Such a crowding-out effect leads to a significant decrease in corporate ESG performance. Meng et al. (2023) find that the collusion interaction of government and companies hinders corporate ESG practices, thus aggravating air pollution.

Research on the impact of market power mainly focuses on three market participants: non-governmental organizations (NGOs), institutional investors and emerging financial market participants such as big-tech companies.

NGOs are intermediaries in information transmission, encouraging and guiding corporate ESG practices. Such NGOs can help companies collaboratively resolve ESG-related conflicts. They can also leverage their

monitoring and communication advantages to impact companies, leading to changes in corporate ESG behaviors (Moosmayer et al., 2019).

Moosmayer et al. (2019) investigate the relationships among companies, NGOs and consumers. They find that while consumers cannot confirm the credibility of sustainable products through trial use, they can alleviate their doubts about credibility through NGO propaganda and third-party certifications. Studying consumers' purchasing intentions for a sustainable athletic product from Li Ning, the authors find that the interaction between Li Ning and two NGOs (the Institute of Public and Environmental Affairs and the Natural Resources Defense Council) served as a signal to consumers. This signal can enhance the credibility of sustainability claims associated with the product, increasing support from consumers.

A number of studies discuss the differential impact of institutional investors on corporate ESG performance. Jiang et al. (2022) find that site visits by institutional investors can significantly improve companies' ESG performance, primarily through enhancing the quality of accounting information, increasing environmental investment and increasing media attention. Liu et al. (2023) differentiate institutional investors into pressure-sensitive and pressure-resistant types. They find that pressure-resistant institutional investors, who focus on long-term corporate interests, enhance corporate ESG performance across all three ESG dimensions, while pressure-sensitive investors driven by short-term interests reduce corporate ESG performance in the environmental and governance dimensions. Wang et al. (2023a) categorize institutional investors into four categories: long-term pressure-sensitive, long-term pressure-resistant, short-term pressure-sensitive and short-term pressure-resistant. They find that the positive correlation between institutional investors and ESG performance is mainly driven by long-term pressure-resistant and short-term pressure-sensitive institutional investors.

Chinese big-tech companies have become important players in the financial market through digital finance. Mu et al. (2022) find that digital finance can boost corporate ESG performance by easing financing constraints. This benefit is more pronounced in companies that are non-state-owned, small-sized, at a lower level of marketization or located in the central and western regions of China; that is, digital finance alleviates the financing challenges faced by disadvantaged companies. Yang et al. (2022) draw similar conclusions and argue that this promotion effect is mainly achieved through financial and technical support.

5.1.2. Internal factors

Previous research on the internal factors influencing corporate ESG performance mostly focuses on ownership structure, corporate governance and level of digitalization.

State-owned enterprises (SOEs) tend to engage in a higher level of ESG practices compared to non-SOEs. As a unique subset of Chinese companies, SOEs are supervised by the State-owned Assets Supervision and Administration Commission. Under state policies (such as environmental and sustainable policies), SOEs are required to engage in ESG practices (Zhang and Huang, 2022). Some studies highlight the pioneering role of SOEs in driving ESG practices. Weber (2014) finds that a higher percentage of SOEs than non-SOEs publish ESG reports. Distinguishing between central and local SOEs, Lin et al. (2021) argue that central SOEs place a higher emphasis on the social benefits of their activities. They are more willing and able to engage in ESG activities than other types of SOEs or non-SOEs.

Regarding corporate governance, Huang et al. (2022) focus on the widespread issue of controlling shareholder pledging in Chinese companies. The authors demonstrate that after controlling shareholders pledge their equity, they are motivated to exploit small and medium-sized shareholders and obtain earnings. As a result, corporate ESG performance significantly deteriorates. Qiu et al. (2022) find that corporate social trust has a positive impact on ESG performance, and it is boosted by the presence of female directors on executive teams. Liu et al. (2022a) find that CPC governance positively influences corporate ESG performance. Because the board of directors plays such an important role in corporate decision-making, the inclusion of Party members on the board boosts ESG performance more than inclusion in executive teams.

Regarding corporate digitalization, Fang et al. (2022) investigate how companies' digitalization level drives ESG performance. In addition, corporate communication technologies can reduce agency costs, in turn improving the governance score. Companies use digital communication tools to connect with stakeholders. By sharing their accomplishments in philanthropy and poverty reduction, companies can strengthen their social reputation and obtain a higher social score. However, digital technologies do not significantly impact

their environmental score. Similar findings are reported by Wang et al. (2023b) and Hu et al. (2023), who suggest that digital strategies and blockchain technology can significantly enhance ESG performance.

5.2. Economic consequences of corporate ESG performance

Many studies investigate the economic consequences of ESG performance among Chinese companies. This section summarizes the impact of ESG performance on corporate value, corporate operations, financing activities and investment. Appendix C summarizes the research on the economic consequences of corporate ESG performance.

5.2.1. Impact of ESG performance on corporate value

Whether ESG performance can affect corporate value is a popular topic in ESG research. Discussions of corporate value mainly involve corporate operational and stock market performance.

Most studies show that ESG performance is positively related to corporate value. There are three mechanisms at work. First, ESG helps reduce information asymmetry and lower financing costs (Wang and Yang, 2022; Xi and Zhao, 2022). Second, ESG can improve corporate profitability and productivity, because it sets high standards for human capital, managerial skills and technical expertise (Zhou et al., 2021; Li et al., 2021). Third, it decreases operational risks. ESG assists companies in establishing a positive image, which has the potential to improve corporate value (Zheng et al., 2023b; Tan et al., 2022; Xi and Zhao, 2022). Of these three mechanisms, Wang et al. (2022a) indicate that the risk-reducing effect is the most crucial. Low operational risks help companies with good ESG performance gain government resources, strengthen supply chain partnerships and acquire financial resources.

However, some researchers find that the relationship between ESG performance and corporate value varies across different industries, competitive strategies and periods of ESG implementation. According to Wang et al. (2022d), there is a U-shaped relationship between industrial companies' ESG performance and financial performance. This relationship is more pronounced in companies that implement differentiated strategies. According to Li and Zheng (2022), ESG is not yet able to increase corporate income growth in China because it is still in its infancy. Hence, the cost of ESG is more noticeable than the positive effect. According to Yi et al. (2022), ESG practices reduce short-term corporate value while increasing it in the long term.

In terms of stock market performance, researchers primarily examine whether companies with higher ESG ratings achieve significant excess returns compared with those with lower ESG ratings. Research to date presents inconsistent conclusions. The majority of studies support the claim that companies with high ESG ratings achieve significant excess returns. Chen et al. (2023a) find that stocks with high ESG scores perform better than those with low ESG scores. This ESG premium is mainly due to insufficient market reactions to ESG information rather than risk compensation. Li (2021) and Zhou et al. (2021) obtain similar results. However, some studies obtain more mixed findings. Feng et al. (2022b) suggest that companies with higher ESG performance can achieve significant excess returns in the short term, but their long-term stock returns diminish as investor attention to ESG wanes. Zhang et al. (2021) find that after the issuance of *Guidelines for Establishing the Green Financial System* in 2016, companies with higher ESG performance had significant excess returns compared with companies with lower ESG performance. Lo and Kwan (2017) examine the market reactions to news reports on different topics and find that because ESG has a more clearly defined scope than sustainability, ESG-related news receives more positive market responses.

Some researchers examine whether companies with higher ESG performance achieved better returns during the COVID-19 pandemic in China. The results consistently demonstrate the significance of ESG performance in times of crisis. Broadstock et al. (2021) use the lockdown event in Wuhan as a shock and find that high-ESG portfolios generally outperformed low-ESG portfolios, suggesting that ESG was used to mitigate financial risk during the market-wide financial crisis caused by COVID-19. However, the marginal benefit of ESG performance on returns is diminished in normal times. Shan and Tang (2023) identify employee satisfaction as a crucial index of ESG. They find that companies with high employee satisfaction achieve significant and positive excess returns, despite the COVID-19 pandemic. This effect is more pronounced in companies with more intangible assets and in knowledge-based industries, meaning that the impact of employee satisfaction on

stock returns is more significant in human capital-intensive companies. Their research supports the idea that companies that do well in normal times can also perform well in times of crisis.

5.2.2. Impact of ESG performance on corporate operations

The influence of ESG performance on corporate operations is primarily reflected in motivating innovation and enhancing productivity. In addition, some studies examine the impact of ESG performance on business management from other perspectives, such as financialization and auditing.

Innovation and productivity are key drivers of corporate growth. Previous research investigates the relationships among corporate ESG performance, innovation and productivity. Regarding innovation, Lin et al. (2021) argue that corporate ESG activities can improve the relationship between companies and stakeholders, which helps companies obtain a range of external knowledge and financial support, thus encouraging innovation. Zhai et al. (2022), Li et al. (2023) and Zheng et al. (2023a) also find a positive relationship between ESG performance and innovation (or specifically green innovation). However, Liu et al. (2022b) use the first release of SynTao ESG ratings as a shock to study whether market pressure can push companies toward green innovation. The results show that ESG significantly boosts the quantity of corporate green innovation instead of its quality, reflecting the opportunistic behavior of managers.

Regarding productivity, Deng et al. (2023) show that ESG is conducive to improving total factor productivity. Sheng et al. (2022) find that ESG performance can boost the total factor productivity of family businesses. They show that the impact is more pronounced when family businesses are at a higher level of marketization, are operating within periods of growth and maturity or are controlled by the first generation.

The influence of ESG on other aspects of corporate management has also been explored. For instance, Pan et al. (2022) find that ESG inhibits firm financialization, and He et al. (2022a) observe that it can deter improper managerial conduct. Xiao et al. (2021) discover that ESG ratings of listed companies can significantly reduce audit fees. Song et al. (2022) provide evidence on ESG practices in the banking industry. They find that banks' ESG spending significantly promotes liquidity. Externally, ESG spending is an important tool for managing banks' reputations, reducing financing costs and alleviating regulatory pressure. Internally, ESG spending can enhance banks' capacities for governance and risk management.

5.2.3. Impact of ESG performance on corporate financing activities

ESG performance primarily influences corporate financing by alleviating financing constraints and enhancing financing efficiency. Discussions of ESG performance in both the bond and stock markets are also critical to corporate financing activities.

Previous studies confirm that ESG significantly alleviates financing constraints and enhances financing efficiency (Qiu and Yin, 2019; Li et al., 2022a; Lai and Zhang, 2022; Chen et al., 2023b). Long and Ou Yang (2022) approach the topic from the perspective of capital structure, discovering that an improvement in corporate ESG performance attracts more financial support from investors, thus optimizing the capital structure for the current and next periods. Media attention to ESG also plays an important role in mitigating the corporate cost of debt. For instance, *Southern Weekly*, the first nationally recognized media outlet to cover ESG topics, publishes annual lists of the 100 "best corporate social responsibility firms" according to ESG performance. Gao et al. (2022) review these ESG lists and find that the media spotlight on ESG significantly decreases the corporate cost of debt. Similarly, Tian and Tian (2022) and Li and Feng (2022) show that better ESG performance is associated with lower informational and operational risks, which further increases corporate trade credit.

Regarding the bond market, Li et al. (2022e) find that companies with higher ESG ratings have lower default risk, and this effect intensifies as bonds increase in maturity. Xu et al. (2022) identify a "greenwashing" phenomenon in China's green bond market, which leads to higher credit spreads for green bonds than traditional bonds. However, ESG ratings can provide non-financial information related to bonds, effectively reducing the credit spreads of green bonds.

Research shows that ESG can reduce companies' stock price crash risk (Feng et al. 2022a; Shuai, 2022), improve the accuracy of analysts' predictions (Luo and Wu, 2022) and increase the proportion of shares held by institutional investors (Zhou et al., 2020). Fu et al. (2020) specifically explore the effects of ESG practices in gambling companies in Macau. They find that four government initiatives related to ESG (an anti-corruption

campaign, visa restrictions, smoking bans and responsible gambling) lead to a significant increase in the institutional ownership of casino companies in general, demonstrating the presence and mechanism of responsible investing in "sin" industries. Further results show that norm-constrained institutions (e.g. pension funds) are prominent responsible investors, whereas natural arbitrageurs (e.g. mutual and hedge funds) do not undertake any significant role in this regard.

5.2.4. Impact of ESG performance on corporate investment

In terms of corporate investment, ESG performance can affect the efficiency of both domestic and foreign investment. Gao et al. (2021) find a positive relationship between ESG performance and overall investment efficiency. On the one hand, ESG alleviates overinvestment by reducing agency problems. On the other hand, ESG reduces underinvestment by reducing agency costs and alleviating financing constraints. Xie and Lv (2022) argue that ESG is a key driver of foreign direct investment, which helps companies gain competitive advantages, such as green innovation and brand reputation. They consequently find that strong ESG can increase the likelihood and scale of foreign investment by listed companies. These advantages help companies not only reduce the cost of foreign financing, but also overcome disadvantages in dealing with different ESG requirements in host countries.

6. Research on ESG investing in China

Scholars have investigated whether ESG investing, as an investment philosophy, can yield excess returns from the perspective of investors. Only a few studies consider the Chinese setting, as shown in Appendix D. In addition, because ESG investment is based on the ESG assessment of companies by financial institutions or third-party agencies (i.e., ESG rating agencies), divergence in ESG ratings has also attracted attention from academia (Li et al., 2022d).

Gao et al. (2020) use national air pollution data to examine the benefits of responsible investment in China. They find that investors' pessimistic sentiments on days with severe air pollution have a negative impact on the stock returns of A-shares, while stocks in the Responsible Investment Index perform better during the same period.

Li et al. (2022d) quantify the uncertainty behind ESG data and propose a robust enhanced indexation model for ESG investment. As global extreme weather intensifies, institutional investors tend to incorporate ESG into their sustainable investment portfolio or portfolios that hedge against climate risk. Against this backdrop, the authors demonstrate that embedding ESG in the enhanced indexation model leads to higher returns and lower risk.

Because ESG ratings are an effective tool for assessing the sustainability of companies and financial products, divergence in ESG ratings has sparked international discussion (Chatterji et al., 2016; Christensen et al., 2022). Divergence in ESG ratings also occurs among Chinese companies. Li et al. (2022d) find divergence in the ratings of three Chinese ESG rating agencies, namely SynTao, CASVI and Huazheng. The authors argue that this divergence affects the willingness of companies to improve their ESG performance. Investors will also suffer substantial investment losses if they apply investment models without considering ESG rating divergence.

7. Characteristics of ESG research in China

This section discusses two characteristics of ESG research in China. First, the research reflects the unique institutional context in China. Second, it mainly adopts quantitative research methods and uses ESG ratings provided by third parties as proxies for ESG performance.

7.1. Unique institutional context

Chinese ESG research is deeply embedded in its institutional context (Cheng et al., 2022; Lennox and Wu, 2022), in particular the top-down institutional framework, differences in corporate ownership structure and increasing interaction between the mainland and Hong Kong capital markets.

First, the development of ESG reflects the top-down institutional framework in China. The 18th National Congress of the CPC incorporated environmental concerns into the Five-Sphere Integrated Plan[5] in 2012; since then, a series of environmental policies have increased companies' awareness of sustainable development and environmental initiatives (Wang et al., 2021; Wang and Wang, 2022; Wang et al., 2022b), thus promoting their ESG practices. For example, in 2016, the People's Bank of China and six other ministries jointly issued the *Guidelines for Establishing a Green Financial System*, which proposed a shift toward ESG investing (Zhang et al., 2021; Li et al., 2022d; Song et al., 2022).

Second, SOEs are at the forefront of corporate ESG practices in China. SOEs are more actively involved in implementing national policies (Weber, 2014; Zhang and Huang, 2022), and their ESG practices are in line with China's national policies, which help to improve China's image on the international stage (Marquis et al., 2017). There are, however, differences in ESG practices between central SOEs and local SOEs (Lin et al., 2021). Central SOEs prioritize furthering social goals and are more equipped and motivated than local SOEs to implement national strategies and policies.

Third, there has been increasing interaction between the capital markets in mainland China and Hong Kong. The CSRC and the Hong Kong Securities Regulatory Commission issued joint announcements to launch the Shanghai–Hong Kong Stock Connect and Shenzhen–Hong Kong Stock Connect in 2014 and 2016, respectively. These actions have promoted market liberalization and the coordinated development of the two markets. Furthermore, the ESG disclosure of listed companies on the Hong Kong Stock Exchange has gradually shifted from voluntary to semi-mandatory to mandatory, driving the ESG disclosure of A-share listed companies in China. The increasing connection and interaction between the two capital markets yields unique research scenarios for ESG research in China.

7.2. Methods and data in Chinese ESG research

The majority of ESG-related articles on China adopt quantitative research methods (98%), while interviews (1%) and case studies (1%) are rarely employed. There is a lack of experimental research methods in ESG studies. However, interviews, case studies and other qualitative methods are essential supplements to the existing research. For example, Marquis et al. (2017) and Moosmayer et al. (2019) use case study methods and interviews respectively to reveal how different participants engage in ESG practices. In addition, Moosmayer et al. (2019) apply psychological methods to measure corporate ESG practices and customer behaviors, providing an interdisciplinary perspective.

Self-constructed ESG indices are rarely employed in ESG-related articles (10%), and typically only in articles published before 2021; more recently, with the emergence of relevant databases, researchers have shifted to adopting professional ESG rating data (77%). The top three ESG rating agencies most frequently used in ESG-related articles are Huazheng (35%), Bloomberg (22%) and SynTao (12%). While ESG rating data are mainly adopted to measure corporate ESG performance, a few studies use ESG ratings as a proxy for corporate ESG spending.

8. Conclusions and future avenues for ESG research in China

This review of the development of ESG practices and research in China has revealed a number of insights. First, mirroring the top-down framework in China, Chinese ESG practices have grown substantially in terms of ESG disclosure, ESG rating and ESG investing. Second, research on ESG in China has focused on corporate ESG disclosure and performance as well as ESG investing. Although the topics of the ESG studies reviewed in this paper are similar to those of ESG research in other countries, China's ESG research enriches international ESG research by showing two distinct characteristics, namely, the country's unique institutional context and the dominance of quantitative research methods. This section proposes the following three avenues for future research: the impact of the interaction between traditional Chinese ethics and the country's

[5] The Five-Sphere Integrated Plan refers to China's overall plan for building socialism with Chinese characteristics—that is, to promote coordinated progress in the economic, political, cultural, social and environmental fields.

modernization on corporate ESG, the impact of the internationalization of Chinese business on ESG, and the development of China's ESG standards.

8.1. Impact of traditional Chinese ethics and modernization

ESG aligns with traditional Chinese ethics, which involves the pursuit of harmony among humanity, nature and society. For example, traditional Chinese ethics emphasizes ecological philosophy and holds that "man is an integral part of nature"; this coincides with the call for environmental management and resource conservation in ESG. Just as Chinese ethics upholds the principle of pursuing profits in the right and proper ways, modern companies undertake social responsibility duties and attempt to promote social welfare. Chinese ethics holds that "the greatest ideal is to create a world truly shared by all," which provides a reference point for the governance of modern companies. However, few studies have linked the ESG practices of Chinese companies with traditional Chinese ethics. Future research could explore the relationship between traditional ethical values and corporate ESG, and whether this relationship varies with different cultural characteristics, regions and industries.

The modernization of China has also shaped the unique ESG practices of Chinese companies. For example, under the rural area revitalization strategy, Chinese companies boost the economic development of villages using local resources, further increasing industrial competitiveness and improving basic public services. These initiatives not only contribute to the social component of ESG but also help fulfill the Sustainable Development Goals of zero hunger and no poverty. A few existing studies discuss the relationship between China's modernization and the ESG of Chinese companies (Wang et al., 2021; Wang et al., 2022b, 2022e). However, these studies may not fully capture how social and economic modernization shapes corporate ESG disclosure and ESG performance in China. Moreover, considering that ESG disclosure in China is still mainly voluntary, future research could focus on the quality of ESG disclosure, such as the role and development of ESG assurance, and the risks associated with ESG disclosure, such as litigation risk.

8.2. Impact of the internationalization of Chinese business

Chinese companies' internationalization encourages their compliance with overseas ESG practices. In this way, Chinese companies improve their competitiveness through considering host countries' employment systems, local procurement, community support and environmental protection requirements. A number of topics thus need to be addressed in the literature, such as how international stakeholders influence the overseas ESG practices of Chinese companies; whether this relationship varies across different industries and countries; and how overseas ESG practices assist Chinese companies' adaptation to the value system of host countries and especially promote their investment in the Belt and Road region.

How the overseas ESG practices of Chinese companies affect their domestic ESG practices is an emerging topic. It is worth investigating whether the international ESG practices of Chinese companies change their domestic ESG practices, and how overseas investors view the ESG performance and disclosure of Chinese companies.

In addition, little is known about the ESG practices of multinational companies in China. According to data from the Ministry of Commerce, China's utilization of foreign capital in 2022 amounted to RMB1.23 trillion, with an increase of 6.3% year-on-year in comparable terms. Thus, it is crucial to examine the ESG practices of multinational companies in China. Future research could discuss how multinational companies practice ESG to obtain legitimacy in China, and whether ESG practices vary with different parent countries and different industries.

8.3. Development of China's ESG standards

Whether to develop independent ESG standards reflecting China's institutional environment or to adopt international standards remains a controversial issue. Some propose that it is useful to adopt ESG standards that incorporate China's unique ESG practices, such as the rural area revitalization strategy, as this helps enhance China's global influence. However, others argue that the adoption of international ESG standards

can increase the comparability of ESG information disclosed by Chinese companies and reduce the cost of preparing reports for cross-border listed companies. A major challenge for regulators is to strike a balance between these two considerations. Future research should adopt diverse research methods and explore the perspectives of various stakeholders, to provide a clear roadmap for ESG practice in China.

Declaration of Competing Interest

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

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Appendices. Supplementary data

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Partial portfolio disclosure, investors' attention, and window dressing

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ABSTRACT

I show that the disclosure of mutual funds' holdings significantly affects investors' investment decisions. As most mutual fund websites, advertisements, and fund-trading platforms only disclose a fund's 10 largest holdings (top-10), this study finds that investors disproportionately focus on these stocks. However, this bias does not lead to additional profit because relative to their peers, funds with good top-10 performance tend to generate poor long-term returns. I design a clean and innovative discontinuity test between the performance of the 10th and 11th portfolio holdings to examine such window dressing behavior. I find that relative to their peers, funds that are small, new, and highly active are more likely to window dress and incur greater costs if they suffer from severe capital outflows. My findings suggest that partial disclosure misleads investors and allows effective window dressing.

1. Introduction

Actively managed mutual funds play a key role in financial markets, and investors use various methods to predict their performance to make investment decisions. With the development of information technology, investors have greater access to funds' portfolio information through trading platforms. However, fund managers can influence investors' exposure to portfolio information by only partially disclosing their portfolios. I examine whether such partial disclosure affects investors' focuses and investment decisions and how fund managers construct fund portfolios based on investors' preference.

Investors' attention can be captured by various fund behaviors. Most studies document a positive relationship between past fund performance and future fund flows (e.g., Grinblatt et al., 1995; Carhart, 1997; Spiegel & Zhang, 2013), and Berk and Green (2004) provide a rational model to explain this positive effect. Ben-David

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et al. (2022) prove that fund investors rely on sample returns to make fund investment decisions. Investors are also highly sensitive to fund expenses and costs. Sirri and Tufano (1998) argue that investors prefer low-cost funds and avoid high expenses when seeking funds. Ivković and Weisbenner (2009) imply that individual investors are sensitive to both expense ratios and redemption loads. A fund's flows are also affected by its star ratings (Del Guercio & Tkac, 2008), management structure (Patel & Sarkissian, 2017), and fund family (Kempf & Ruenzi, 2008) and by investors' level of sophistication (Evans & Fahlenbrach, 2012).

I show that investors disproportionately focus on a fund's 10 largest holdings (hereafter "top-10 portfolio") because they are more prominently disclosed. I find that a one standard deviation increase in the returns of a fund's top-10 portfolio leads to 1.13%, or $16 million, in additional quarterly inflows. This study adds to the literature on investor attention to portfolio construction. Kothan and Warner (2001) indicate that fund investors are aware of funds' stock trades. Frazzini and Lamont (2008) use the "dumb money" theory to show that investors' sentiments about funds' holdings are strongly associated with their wealth allocation.

These findings are consistent with Solomon et al. (2014), who find that investors are more interested in fund holdings that have higher exposure, as top-10 portfolios are frequently shown on fund companies' official websites,[1] on fund advertisements, and on online trading platforms[2] worldwide. In a *Wall Street Journal* article, Burton (2015) points out investors' overemphasis on funds' top-10 portfolios. In addition, I reveal that fund investors understand the importance of top-10 portfolio weights because they react strongly to the performance of a fund's top-10 portfolio if it is consistently a large percentage of the fund's holdings.

However, financial information platforms might not help investors make better fund investment decisions. Tetlock (2010) indicates that online information intermediaries reduce the cost of acquiring information and the information asymmetry between investors and firms, but they can also aggravate investors' biases (Barber & Odean, 2008), encourage manipulation (Gurun and Butler, 2012), and distort information analysis (Blankespoor et al., 2020). My findings are consistent with the latter because fund investors react irrationally to funds' portfolio construction.

This paper also contributes to the literature on portfolio construction and fund manager skills. I argue that the construction of a top-10 portfolio reveals little about the fund manager's investing skills. Many studies connect portfolio construction with a manager's stock-picking ability. Kacperczyk, Sialm, and Zheng (2005) argue that the more concentrated a fund's industrial holdings, the greater the fund manager's investment knowledge and the higher the fund's abnormal returns. Kacperczyk and Seru (2007) exploit portfolio construction to analyze fund managers' analytical skills. Kacperczyk et al. (2014) also observe managers' stock-picking behavior and find that a manager's ability to pick stocks is closely related to their awareness of market conditions. My results show that top-10 performance has little effect on a fund's short-term future returns; moreover, and top-10 market adjusted returns are negatively associated with a fund's long-term future returns.

Next, I find that funds window dress their top-10 portfolios to obtain additional fund inflows. Many studies document fund manager actions that are intended to attract investors' attention without improving the fund's performance or its manager's skills. As fund managers are paid based on a fund's net assets, which is directly related to fund flows but not fund performance, they are willing to boost short-term inflows to increase their short-term compensation, potentially hurting the fund's long-term value (Bhattacharyya & Nanda, 2013). Thus, Carhart et al. (2002) and Patel and Sarkissian (2021) show that fund managers have incentives to engage in excessive buying to "pump" up fund's size and thus increase their wages and other private benefits. Del Guercio and Tkac (2008) explore whether fund managers sacrifice long-term returns to boost short-term Morningstar ratings because they value quick capital inflows more than they value long-term returns.

[1] For example, the official website of the Fidelity Magellan Fund simply lists its top-10 holdings and the top 10% of its portfolio, along with other important fund characteristics such as fund strategy, Morningstar ratings, and risk preferences. To access a portfolio's full composition, investors must click several more times. For more details, please check the Fidelity website: https://institutional.fidelity.com/app/funds-and-products/21/fidelity-magellan-fund-fmagx.html.

[2] For example, Eastmoney (东方财富天天基金), one of the largest Chinese fund trading platforms, only provides a fund's 10 largest holdings on the fund introduction page, with their most recent returns near the holding weights. For more details, please check the Eastmoney website: https://fund.eastmoney.com/data/fundranking.html.

To prove that some fund managers engage in top-10 portfolio window dressing, I design a clean and delicate experiment to differentiate window dressing from momentum trading. As both strategies encourage fund managers to buy good stocks and sell bad stocks, many researchers have great difficulty disentangling the two strategies (Musto, 1999; Agarwal et al., 2014). First, I find the discontinuity in exposure between the 10th and 11th holdings with highly similar portfolio weights because the close weight difference eliminates the momentum factor. Next, I compare the returns of the two holdings before and after the portfolio disclosure and show that the 10th holding only outperforms the 11th just before the quarterly disclosure and has a non-significant performance difference in other months. This is solid evidence of top-10 portfolio window dressing.

Finally, this study identifies the types of funds that are the most likely to engage in harmful window dressing, filling a gap in the literature and adding to the findings of Agarwal et al. (2014), who find that window dressers have little skill and high turnover. I find that new and small funds with large trading volumes and high expense ratios tend to window dress when suffering from severe capital outflows.

Overall, my findings suggest that regulators should impose requirements on funds' portfolio disclosures that cover all forms of information dissemination and educate investors to read the complete list of stocks in a fund's portfolio before deciding whether to invest, as Miller and Skinner (2015) suggest for stock markets.

The rest of this paper is organized as follows. Section 2 describes the data, construction of the key variables, and hypotheses. Section 3 examines fund investors' reactions to top-10 portfolio construction. Section 4 discusses the impact of top-10 portfolios on funds' future performance and proves the existence of portfolio window dressing. Section 5 analyzes the types of funds that engage in window dressing. Section 6 concludes the paper.

2. Data and methodology

I use four main data sources: the Center for Research in Security Prices (CRSP) Survivor Free Mutual Fund for detailed fund information, Thomson Reuters for mutual funds' quarterly portfolio holdings, CRSP for stock prices, and Compustat for firm financials. The sample period is from 1980 to 2020.

2.1. Mutual fund characteristics and performance measures

I construct a sample of mutual funds from January 1980 to December 2020 using the CRSP Mutual Fund Database. I limit the sample to US domestic, actively managed equity funds and exclude index funds, international funds, bond funds, precious metals, and other asset classes, according to both Thomson Investment Objective Codes and CRSP Mutual Fund Objective codes. I focus on US funds because the US mutual fund market is highly developed with abundant data.

I use Carhart (1997) four-factor model to examine fund performance. The following equation shows the detailed calculation

$$r_{i,t} - R_{f,t} = \alpha_i + \beta_1\left(R_{m,t} - R_{f,t}\right) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 UMD_t + \epsilon_{i,t} \tag{1}$$

where $r_{i,t}$ is the return of fund i in year t, $R_{f,t}$ is the 30-day T-bill return, $R_{m,t}$ is the monthly return on the CRSP value-weighted composite index, and SMB_t, HML_t, and UMD_t are returns on size, book-to-market, and momentum, respectively. I obtain these factor returns from the Fama–French & Liquidity Factors database of Wharton Research Data Services (WRDS). To compute the 36-month long-term alpha, I run this four-factor regression model with a rolling 36-month window. I calculate the fund tracking error as the standard deviation of the residual from Eq. (1). Then, I follow DGTW (1997)[3] and measure the performance of a mutual fund using portfolio characteristic–based benchmarks. Then, I create quarterly fund flows following the definition of Sirri and Tufano (1998):

$$DollarFlow_{i,t} = \frac{TNA_{i,t} - TNA_{i,t-1} * (1 + r_{i,t})}{TNA_{i,t-1}} \tag{2}$$

[3] For full details please see Daniel et al. (1997).

where $TNA_{i,t}$ is the total net assets of fund i at time t.

The sample includes 3,671 distinct US domestic active equity funds and 132,809 fund-quarter observations. During the sample period, the funds on average (median) had $1.42 billion ($342.5 million) in assets, generated 2.39% (-1.81%) quarterly capital flows, and earned 2.22% (3.00%) quarterly returns with a 1.20% (1.17%) expense ratio and 76.7% (59%) annual turnover. Consistent with the literature (for example, Glode, 2011; Kacperczyk et al., 2014), a fund's Carhart four-factor alpha is slightly negative with an average (median) of −0.08% (-0.08%). Panel A of Table 1 provides the summary statistics for the mutual fund characteristics.

2.2. Portfolio holdings and Top-10 portfolios

I collect data on fund holdings from Thomson Reuters, which reports the fund portfolio disclosures submitted to the Securities and Exchange Commission. Before May 2004, funds were required to report at least semi-annually. In 2004, the Securities and Exchange Commission began requiring mutual funds to report a complete list of their equity holdings on a quarterly basis. To avoid discontinuity in the earliest observations in the sample, I use the most recent semi-annual holdings before a quarter without a filing as that quarter's holdings (also see Wermers et al., 2008; Solomon et al., 2014). The results are similar without this substitution.

Next, I match stock holdings to their prices and returns from CRSP using the "permno" identifier in CRSP, and I match holdings to their firm's returns and other financial terms using Compustat's "gvkey." I match

Table 1
Fund and Portfolio Summary Statistics.

Panel A: Fund Characteristics

Variable	Mean	St.Dev	P10	P25	Median	P75	P90
Fund Total Net Asset (In million)	1,417.71	3,399.13	37.00	102.10	342.50	1,146.20	3,277.20
Fund Quarter Flow	2.39%	508.56%	−8.56%	−4.60%	−1.81%	1.51%	7.70%
Fund Quarter Raw Return	2.22%	9.32%	−9.94%	−1.86%	3.00%	7.45%	12.63%
Fund Quarter Market Adjusted Return	−0.13%	4.48%	−4.59%	−2.16%	−0.24%	1.78%	4.41%
Fund 36-months Four-factor Alpha	−0.08%	0.37%	−0.47%	−0.26%	−0.08%	0.10%	0.32%
Fund Turnover	76.68%	66.44%	16.00%	31.00%	59.00%	101.00%	157.92%
Expense Ratio	1.20%	0.40%	0.78%	0.96%	1.17%	1.42%	1.72%
Fund Age	17.602	13.782	5.756	8.663	13.751	21.244	32.997

Panel B: Portfolio Characteristics

Variable	Mean	St.Dev	P10	P25	Median	P75	P90
Number of Stocks Held	104.27	137.42	32.00	46.00	69.00	107.00	188.00
Top-10 Portfolio Weights (Weight10)	32.73%	13.98%	16.73%	23.06%	30.60%	40.13%	51.60%
Top-10 Quarter Raw Return (Top10Ret)	8.25%	12.00%	−4.49%	1.67%	7.37%	13.57%	21.28%
Top-10 Quarter Market Adjusted Return	5.86%	9.08%	−2.41%	0.58%	4.18%	9.15%	15.84%
Holdings Quarter Raw Return	2.64%	9.96%	−10.33%	−1.75%	3.56%	8.27%	13.71%
Holdings Quarter Market Adjusted Return	0.28%	4.75%	−4.30%	−1.74%	0.20%	2.24%	4.92%
Top-10 36-months Four-factor Alpha	1.20%	1.70%	−0.40%	0.21%	0.92%	1.84%	3.07%
Holdings 36-months Four-factor Alpha	0.01%	0.39%	−0.39%	−0.17%	0.01%	0.19%	0.42%

Panel C: Performance Correlation

Variable	(1)	(2)	(3)	(4)	(5)	(6)
Fund Quarter Raw Return	1.000					
Top-10 Quarter Raw Return	0.766	1.000				
Holdings Quarter Raw Return	0.978	0.769	1.000			
Fund 36-months Four-factor Alpha	0.019	0.002	0.004	1.000		
Top-10 36-months Four-factor Alpha	−0.030	0.340	−0.031	0.107	1.000	
Holdings 36-months Four-factor Alpha	0.010	0.000	0.025	0.821	0.093	1.000

This table shows the summary statistics for the sample of US actively managed funds from 1980 to 2020. There are 3,671 distinct US domestic active equity funds and 132,809 fund-quarter observations. The detailed variable definitions are in Appendix A.

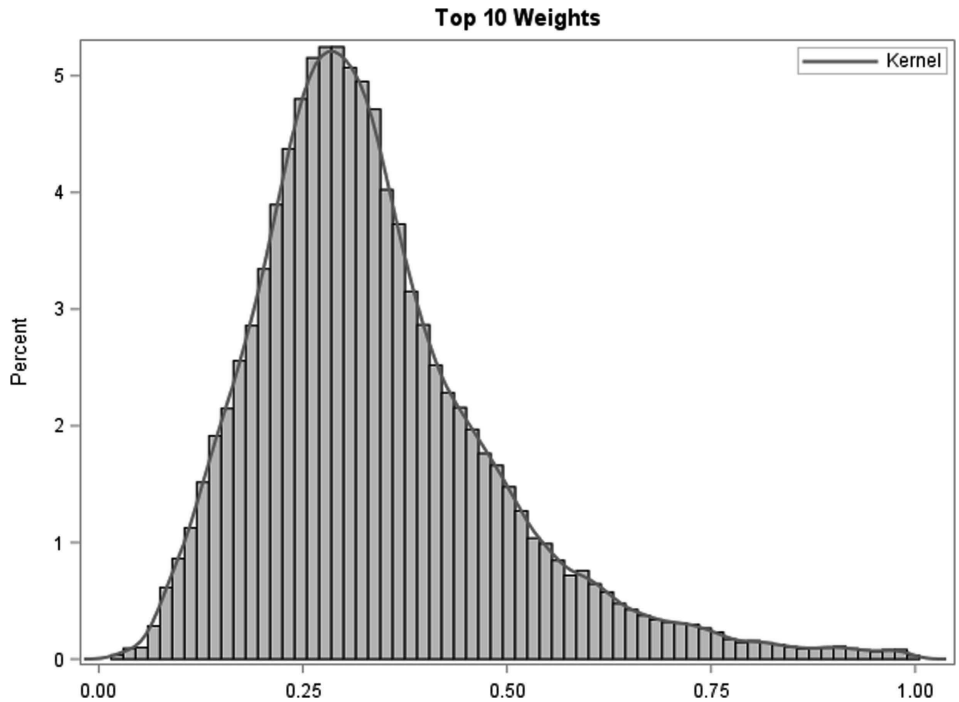

Fig. 1. Distribution of Top-10 Portfolio Weights (Weight10). This figure shows the density distribution of top-10 portfolio weights. The average Weight10 is 32.7%, and the median is 30.6%.

holding data to mutual fund data using the Wharton Financial Institution Center Number (WFICN) identifier in the MFLINKS table provided by Russ Wermers through WRDS. In the CRSP database, mutual funds are differentiated at the share class level by a "fundno" identifier, so I aggregate multiple share classes according to their WFICN. Then I compute a fund's net assets by summing all share classes with the same WFICN, and I compute other fund variables, such as returns and flows, by averaging them for all share classes with the same WFICN.

After matching, I exclude funds with net assets of less than $5 million and funds with missing styles or names. I also exclude funds that hold fewer than 10 stocks to ensure that fund managers can choose which 10 largest holdings they disclose. Panel B of Table 1 shows that the funds in the sample have on average (median) 106 (69) holdings and 3.02% (3.72%) quarterly returns.

For the top-10 portfolios, I focus on the 10 holdings with the largest weights in each fund-quarter disclosure and rebalance it quarterly using each fund's disclosure. Although the results with the filled quarter observations are identical to those with disclosed quarter observations, stock price changes affect the weights of the holdings, so their order can vary. The performance of a top-10 portfolio[4] is the weighted average return of the fund's 10 largest holdings and excludes the return on its other holdings, as follows:

$$Weight_{i,s,t} = Holding_{i,s,t-1} * Price_{s,t-1} / \left(\sum\nolimits_{s \in Port} Holding_{i,s,t-1} * Price_{s,t-1}\right) \tag{3}$$

$$Weight10_{i,t} = \sum\nolimits_{s \in Top10} Weight_{i,s,t}; Top10Ret_{i,t} = \sum\nolimits_{s \in Top10} Ret_{s,t} * Weight_{i,s,t} \tag{4}$$

where $Holding_{i,s,t}$ is the number of shares of stock s held by fund i in quarter t, $Return_{s,t}$ is the return of stock s in quarter t, $Price_{s,t}$ is the price of stock s in quarter t, and $Weight_{i,s,t}$ is the portfolio weight of the holding calculated using the disclosure snapshot.

[4] Annual $Top10Ret_{i,t}$ is not the return for a fixed snapshot of a portfolio in the trailing year. It is the quarterly rebalanced portfolio return.

On average (median), a fund's top-10 holdings constitute more than 33% (31%) of its portfolio and generate 3.19% (3.84%) better quarterly raw returns compared with overall portfolio performance (3.02% [3.72%]). Fig. 1 shows the distribution of the sample's top-10 weights.

2.3. Hypotheses

Fund investors make investment decisions based on various fund characteristics such as performance (Chang & Lewellen, 1984; DGTW, 1997), expense ratio (Ferris & Chance, 1987), management fee (Maggio and Kacperczyk, 2017), trading activism (Pástor et al., 2017), star ratings (Del Guercio & Tkac, 2008), management structure (Kostovetsky & Warner, 2015), and fund family (Chuprinin and Sosyura, 2018). Most importantly, investors use a fund's portfolio disclosure to estimate its manager's stock-picking skill (e.g., Kacperczyk et al., 2005, 2008; Cremers & Petajisto, 2009).

Fund investors do not typically value fund performance measures equally. Ben-David et al. (2022) show that fund investors are not as sophisticated as previously believed. Rather, they tend to emphasize simple raw returns instead of considering complicated performance measures such as alphas. It is highly unlikely that fund investors value a fund's holdings according to their weights. Naïve investors consider a fund's 10 largest holdings more than they consider its portfolio weight percentages because on both mutual fund websites and mobile financial applications, information about a fund's top-10 holdings is more accessible than information about its other holdings. Therefore, fund inflows should be disproportionally more sensitive to the performance of a fund's top-10 portfolio, relative to the performance of its other holdings and its overall performance. Thus, I formulate the following hypothesis:

Hypothesis 1 (over-attention hypothesis). Due to limited attention, investors overly focus on a fund's top-10 portfolio because of its prominence, as future fund flows are positively related to the performance of a fund's top-10 portfolio.

However, investors usually cannot accurately measure fund managers' skills by observing fund characteristics and portfolios. Fund managers investigate and understand investors' preferences, so unskilled managers who cannot realize positive returns can manipulate their portfolio disclosures to attract investors' attention (Musto, 1999). Such manipulation includes portfolio pumping in which they sell poorly performing stocks and buy well-performing stocks (Patel & Sarkissian, 2021) and stocks with high media exposure (Solomon et al., 2014). This window dressing strategy contributes little to improving fund performance and incurs additional costs. Meanwhile, many fund investors, especially unsophisticated retail investors, cannot differentiate between skilled trades and window dressing behavior and invest equally in both types of funds. Thus, fund portfolio disclosures are misleading investors to invest in unprofitable funds.

Similarly, fund managers can use either of two strategies to build their top-10 portfolios. They can use the momentum trading strategy (Grinblatt et al., 1995; Carhart, 1997) or professional stock-picking analysis, both of which reveal a fund manager's skills. Alternatively, they can pump recently well-performing but overpriced stocks into their top 10, potentially hurting the fund's future performance because of increased expenses from buying overpriced stocks. Fund managers have an incentive to sacrifice long-term fund performance by using window dressing to increase their compensation, which is directly related to net assets under management, not returns (Bhattacharyya & Nanda, 2013). Accordingly, I make the following two-part hypothesis:

Hypothesis 2 (window dressing hypothesis). Mutual funds with relatively good top-10 performance do not generate better future performance than their peers. Moreover, the worse a fund's performance, the more likely its manager is to window dress.

3. Top-10 holdings and capital flows

This section presents the results regarding funds' capital flows. I examine the over-attention hypothesis by testing the effect of top-10 performance on future fund flows. Then, I exploit the relationship between top-10 portfolio weights and investors' reactions.

3.1. Top-10 portfolio returns and future fund flows

In this subsection, I test whether top-10 portfolios disproportionally affect capital flows. Specifically, I examine how capital flows react to top-10 returns after controlling for fund performance and other fund characteristics. I start the analysis with a set of panel regressions using quarterly fund flows as the dependent variable. The regression model is specified as follows:

$$FundFlow_{f,t} = \alpha_i + \beta_1 Top10Ret_{i,t-1} + \beta_2 FundRet_{i,t-1} + \beta_3 FundFlow_{i,t-1} + \beta_4 log(TNA_{i,t-1}) + \beta_5 log(FundAge_{i,t-1}) + \beta_6 ExpenseRatio_{i,t-1} + \beta_7 Turnover_{i,t-1} + Style + Time + \epsilon_{i,t-1} \quad (5)$$

The main independent variable $Top10Ret_{i,t-1}$ is the weighted average return for the top-10 portfolios using Eq. (4) adjusted by the CRSP market value-weighted index[5] following Solomon et al. (2014) over various time horizons from a quarter to a year. I also examine capital flows using the top-10 Capital Asset Pricing Model (CAPM) alpha and Carhart four-factor alpha based on Eq. (1).

The other independent variables include the fund's preceding 36-month market adjusted return or four-factor alpha. I control for long-term fund performance to capture fund manager skill and to avoid multicollinearity between fund and top-10 quarterly returns. I control for fund flow in the trailing quarter to capture fund flow momentum that might affect future fund flow. I also include the natural logarithm of each fund's age, calculated as the number of years since the fund was first offered in CRSP; the natural logarithm of total net assets; expense ratio; and annual turnover.

To control for fund flows affected by common fund styles or fund objectives, I include style-objective fixed effects using CRSP style codes. Each CRSP style code consists of up to four characteristics such as fund style and fund investments. I further include time fixed effects by quarter to control for general market conditions. Standard errors are clustered by fund and time.

The results in Table 2 show that the market adjusted returns of top-10 portfolios positively affect future fund flows, and this positive effect remains strong even when controlling for long-term fund performance. Before the addition of fund performance, the coefficient of top-10 past annual market adjusted returns is 0.518 (t-statistics = 7.19). Thus, a one standard deviation increase in top-10 adjusted monthly returns (2.18%) can generate 1.13%, or \$16 million, in additional quarterly inflows. This is economically important compared with the average quarterly fund inflow of 2.39%.

Moreover, comparing the results in columns (1)–(3) with those in columns (4)–(6) reveals that investors' attention to funds' top-10 holdings is largely based on the most recent quarter's top-10 performance, especially after controlling for funds' long-term adjusted returns in column (5). Surprisingly, investors pay twice as much attention to top-10 portfolios, compared with the attention paid to overall fund performance. Using the same performance measures as in columns (2) and (5), the coefficients of top-10 market adjusted returns are almost double those of funds' 36-month adjusted returns (0.185/0.0998 = 1.85). Given that the average top-10 portfolio is only 33% of a fund's total holdings, investors overemphasize top-10 returns in estimating fund future performance. The results are similar if top-10 portfolio performance is measured using raw returns or DGTW returns. These panel results thus prove the over-attention hypothesis, that fund investors focus on the most recent performance of a fund's top-10 portfolio, which is prominently disclosed compared with its other holdings.

3.2. Top-10 portfolio returns and weights

Thus far, I have focused on returns, differentiating between the attention investors pay to a fund's top-10 portfolio and to the fund as a whole, but the role of the weights of the top-10 holdings remains unknown. Kothari and Warner (2001) and Pollet and Wilson (2008) find that fund investors are both sensitive to fund and portfolio returns and affected by changes in portfolio weights and holdings. Therefore, investors should be aware of the weights of a fund's top-10 portfolio because they rely heavily on its returns, as shown in Sec-

[5] The results are similar in magnitude and significance when using raw returns.

Table 2
Effect of Top-10 Portfolio Performance on Mutual Fund Flows.

	(1)	(2)	(3)	(4)	(5)	(6)
Next Quarter Fund Flow						
Top10AnnualAdj	0.518***	0.185**	0.411***			
	(7.19)	(2.46)	(6.07)			
Top10QtrAdj				0.269***	0.188***	0.216***
				(7.73)	(4.78)	(5.57)
Top10RestAdj				0.244***	−0.00613	0.191***
				(4.15)	(−0.09)	(3.30)
Fund36mAdj		0.0998***			0.0999***	
		(8.82)			(8.90)	
Fund4Alp			5.936***			5.906***
			(18.20)			(18.06)
Flow	0.000144	0.000132*	0.000116	0.000147	0.000136*	0.000119
	(1.61)	(1.68)	(1.51)	(1.64)	(1.71)	(1.55)
LTNA	0.00252***	0.000935***	0.000502	0.00259***	0.00100***	0.000568*
	(6.98)	(2.66)	(1.52)	(7.14)	(2.86)	(1.72)
LAGE	−0.0119***	−0.00923***	−0.00895***	−0.0118***	−0.00910***	−0.00885***
	(−10.61)	(−9.06)	(−8.59)	(−10.51)	(−8.95)	(−8.52)
EXP	−0.797***	−0.643***	−0.486***	−0.821***	−0.666***	−0.507***
	(−4.11)	(−3.36)	(−2.61)	(−4.25)	(−3.50)	(−2.72)
Turnover	−0.00713***	−0.00453***	−0.00368***	−0.00715***	−0.00454***	−0.00370***
	(−6.94)	(−4.78)	(−4.19)	(−6.97)	(−4.78)	(−4.20)
Constant	0.0149***	0.0175***	0.0183***	0.0136***	0.0162***	0.0173***
	(3.09)	(3.78)	(4.04)	(2.84)	(3.52)	(3.82)
Style and Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Clustered	Yes	Yes	Yes	Yes	Yes	Yes
Observations	111,001	111,001	111,001	111,001	111,001	111,001
R-squared	0.047	0.092	0.109	0.049	0.094	0.110

This table reports the regression results from estimating the relationship between top-10 portfolio past market adjusted returns and future quarter fund flows. The sample period is from 1980 to 2020. The dependent variable is next quarter fund flow. Detailed variable definitions are in Appendix A. Reported *t*-statistics in brackets are based on standard errors clustered by fund. ***, **, and * indicate significance at the 0.01, 0.05, and 0.10 levels, respectively (two-tailed).

tion 3.1. In this subsection, I explore the effect of top-10 portfolio weights by adding an interaction between top-10 portfolio weights and top-10 market adjusted returns to regression model (5) as follows:

$$FundFlow_{f,t} = \alpha_i + \beta_1 Top10Ret_{i,t-1} + \beta_2 Top10Ret_{i,t-1} * Weight10_{i,t-1} + \beta_3 Weight10_{i,t-1} + FundControls + Style + Time + \epsilon_{i,t-1} \quad (6)$$

where $Weight10_{i,t-1}$ is the sum of the weights of a fund's 10 largest holdings, as calculated in Eq. (4).

In columns (1) and (4) of Panel A in Table 3, the coefficients of the interactions of *Weight10* and quarterly and annual top-10 adjusted returns (0.157 and 0.198, respectively) are significant and positive (*t*-statistics = 3.10 and 3.63, respectively). Moreover, the interaction terms are significantly greater than zero at the 1% significance level, with values of 0.570 and 0.644, respectively. These positive coefficients indicate that funds that heavily weight their top-10 portfolios enjoy greater fund inflows if their top-10 portfolio obtains high returns. For example, a fund with a 40% *Weight10* (75th percentile) would experience 33% (1.33 = (0.157 + 0.57 * 0.4)/(0.157 + 0.57 * 0.23) - 1) more inflows than a fund with a 23% *Weight10* (25th percentile). This attention gap further proves that fund investors are highly exposed to and closely follow funds' top-10 portfolio disclosures, and they assume that a heavily weighted top-10 portfolio should have a stronger effect on a fund's future returns.

In columns (2) and (3) of Panel A in Table 3, the coefficients of the interaction term between quarterly adjusted returns and *Weight10* remain significant and positive when fund performance is controlled. The magnitude of the coefficient in column (2) is significantly larger than the coefficient of fund adjusted returns, which is consistent with the results in Table 2. This implies that fund investors believe that the performance of funds with high concentrations of a few stocks can be predicted by these heavily weighted holdings. The results for the annual regressions in columns (5) and (6) are similar but slightly weaker, providing evidence that investors understand the relevance of time and emphasize a fund's most recent performance.

Among the six regressions in Panel A, none of the coefficients of *Weight10* are positive, and the coefficient in column (3) is substantially less than zero. This non-significant and negative relationship suggests two alternative explanations. First, investors understand that independent portfolio weights do not determine a fund's future performance; second, investors do not care about top-10 portfolio weights at all. According to the interaction coefficients, investors do consider portfolio weights; therefore, the explanation that investors do not care can be eliminated. The first explanation further implies that investors combine returns and weights to make investment decisions, which is consistent with the literature (e.g., Pollet & Wilson, 2008).

In Panel B of Table 3, I sort the fund-quarter portfolios by *Weight10* and divide the sample into three groups: *Low10* (a dummy variable that equals one if *Weight10* is in the bottom third), *Mid10* (equals one if *Weight10* is in the middle third), and *High10* (equals one if *Weight10* is in the top third). Similar to the results in Panel A, the inflow of funds in the *High10* group is the most sensitive to trailing quarter top-10 adjusted returns. On average, the *High10* funds, relative to the *Low10* funds, receive 69% more inflows if their top-10 portfolios perform well. In columns (4) to (6) of Panel B, there is less variation in investors' reactions to top-10 annual performance among the *Weight10* groups, and most of the variations are generated by the quarterly returns in columns (1) to (3). Thus, the results support the over-attention hypothesis.

In summary, the returns of a fund's top-10 portfolio have strong positive predictive power for future fund inflows. The greater the weight of the top-10 holdings in a fund's portfolio, the stronger its effect on fund flows because investors are aware of the connection between portfolio weights and portfolio performance.

4. Top-10 portfolio and window dressing

This section presents the fund return results. I test the window dressing hypothesis by examining the effect of a fund's top-10 portfolio performance on its future performance using panel regressions and double-sorting comparisons. Then, I provide an innovative and clean research design to further prove the existence of window dressing.

Table 3
Effect of Top-10 Performance on Mutual Fund Flows with Different Weights.

Panel A: Next Quarter Fund Flow Test Interacting with Top-10 Portfolio Weights

	(1)	(2)	(3)	(4)	(5)	(6)
Next Quarter Fund Flow						
Top10QtrAdj	0.157***	0.0521**	0.160***			
	(3.10)	(2.03)	(3.24)			
Top10QtrAdj	0.570***	0.467***	0.299**			
*Weight10	(4.48)	(3.78)	(2.40)			
Top10AnnualAdj				0.198***	0.0347	0.204***
				(3.63)	(0.65)	(3.85)
Top10AnnualAdj				0.644***	0.111**	0.106
*Weight10				(3.47)	(2.55)	(0.60)
Weight10	−0.00215	−0.00416	−0.0121***	−0.00102	−0.00257	−0.00907*
	(−0.49)	(−1.00)	(−2.73)	(−0.22)	(−0.59)	(−1.92)
Fund36mAdj		0.0990***			0.102***	
		(9.20)			(9.00)	
Fund4Alp			5.910***			5.940***
			(17.40)			(17.62)
Flow	0.000165	0.000147*	0.000132	0.000157	0.000145*	0.000127
	(1.64)	(1.69)	(1.56)	(1.59)	(1.66)	(1.50)
LTNA	0.00287***	0.00107***	0.000638*	0.00279***	0.000975***	0.000580*
	(7.27)	(2.99)	(1.88)	(7.14)	(2.66)	(1.68)
LAGE	−0.0127***	−0.00953***	−0.00914***	−0.0124***	−0.00962***	−0.00906***
	(−11.18)	(−9.37)	(−8.96)	(−11.00)	(−9.46)	(−8.91)
EXP	−0.726***	−0.612***	−0.367*	−0.773***	−0.530***	−0.361*
	(−3.65)	(−3.15)	(−1.94)	(−3.82)	(−2.68)	(−1.89)
Turnover	−0.00565***	−0.00429***	−0.00289***	−0.00609***	−0.00374***	−0.00291***
	(−5.18)	(−4.19)	(−3.10)	(−5.44)	(−3.59)	(−2.97)
Constant	0.0154***	0.0178***	0.0214***	0.0143***	0.0190***	0.0207***
	(3.10)	(3.81)	(4.45)	(2.87)	(4.01)	(4.26)
Style and Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Clustered	Yes	Yes	Yes	Yes	Yes	Yes
Observations	111,001	111,001	111,001	111,001	111,001	111,001
R-squared	0.049	0.097	0.111	0.046	0.093	0.108

Panel B: Next Quarter Fund Flow Test Interacting with Three Weight10 Groups

	(1)	(2)	(3)	(4)	(5)	(6)
Next Quarter Fund Flow						
Top10QtrAdj	0.254***	0.136***	0.233***			
*Low10	(6.48)	(3.45)	(5.79)			
Top10QtrAdj	0.328***	0.196***	0.266***			
*Mid10	(7.60)	(4.47)	(5.86)			
Top10QtrAdj	0.455***	0.293***	0.306***			

Table 3 (*continued*)

Panel B: Next Quarter Fund Flow Test Interacting with Three Weight10 Groups						
	(1)	(2)	(3)	(4)	(5)	(6)
*High10	(7.82)	(5.33)	(4.96)			
Top10AnnualAdj				0.302***	0.0530	0.236***
*Low10				(6.52)	(1.26)	(5.49)
Top10AnnualAdj				0.404***	0.0850	0.278***
*Mid10				(6.61)	(1.38)	(4.81)
Top10AnnualAdj				0.534***	0.103**	0.256***
*High10				(6.52)	(2.28)	(3.56)
Fund36mAdj		0.0990***			0.102***	
		(9.20)			(9.01)	
Fund4Alp			5.880***			5.911***
			(17.36)			(17.55)
Flow	0.000164	0.000147*	0.000133	0.000158	0.000145*	0.000128
	(1.64)	(1.69)	(1.56)	(1.59)	(1.66)	(1.50)
LTNA	0.00289***	0.00110***	0.000717**	0.00282***	0.000999***	0.000642*
	(7.35)	(3.09)	(2.12)	(7.17)	(2.72)	(1.86)
LAGE	−0.0127***	−0.00958***	−0.00936***	−0.0124***	−0.00968***	−0.00924***
	(−11.26)	(−9.46)	(−9.13)	(−11.03)	(−9.55)	(−9.04)
EXP	−0.737***	−0.629***	−0.416**	−0.778***	−0.545***	−0.401**
	(−3.76)	(−3.28)	(−2.22)	(−3.89)	(−2.77)	(−2.11)
Turnover	−0.00555***	−0.00417***	−0.00271***	−0.00599***	−0.00369***	−0.00281***
	(−5.09)	(−4.09)	(−2.90)	(−5.36)	(−3.55)	(−2.87)
Constant	0.0145***	0.0164***	0.0177***	0.0137***	0.0181***	0.0178***
	(2.98)	(3.60)	(3.90)	(2.77)	(3.89)	(3.88)
Style and Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Clustered	Yes	Yes	Yes	Yes	Yes	Yes
Observations	111,001	111,001	111,001	111,001	111,001	111,001
R-squared	0.050	0.097	0.111	0.046	0.093	0.108

This table reports the regression results from estimating the relationship between top-10 portfolio past market adjusted returns and future quarter fund flows combined with top-10 weight changes. In Panel A, top-10 portfolio performance is interacted with *Weight10* directly, and in Panel B, the funds in the sample are separated into three groups with different portfolio concentrations. The sample period is from 1980 to 2020. The dependent variable is next quarter fund flow. Detailed variable definitions are in Appendix A. Reported t-statistics in brackets are based on standard errors clustered by fund. ***, **, and * indicate significance at the 0.01, 0.05, and 0.10 levels, respectively (two-tailed).

4.1. Top-10 portfolio returns and future fund performance

4.1.1. Regression results

For the window dressing analysis, I use regression model (5) and replace the dependent variable with funds' future returns, and the results are shown in Table 4. In Panel A, I examine the short-term effect of top-10 portfolio returns on future fund performance. Kacperczyk et al. (2005) and Ma et al. (2019) find that fund portfolios reveal managers' stock-picking skills and predict future fund performance. Thus, if a fund's top-10 portfolio reflects its manager's stock-picking skills, we expect funds with better top-10 performance to generate higher future returns. However, past top-10 market adjusted returns have a non-significant effect on a fund's future quarter returns, the coefficient of which varies from 0.005 to 0.013. The only economically and statistically significant coefficients are those of the expense ratios because a fund's returns are its profits after costs, and expense ratios rarely change (Sharpe, 1966).

Next, I examine the long-term effect of a fund's top-10 portfolio by expanding future returns to one year, and Panel B of Table 4 shows the significant, but negative, effect. In columns (1) to (3), respectively, the top-10 trailing-year market adjusted returns have negative coefficients of −0.377 (t-statistic = -2.02) and −0.369 (t-statistics = -2.26) significant at the 5% level, and −0.393 (t-statistic = -1.71) significant at the 10% level, even after controlling for long-term performance. This result strongly implies that a fund's top-10 portfolio does not reveal its manager's ability to generate profits and that improving the performance of the top-10 portfolio might even hurt the fund. In column (3), I find that a fund's 36-month four-factor alpha indeed predicts performance persistently because winning funds are more likely to win in the future (Carhart, 1997; Snap and Tiwari, 2004).

In columns (4) to (6), the top-10 trailing-year market adjusted returns are decomposed into trailing-quarter returns and the returns of the other 9 months. The regression results show that the negative coefficient is mostly driven by the long-horizon top-10 returns from the previous 4–12 months, while the most recent quarter's top-10 performance has no significant effect. This can be explained by fund managers not dealing with their window dressing holdings immediately. Rather, they wait a quarter and sell them gradually over the years. Taken together, the results in columns (1) to (3) provide sufficient evidence that fund managers intentionally adjust and disclose a fund's 10 largest holdings to increase capital inflows, but this window dressing behavior damages future returns, similar to other window dressing strategies (Bhattacharyya & Nanda, 2013). All of the results are robust to replacing market adjusted returns with DGTW returns. Thus, my window dressing hypothesis is supported.

4.1.2. Double sorting results

To better capture the impact of boosting a fund's top-10 performance under different operating conditions, I double sort the sample into 5*5 portfolios according to past top-10 returns and then by past fund returns or flows. Then I compare funds' future returns within each fund performance quintile.

A fund's preceding 36-month four-factor alpha provides a good estimate of a fund manager's skills (Choi et al., 2016), so the funds in the quintile with the smallest four-factor alpha represent the fund managers with the least skill and worst fund profitability. Next, a fund's previous-quarter flows only measure its recent operating conditions, such as an emerging increase in inflows (Ivković & Weisbenner, 2009). Top-10 performance is used to approximate the probability of window dressing based on the results in Table 4, and thus multicollinearity is avoided.

In Panel A of Table 5, I examine funds' future annual market adjusted returns double-sorted according to their preceding 36-month four-factor alpha and top-10 previous-year market adjusted returns. First, I compare future returns by row and discover that the funds in row (5) always significantly outperform those in row (1). This important result implies that good past top-10 performance hurts future fund performance for all five portfolios of funds while increasing capital inflows. This strong contradiction implies window dressing behavior. Moreover, within the worst performing portfolio in column (1), the funds with the best performing top-10 portfolio experience the largest loss (−1.10%, t-statistic = 5.45) compared with those with the worst performing top-10. This implies that among the worst performing funds, those that window dress perform even worse (-1.01% and 0.85%, for the two lowest future returns) in the future. However, poorly performing funds that maintain their original investment strategies are likely to improve their performance (0.26%, for

Table 4
Effect of Top-10 Portfolio Performance on Mutual Fund Performance.

Panel A: Next Quarter Fund Market Adjusted Return Test

	(1)	(2)	(3)	(4)	(5)	(6)
Next Quarter Fund Market Adjusted Return						
Top10AnnualAdj	0.0130	0.00433	0.00504			
	(0.14)	(0.05)	(0.05)			
Top10QtrAdj				0.0944	0.0925	0.0920
				(1.33)	(1.29)	(1.30)
Top10RestAdj				−0.0760	−0.0832	−0.0814
				(−0.91)	(−1.06)	(−0.98)
Fund36mAdj		0.00475			0.00493	
		(0.59)			(0.63)	
Fund4Alp			0.326*			0.318*
			(1.89)			(1.83)
Flow	−0.000020**	−0.000020**	−0.000021**	−0.000018***	−0.000019***	−0.000019***
	(−2.56)	(−2.52)	(−2.56)	(−2.99)	(−2.93)	(−2.98)
LTNA	−0.000173	−0.000231*	−0.000253	−0.000163	−0.000224	−0.000242
	(−1.04)	(−1.66)	(−1.43)	(−1.01)	(−1.63)	(−1.40)
LAGE	−0.000126	0.0000122	−0.00000957	−0.000139	0.00000505	−0.0000247
	(−0.26)	(0.03)	(−0.02)	(−0.29)	(0.01)	(−0.05)
EXP	−0.158**	−0.157**	−0.141**	−0.155**	−0.154**	−0.139*
	(−2.15)	(−2.12)	(−1.97)	(−2.13)	(−2.10)	(−1.95)
Turnover	−0.0000670	−0.0000166	0.000113	−0.0000770	−0.0000246	0.0000989
	(−0.10)	(−0.02)	(0.17)	(−0.12)	(−0.03)	(0.15)
Constant	0.00237	0.00225	0.00253	0.00232	0.00220	0.00247
	(1.10)	(1.01)	(1.18)	(1.08)	(0.99)	(1.16)
Style and Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Clustered	Yes	Yes	Yes	Yes	Yes	Yes
Observations	111,001	111,001	111,001	111,001	111,001	111,001
R-squared	0.086	0.086	0.087	0.090	0.090	0.090

Panel B: Next Year Fund Market Adjusted Return Test

	(1)	(2)	(3)	(4)	(5)	(6)
Next Year Fund Market Adjusted Return						
Top10AnnualAdj	−0.377**	−0.369**	−0.393*			
	(−2.02)	(−2.26)	(−1.71)			
Top10QtrAdj				0.00636	0.00786	0.00136
				(0.05)	(0.07)	(0.01)
Top10RestAdj				−0.378**	−0.372**	−0.389*
				(−2.04)	(−2.24)	(−1.72)
Fund36mAdj		−0.00419			−0.00396	
		(−0.18)			(−0.17)	
Fund4Alp			0.666**			0.658**
			(2.08)			(2.05)

(continued on next page)

Table 4 (*continued*)

Panel B: Next Year Fund Market Adjusted Return Test

	(1)	(2)	(3)	(4)	(5)	(6)
Flow	−0.000074***	−0.000074***	−0.000077***	−0.000072***	−0.000072***	−0.000075***
	(−4.16)	(−4.24)	(−4.09)	(−4.55)	(−4.63)	(−4.45)
LTNA	−0.00102**	−0.000967**	−0.00117**	−0.00101**	−0.000960**	−0.00116**
	(−2.02)	(−2.30)	(−2.32)	(−2.02)	(−2.29)	(−2.32)
LAGE	−0.000282	−0.000406	−0.0000392	−0.000299	−0.000416	−0.0000590
	(−0.25)	(−0.33)	(−0.03)	(−0.27)	(−0.33)	(−0.05)
EXP	−0.657***	−0.657***	−0.626***	−0.654***	−0.654***	−0.623***
	(−3.69)	(−3.69)	(−3.50)	(−3.68)	(−3.69)	(−3.50)
Turnover	−0.000971	−0.00102	−0.000598	−0.000980	−0.00102	−0.000611
	(−0.72)	(−0.68)	(−0.43)	(−0.73)	(−0.69)	(−0.44)
Constant	0.0107**	0.0108**	0.0109**	0.0107**	0.0108**	0.0109**
	(2.17)	(2.06)	(2.22)	(2.17)	(2.07)	(2.23)
Style and Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Clustered	Yes	Yes	Yes	Yes	Yes	Yes
Observations	111,001	111,001	111,001	111,001	111,001	111,001
R-squared	0.122	0.122	0.123	0.123	0.123	0.124

This table reports the regression results from estimating the relationship between top-10 portfolio past market adjusted returns and future fund performance. In Panel A, the dependent variable is next quarter fund market adjusted return, and in Panel B, the dependent variable is next year fund market adjusted return. The sample period is from 1980 to 2020. Detailed variable definitions are in Appendix A. Reported t-statistics in brackets are based on standard errors clustered by fund. ***, **, and * indicate significance at the 0.01, 0.05, and 0.10 levels, respectively (two-tailed).

Table 5
Future Returns for 25 Portfolios Grouped by Fund and Top-10 Performance.

Panel A: 25 Portfolios with Fund Alpha Tests on Next Year Fund Market Adjusted Return

							Fund4Alp (Overall fund skills)	
		(1)	(2)	(3)	(4)	(5)	(5)-(1)	T-stat
Top10AnnualAdj	(1)	0.26%	−0.14%	0.24%	0.31%	0.47%	0.22%	1.07
	(2)	−0.35%	−0.32%	−0.43%	−0.08%	0.15%	0.50%**	2.57
	(3)	−0.55%	−0.71%	−0.61%	−0.55%	−0.01%	0.54%***	2.89
	(4)	−1.01%	−0.71%	−0.64%	−0.47%	−0.28%	0.73%***	4.27
	(5)	−0.85%	−0.55%	−0.45%	−0.42%	−0.03%	0.82%***	4.64
	(5)-(1)	−1.10%***	−0.42%**	−0.69%***	−0.73%***	−0.50%***		
	T-stat	−5.45	−2.19	−3.55	−3.89	−2.80		

Panel B: 25 Portfolios with Fund Alpha Tests on Next Quarter Fund Market Adjusted Return

							Fund4Alp (Overall fund skills)	
		(1)	(2)	(3)	(4)	(5)	(5)-(1)	T-stat
Top10AnnualAdj	(1)	−0.21%	−0.23%	−0.02%	−0.08%	0.07%	0.28%***	3.22
	(2)	−0.23%	−0.13%	−0.24%	−0.08%	0.09%	0.32%***	3.76
	(3)	−0.20%	−0.17%	−0.11%	−0.09%	−0.05%	0.15%*	1.83
	(4)	−0.17%	−0.17%	−0.10%	−0.11%	0.01%	0.18%**	2.13
	(5)	−0.18%	−0.15%	−0.10%	−0.01%	0.15%	0.33%***	3.85
	(5)-(1)	0.032%	0.082%	−0.077%	0.074%	0.079%		
	T-stat	0.37	1.11	−0.9	0.87	0.93		

Panel C: 25 Portfolios with Fund Flow Tests on Next Year Fund Market Adjusted Return

							Fund Quarterly Flow	
		(1)	(2)	(3)	(4)	(5)	(5)-(1)	T-stat
Top10AnnualAdj	(1)	0.65%	0.19%	0.01%	−0.13%	0.20%	−0.45%**	−2.17
	(2)	0.25%	−0.02%	−0.36%	−0.58%	−0.43%	−0.68%***	−3.62
	(3)	−0.14%	−0.62%	−0.58%	−0.59%	−0.51%	−0.37%**	−2.09
	(4)	−0.48%	−0.60%	−0.54%	−0.61%	−0.75%	−0.27%*	−1.65
	(5)	−0.28%	−0.28%	−0.33%	−0.46%	−0.55%	−0.26%	−1.46
	(5)-(1)	−0.94%***	−0.47%**	−0.34%*	−0.33%*	−0.75%***		
	T-stat	−4.28	−2.36	−1.86	−1.91	−4.21		

This table reports the future return comparison results after double sorting the funds into 25 portfolios according to fund and top-10 past performance. In Panel A, the funds are sorted by *Fund4Alp* and *Top10AnnualAdj* and their next-year market adjusted returns are compared. In Panel B, the funds are sorted by *Fund4Alp* and *Top10AnnualAdj* and their next-quarter market adjusted returns are compared. In Panel C, the funds are sorted by *Fund4Alp* and *Flow* and their next-year market adjusted returns are compared. The sample period is from 1980 to 2020. The detailed variable definitions are provided in Appendix A. ***, **, and * indicate significance at the 0.01, 0.05, and 0.10 levels, respectively (two-tailed).

funds with the third highest future returns). Therefore, funds that window dress their top-10 portfolios attract investors' attention but hurt fund performance within a year.

Panel B of Table 5 compares the future short-term market adjusted returns of 25 groups of funds. As in Panel A, the funds in column (5) with the best previous four-factor alpha consistently outperform the funds in column (1), so momentum appears to be the main driving factor for quarterly returns. However, I do not find any significant return differences between the rows across all five columns. This is similar to the results in Panel A of Table 4. The damage from window dressing does not emerge immediately, so investors might not be aware of the window dressing behavior right away.

In Panel C, I change the fund sorting criteria to the previous quarter's inflows. As a fund's flows are directly related to its manager's salary, the managers of funds with the highest outflows desperately need to attract investors' attention. If these managers lack investment skills, they can simply boost their fund's top-10 portfolio returns to obtain more capital, but such funds are likely to generate even worse returns in the future. The results in column (1) of Panel C show that funds with the best top-10 performance are outperformed the most by those with the worst top-10 performance (-0.94%, t-statistic $= 4.28$). This outperformance also exists in the other four columns, further confirming that fund managers exploit investors' overemphasis on highly exposed top-10 portfolios to increase fund inflows.

To conclude, I use 5*5 portfolio classifications based on fund and top-10 portfolio performance to show that top-10 portfolio performance is negatively associated with a fund's long-term market adjusted performance, which is evidence of fund managers using top-10 portfolios as window dressing.

4.2. Window dressing strategy and holding comparison

In this subsection, I provide detailed evidence of window dressing by carefully comparing top-10 holdings with non-top-10 holdings. The momentum trading mechanism is similar to window dressing in that both strategies encourage fund managers to buy good stocks and sell bad stocks. The difference between the two strategies is that ex post realized returns under the momentum strategy should increase with larger loads on momentum factor.

4.2.1. gap between 10th and 11th holdings

Unlike Musto (1999) and Agarwal et al. (2014), who use fund performance to differentiate between window dressing and momentum trading, I test for discontinuity between funds' 10th and 11th holdings. I focus on these pairs because they have similar portfolio weights but different disclosure levels. To minimize the effect of momentum trading, I sort the sample according to the percentage difference in the weights of a fund's 10th and 11th holdings, which I define as *HoldGap*:

$$HoldGap_{s,t} = Holding10_{i,t-1} - Holding11_{i,t-1} \tag{7}$$

where $Holding10_{i,t-1}$ represents the weight of the 10th holding, and *HoldGap* is guaranteed to be positive. The absolute dollar value difference cannot be used because fund size must be considered when analyzing the window dressing strategy.

Then, I classify the fund-quarter observations into quartiles according to their quarterly *HoldGap*, and the summary statistics of each group are presented in Table 6. The micro group includes the observations in the smallest *HoldGap* quartile, and because the average (median) weight difference between the 10th and 11th holdings is less than 0.01% (0.0085%), the average weight of both is 1.87%. The largest *HoldGap* among the observations in the micro group is 0.02%, which represents less than $0.25 million. Next, the observations in the second and third quartiles are assigned to the small group, and their average (median) *HoldGap* is 0.05% (0.08%). Mathematically, the average weight of the 10th holdings in the small group should be larger than that in the micro group (2.37% greater than 1.87%) because the weight of the 10th holdings should be as large as *HoldGap*. However, the average weight of the 11th holdings in the small group is also greater than the average in the micro group. Consistently, the observations in the large group have the largest *HoldGap*, ranging from 0.08% to 7.84%, and the portfolio weights of both the 10th and 11th holdings are the largest among the three groups (3.07% and 2.82%, respectively).

Table 6
Summary Statistics of Holdings by *HoldGap* Groups.

	Average Holdings (%)		HoldGap (%)		
	10th	11th	Max	Mean	Median
Micro	1.87	1.87	0.02	0.0094	0.0085
Small	2.37	2.33	0.08	0.05	0.04
Large	3.07	2.82	7.84	0.25	0.16

This table provides the summary statistics for the average weights and weight differences, *HoldGap*, between the 10th and 11th holdings when the portfolio is disclosed. The micro group includes the portfolios in the smallest *HoldGap* quartile; the small group includes the portfolios in two middle *HoldGap* quartiles, and the large group includes the portfolios in the largest *HoldGap* quartile.

Table 7
Performance Gaps between Pairs in the Micro *HoldGap* Group.

Group	Months to Disclosure				
	m-12	m-6	m-5	m-4	m-3
All	0.09%	−0.18%	−0.15%	−0.12%	−0.47%
Active	0.07%	−0.18%	−0.17%	−0.15%	−0.55%
Passive	0.21%	−0.20%	0.01%	0.13%	0.20%
	Window Dressing Period			Holding Period	
	m-2	m-1	m	m + 1	m + 2
All	1.57%***	1.26%***	1.23%***	−0.23%	0.00%
Active	1.88%***	1.49%***	1.44%***	−0.27%	−0.01%
Passive	−1.01%*	−0.71%	−0.60%	0.09%	0.11%
	Holding Period				
	m + 3	m + 4	m + 5	m + 6	m + 12
All	0.09%	0.03%	0.18%	0.17%	−0.10%
Active	0.05%	0.05%	0.18%	0.21%	−0.09%
Passive	0.42%	−0.12%	0.20%	−0.14%	−0.16%

This table shows the difference in raw returns between the 10th and 11th holdings of portfolios in the micro *HoldGap* group. This subsample is also restricted by the "newly raised and listed" criteria. "Active" includes funds that bought stocks to raise a holding to the 10th position, while "Passive" includes the rest. The portfolio holdings are disclosed at the end of month *m*, and "Months to Disclosure" indicates the number of months before or after a disclosure. Detailed variable definitions are in Appendix A. ***, **, and * indicate significance at the 0.01, 0.05, and 0.10 levels, respectively (two-tailed).

These results support my discontinuity research design in that funds with a large *HoldGap* are less likely to window dress, so their portfolio weights are likely to be determined by their investment strategy. Accordingly, funds with a large *HoldGap* incur substantial additional costs to increase the weight of their 10th holding, and thus the micro group includes the observations with the most window dressing.

4.2.2. Performance gap between Funds' 10th and 11th holdings

The following tests focus on the micro group because a micro *HoldGap* ensures that fund managers incur little cost to adjust their 10th and 11th holdings. In addition, the managers of funds in the micro group do not order this pair of holdings via momentum, as the holdings are too close to each other. To eliminate the disclosure effects of the current 10th holdings, I further select pairs in the micro group whose 10th holdings are newly raised and listed at the top-10 position, which is likely to indicate window dressing behavior. An example of a newly raised and listed 10th holding is Thrivent Large Cap Stock Fund's purchase of 588,000 shares of Verizon Communications stock with a market value of $14.8 million on June 30, 1994, which elevated Verizon to the 10th position in its portfolio. After restricting the sample to the observations in the micro *HoldGap* group that include newly raised and listed 10th holdings, I obtain 4,031 holding pairs, which is 3% of the sample.

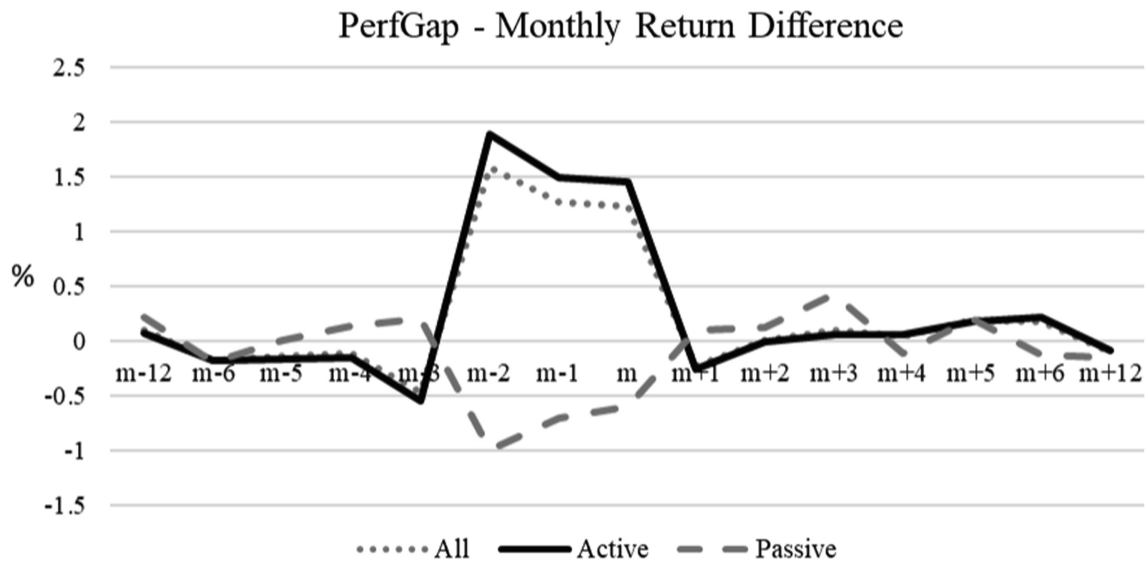

Fig. 2. Monthly Return Difference between Holding Pairs of Micro HoldGap. This figure shows the monthly raw return differences between the 10th and 11th holdings. The solid line represents the PerfGap of active pairs; the dashed line represents the PerfGap of passive pairs, and the dotted line represents the PerfGap of all pairs.

I divide these pairs into two groups according to trading direction because fund managers can change the order of a fund's holdings by buying or selling stocks to change their weight. Thus, newly raised and listed 10th holdings can be constructed either by buying more shares of a stock (active window dressing) or by selling shares of a stock in the top-10 list (passive window dressing). Again, because *HoldGap* is extremely small for these pairs, momentum is not the dominating factor. Ultimately, there are 3,208 *Active10* pairs and 828 *Passive10* pairs.

Finally, I compare the monthly returns[6] of the selected pairs at various points from one year before the portfolio disclosure to one year after, and I define the difference as *PerfGap*. Table 7 shows the monthly return differences, with "months to disclosure" indicating the time relative to the portfolio disclosure. The portfolios are disclosed at the end of month m, so the funds begin to experience the performance difference in month $m + 1$. Next, I split the timeline into three periods relative to the disclosure: observation (month m-12 to m-3), window dressing (month m-2 to m), and holding (month $m + 1$ to $m + 12$). During the observation period, the returns of the 10th and 11th holdings do not substantially differ, which is explained by the fact that window dressers only consider recent performance.

The results in the window dressing period are much more interesting. First, the active pairs have significant and positive return differences from m-2 to m as the 10th holdings start to outperform the 11th holdings in the months leading up to the disclosure, from 1.88% to 1.44% at the 1% significance level. At this stage, the active funds are buying well-performing stocks, which can be interpreted as window dressing. Meanwhile, the passive pairs have a negative performance difference, and this difference is significant in month m-2. Thus, the funds with passive pairs are not window dressing because they are not buying to construct their 10th holding.

However, after the portfolio disclosure that excessively exposes investors to funds' top-10 holdings, the positive performance gap for the active pairs quickly disappears. This result further indicates the use of window dressing because whether a holding is in the 10th or 11th position reveals little about a fund manager's skill; instead, the driving factor is likely to be the upcoming portfolio disclosure and the desire to attract capital inflows by capturing investor attention. Unsurprisingly, the return differences for the passive pairs are not significantly different from zero. Fig. 2 presents a graph of the monthly raw return differences. The solid black

[6] The raw return difference and adjusted return difference are the same after cancelling out the CRSP market value-weighted return.

Table 8
Effect of Top-10 Performance on Top-10 Performance with Different Weights.

	(1)	(2)	(3)	(4)	(5)	(6)
Next Quarter Top-10 Market Adjusted Return						
Top10QtrAdj	1.654***	1.658***	1.654***			
	(12.57)	(12.55)	(12.57)			
Top10QtrAdj	−2.113***	−2.110***	−2.098***			
*Weight10	(−10.71)	(−10.74)	(−10.66)			
Top10AnnualAdj				2.092***	2.128***	2.091***
				(12.36)	(12.78)	(12.39)
Top10AnnualAdj				−2.435***	−2.329***	−2.382***
*Weight10				(−7.31)	(−7.47)	(−7.30)
Weight10	−0.0453***	−0.0452***	−0.0449***	−0.0262***	−0.0257***	−0.0257***
	(−7.24)	(−7.19)	(−7.12)	(−3.51)	(−3.45)	(−3.43)
Fund36mAdj		−0.00302			−0.0216**	
		(−0.32)			(−2.35)	
Fund4Alp			−0.308			−0.561**
			(−1.06)			(−2.26)
Flow	−0.000054***	−0.000054***	−0.000053***	−0.000087***	−0.000084***	−0.000084***
	(−4.68)	(−4.71)	(−4.62)	(−4.74)	(−5.11)	(−4.85)
LTNA	−0.00166***	−0.00160***	−0.00154***	−0.00184***	−0.00145***	−0.00163***
	(−3.82)	(−3.85)	(−3.75)	(−4.03)	(−3.41)	(−3.67)
LAGE	−0.00255***	−0.00265***	−0.00274***	−0.00146*	−0.00206**	−0.00178**
	(−2.85)	(−2.85)	(−3.03)	(−1.87)	(−2.42)	(−2.21)
EXP	1.345***	1.342***	1.326***	1.080***	1.031***	1.041***
	(7.08)	(7.00)	(6.92)	(6.26)	(6.09)	(6.04)
Turnover	0.0103***	0.0102***	0.0101***	0.00831***	0.00779***	0.00801***
	(6.75)	(6.60)	(6.48)	(6.08)	(5.81)	(5.77)
Constant	0.0489***	0.0488***	0.0486***	0.0380***	0.0370***	0.0375***
	(7.84)	(7.88)	(7.85)	(5.27)	(5.25)	(5.22)
Style and Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Clustered	Yes	Yes	Yes	Yes	Yes	Yes
Observations	111,210	111,210	111,210	111,210	111,210	111,210
R-squared	0.280	0.280	0.280	0.284	0.286	0.284

This table reports the regression results for the relationship between top-10 portfolio past market adjusted returns and future quarter top-10 portfolio performance combined with top-10 wt changes. Top-10 portfolio performance is interacted with *Weight10* directly. The sample period is from 1980 to 2020. The dependent variable is next quarter top-10 market adjusted return. Detailed variable definitions are in Appendix A. Reported *t*-statistics in brackets are based on standard errors clustered by fund. ***, **, and * indicate significance at the 0.01, 0.05, and 0.10 levels, respectively (two-tailed).

line represents the active *PerfGap* group, which peaks in the quarter before disclosure. The dashed gray line represents the passive *PerfGap* group, whose only significant value is −1.01% at month *m*-2.

Consistent with previous findings (Agarwal et al., 2014), mutual fund managers who incur little cost to window dress tend to blindly increase the weights of well-performing holdings right before a disclosure. Such portfolio decisions do not improve fund performance because the 10th holdings do not outperform the 11th holdings after the disclosure. These results provides solid evidence of top-10 portfolio window dressing behavior.

To summarize, the panel regression results show that top-10 performance is negatively associated with funds' future returns and that the damage caused by window dressing does not occur immediately. Next, I compare 10th and 11th holdings to provide further evidence of the validity of my window dressing hypothesis.

5. Fund characteristics and window dressing costs

In this section, I explore which fund characteristics facilitate top-10 portfolio construction and how top-10 portfolio window dressing hurts funds.

5.1. Fund characteristics of window dressing

According to the window dressing hypothesis, mutual fund managers have an incentive to disclose a well-performing top-10 portfolio by buying stocks that might be overpriced. In this subsection, I investigate which funds are likely to engage in such window dressing. According to the results in Section 3.2, fund investors are sensitive to the combination of top-10 performance and top-10 weights, so I use panel data regression model (6) with an interaction between top-10 performance and *Weight10* and change the dependent variable to future-quarter top-10 market adjusted returns.

The results in Table 8 reveal several important attributes of the top-10 window dressing preference. First, the coefficients of past top-10 adjusted returns are all positive and significant,[7] implying strong performance persistence within top-10 portfolios; however, such performance persistence does not generate additional profits. Thus, mutual funds with a history of window dressing tend to continue to window dress.

Second, the coefficients of *Weight10* are negative and significant at the 1% level for all six regressions. This reflects the importance of flexibility in portfolio construction. For top-10 holdings with low weights, fund managers incur little additional expense to window dress their fund disclosures. Moreover, the interaction terms are negatively related to future top-10 performance. Taken together, this suggests that fund managers with small but poorly performing top-10 portfolios have the strongest motivation to reconstruct their 10 largest holdings to quickly attract inflows without improving their skills.

Third, funds experiencing worse capital inflows have higher incentives to window dress as the significance of the fund flow coefficients are all significant at the 1% level, but their magnitudes are economically small, which suggests that managers of funds with weak capital inflows have a strong incentive to window dress. This finding is consistent with the results in Panel C of Table 5 and the findings of Bhattacharyya and Nanda (2013).

Next, funds with smaller sizes tend to generate higher portfolio performance and to window dress. In Table 8, the coefficients of log total net assets range from −0.15% to −0.18% at the 1% significance level. This indicates that a one standard deviation decrease in the log of fund size generates a 0.18%*1.68 = 0.30% improvement in top-10 performance, leading to a 0.12% ($1.7) increase in fund flows, on average. Similarly, the coefficient of fund age is approximately −0.25% for quarterly top-10 returns and approximately −0.18% for annual top-10 returns. This implies that new funds tend to choose well-performing stocks for their top-10 portfolios. Thus, small and new funds are likely to window dress as they have less consistent and more aggressive investment strategies (Gompers & Lerner, 1999).

Finally, I find that funds with high costs and large trading volumes tend to window dress. As shown in Table 8, a fund's expense and turnover ratios have significant and positive predictive power for top-10 future returns. This result is inversely related to future performance, indicating that the high cost of window dressing and increased flexibility required for portfolio changes benefit the top-10 portfolio while hurting overall performance (Agarwal et al., 2014). The next subsection provides more details on the effects of fund turnover and expense ratio on window dressing.

5.2. Window dressing costs

In this subsection, I investigate the main factor that causes window dressing behavior to reduce fund performance. Window dressing reshapes a fund's holdings before a disclosure to capture investors' attention, inducing excessive trading costs.

I first consider the relationship between fund turnover and top-10 window dressing. Flexibility of holdings is an important prerequisite for window dressing, and funds with high turnover usually have large liquidity needs and incur high costs (Yan, 2008). However, Pástor et al. (2017) argue that active funds with high turnover achieve high benchmark adjusted returns if the manager has outstanding stock-picking skills.

To better understand the effect of portfolio flexibility on window dressing, I use the 5*5 double-sorting classification used in Table 5 and compare the turnover ratios of the 25 groups of active funds. The results in Panel

[7] The correlation between the two periods of top-10 adjusted returns is 0.41.

Table 9
Fund Turnover and Expense Among 25 Groups by Fund and Top-10 Performance.

Panel A: 25 Portfolios with Fund Alpha Tests on Fund Turnover Ratio

							Fund4Alp (Overall fund skills)	
		(1)	(2)	(3)	(4)	(5)	(5)-(1)	T-stat
Top10AnnualAdj	(1)	93.33%	81.78%	77.24%	75.77%	72.28%	−21.05%***	−11.45
	(2)	85.45%	72.22%	68.30%	62.01%	59.24%	−26.21%***	−14.70
	(3)	85.31%	74.08%	66.64%	62.13%	57.98%	−27.32%***	−14.71
	(4)	92.67%	75.97%	69.79%	62.89%	59.31%	−33.36%***	−17.24
	(5)	136.15%	98.47%	83.01%	77.78%	71.28%	−64.86%***	−28.03
	(5)-(1)	42.81%***	16.69%***	5.76%***	2.004%	−1.002%		
	T-stat	18.59	8.06	3.20	1.03	−0.54		

Panel B: 25 Portfolios with Fund Alpha Tests on Fund Expense Ratio

							Fund4Alp (Overall fund skills)	
		(1)	(2)	(3)	(4)	(5)	(5)-(1)	T-stat
Top10AnnualAdj	(1)	1.24%	1.13%	1.09%	1.08%	1.12%	−0.12%***	−12.49
	(2)	1.28%	1.18%	1.12%	1.12%	1.15%	−0.13%***	−13.67
	(3)	1.26%	1.15%	1.10%	1.09%	1.12%	−0.14%***	−13.12
	(4)	1.29%	1.16%	1.12%	1.09%	1.13%	−0.16%***	−15.12
	(5)	1.38%	1.21%	1.14%	1.14%	1.18%	−0.20%***	−19.44
	(5)-(1)	0.14%***	0.09%***	0.05%***	0.06%***	0.06%***		
	T-stat	13.21	8.76	5.47	6.14	6.54		

This table reports fund turnover and expense ratio comparison results from double sorting funds into 25 portfolios based on *Fund4Alp* and *Top10AnnualAdj*. In Panel A, funds are compared by their annual portfolio turnover. In Panel B, funds are compared by their expense ratios. The sample period is from 1980 to 2020. Detailed variable definitions are in Appendix A. ***, **, and * indicate significance at the 0.01, 0.05, and 0.10 levels, respectively (two-tailed).

A of Table 9 show that the poorly performing funds in column (1) make significantly more trades than the best performing funds in column (5), ranging from 21.05% (t-statistic = 11.45) to 64.86% (t-statistic = 28.03). This result is consistent with Yan (2008), who shows that poorly performing funds have greater liquidity needs. Moreover, comparing the funds vertically, I find that the funds with poor performance trade more frequently to improve their disclosed top-10 performance, as shown in columns (1) to (3).

Specifically, focusing on the quintile of funds with the worst performance in column (1), those at the bottom have the largest turnover of all 25 groups at 136.15%, and their turnover ratios are on average 42.81% greater than those of the funds with the worst alphas and worst top-10 returns, or 42.81%/93.33% = 46% times larger in percentage (t-statistic = 18.59). As fund performance improves, the significant turnover differences between rows (5) and (1) gradually shrink from 42.81%, 16.69% (t-statistic = 8.06), and 5.76% (t-statistic = 3.20) in columns (1) to (3), respectively, to become not significant at 2.0% (t-statistic = 1.03) in column (4) and negative (-1.0%, t-statistic = -0.54) in column (5). Thus, the worst performing funds engage in the severest window dressing as evidenced by their high trading volume and turnover. In comparison, better performing funds on average trade less and are less likely to window dress their disclosed top-10 holdings.

Additional trades always generate additional transaction costs. As shown in Table 8, fund expense ratios are positively associated with top-10 performance, and a fund's expense ratio is widely recognized as a crucial factor that negatively affects fund returns (e.g., Sirri & Tufano, 1998; Evans & Fahlenbrah, 2012). Panel B of Table 9 tabulates the funds' expense ratios into 25 groups double sorted by fund alpha and top-10 adjusted returns. Similar to the turnover results in Panel A, the funds in the worst performing quintile incur significantly higher expenses than the funds in the other four quintiles, which is consistent with the literature.

As shown in column (1), the funds that engage in window dressing behavior via their top-10 portfolios have 0.14% larger expense ratios than the other funds, which means that on average, these funds spend 0.14%/1.24% = 11% more, and this additional expense does not contribute to future profits. Therefore, the worst performing funds engage in the severest window dressing, which incurs additional costs and results in them having the largest expense ratios. In comparison, better performing funds on average have lower expenses and are less likely to window dress.

To conclude this section, I show that small and new funds produce better top-10 returns via portfolio reconstruction if they are experiencing asset outflows. Finally, the underperformance related to window dressing can be explained by the transaction costs associated with high portfolio turnover, which further confirms my window dressing hypothesis.

6. Conclusion

In this paper, I show how fund investors' investment decisions are affected by a fund's portfolio disclosures. Investors allocate their wealth to mutual funds and expect to earn excess profits by considering a portfolio's construction. When considering fund portfolios and investment decisions, investors disproportionately focus on a fund's 10 largest holdings, which are highly visible and accessible. I argue that fund investors are aware of the importance of portfolio weights as they are more interested in funds that allocate a large proportion of their holdings to stocks that have performed well recently.

I also find that fund managers understand the salience of capital flows and window dress their high-exposure top-10 to attract investors' attention. Unlike the momentum trading strategy, I find little evidence that good top-10 portfolio performance is related to superior investment decision-making. I prove this by showing that there is a negative association between a fund's top-10 returns and its future performance. The discontinuity experiment provides additional evidence of window dressing behavior by fund managers in which they select stocks for their top-10 according to recent stock returns rather than by using analytical skill. Finally, I find that small and new funds with high trading volumes tend to engage in window dressing when suffering from severe capital outflows, and the associated trading costs damage their future performance.

Overall, my results suggest that fund investors should consider a fund's entire portfolio before making an investment decision to avoid being misled by top-10 portfolio window dressing. In addition, fund regulators should require funds to provide investors access to timely and complete portfolio information on all mobile investment platforms.

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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Appendix A. Formulas and definitions

The following table provides the definitions of the variables used in this study. The variables are listed in the order in which they are introduced in the text.

Variable	Definition
Fund Total Net Assets	Sum of total net assets under management at the fund level.
Fund Quarter Flow	(*TNAt* - *TNAt*-1 * *Rt*)/*TNAt*-1, where *R* is the fund's return and *TNA* is the fund's total net assets.
Fund Quarter Raw Return	Weighted average of share class returns, from CRSP.
Fund Quarter Market Adjusted Return	*Fund Quarter Raw Return* minus the CRSP value-weighted index.
Fund 36-months four-factor Alpha (Fund4Alp)	The intercept of the Carhart (1997) regression using fund returns from the previous 36 months.
Fund Turnover	The weighted average of share-class turnover, from CRSP.
Expense Ratio (EXP)	The weighted average of share-class expense ratio, from CRSP.
Fund Age	The number of years since the fund's inception.
Number of Stocks Held	The number of domestic stocks held by a fund, from Thomson Reuters.
Top-10 Portfolio	The subportfolio with the 10 largest weights in each fund's quarterly disclosure, rebalanced quarterly.
Top-10 Portfolio Weights (Weight10)	The sum of the holding weights of the top-10 portfolio.
Top-10 Quarter Raw Return (Top10Ret)	The weighted average of a fund's top-10 portfolio returns {*Ht*-1, *i***Rt*}, from Thomson Reuters.
Top-10 Quarter Market Adjusted Return	*Top10Ret* minus the CRSP value-weighted index.
Holdings Quarter Raw Return	The weighted average of a fund's returns {Ht-1,i*Rt}, from Thomson Reuters.
Holdings Quarter Market Adjusted Return	*Holdings Quarter Raw Return* minus the CRSP value-weighted index.
Top-10 36-months four-factor Alpha	The intercept of the Carhart (1997) regression using *Top10Ret* from the previous 36 months.
Holdings 36-months four-factor Alpha	The intercept of the Carhart (1997) regression using the fund's returns from the previous 36 months.
Top10AnnualAdj	The monthly average of *Top-10 Annual Market Adjusted Return*.
Top10QtrAdj	The monthly average of *Top-10 Quarter Market Adjusted Return*.
Top10RestAdj	The monthly average of *Top-10 Market Adjusted Return* from the previous year to the previous quarter.
Fund36mAdj	The monthly average of *Fund Adjusted Return* in the previous 36 months.
Log of Total Asset (LTNA)	The natural logarithm of total net assets.
Log of Fund Age (LAGE)	The natural logarithm of fund age.

(*continued on next page*)

(*continued*)

Variable	Definition
Low10	A dummy variable that equals one if *Weight10* is in the bottom third, and zero otherwise.
Mid10	A dummy variable that equals one if *Weight10* is in the middle third, and zero otherwise.
High10	A dummy variable that equals one if *Weight10* is in the top third, and zero otherwise.
HoldGap	The percentage weight difference between the 10th and 11th largest holdings.
PerfGap	The monthly raw return (market adjusted return) difference between the 10th and 11th largest holdings.
Month to Disclose	The number of months to the portfolio disclosure; m represents the disclosure month; m-(+)t is t months before (after) disclosure.

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How do board features and auditor characteristics shape key audit matters disclosures? Evidence from emerging economies

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ABSTRACT

This study examines how corporate board features and auditor characteristics in Bangladesh influence the disclosure of key audit matters (KAM) in annual reports from 2018 to 2021. Using ordinary least squares (OLS) regressions, the study finds that factors such as chair gender, the presence of women on the board, audit committee (AC) size, auditor tenure, and client-auditor relationship significantly affect KAM disclosure. However, AC expertise, family CEO succession, and board political connections do not have significant effects. Notably, having a family member CEO with a long-tenured auditor has a negative association with KAM disclosure, while a politically connected family CEO has a positive association with such disclosures. Additionally, Big-4 auditors of important clients are negatively associated with KAM disclosure.

1. Introduction

Independent auditing is a widely used monitoring system to minimize agency costs and enhance firm value when managers (agents) do not monopolize shares. Auditors' dexterity in detecting and reporting any departure from generally accepted accounting principles (GAAP) or infringement of a contract by management is a prime indicator of their professional competence and independence. However, a wide range of audit failures in recent decades raises questions about the auditor's role, and the profession has come under severe criticism (Lennox et al., 2018; Bédard et al., 2019). Studies highlight the need for better quality information in independent audit reports (Church et al., 2008; Vanstraelen et al., 2012). Even in the 21st century, the audit

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expectation gap remains a major concern (Reza and Karim, 2018). Consequently, the International Auditing and Assurance Standards Board (IAASB) issued a series of exposure drafts of new standards, welcoming valuable comments from accounting and auditing professionals to finalize detailed reporting by auditors.

The adoption of such extended audit reporting has been a global phenomenon, with more than 120 countries now requiring listed companies to report key audit matters (KAMs) in independent audit reports. The main argument for the adoption of such audit-specific reporting around the world is that the use of this principles-based audit reporting would benefit global capital market participants by providing investors with a better opportunity to make more informed decisions. The key objective of KAMs is to reduce the "information gap" and help information users better understand the reasons and justifications behind expressed audit opinions (Bedard et al., 2015).

However, contemporary studies in developed markets are inconclusive regarding the adequacy of the new ISA 701 standard that mandates the disclosure of KAMs in independent auditors' reports of listed companies (Rahaman and Chand, 2022). While recent academic research extensively examines the efficacy of KAM communication in developed economies, studies that investigate emerging economies are limited (Rahaman et al., 2023). Studies provide more evidence on various institutional settings, regulatory frameworks and accounting technologies in developing countries than in developed countries (Nahar et al., 2020). Therefore, the present study aims to determine the association between corporate governance features, auditor characteristics and KAM disclosure in Bangladesh, a growing economy that represents the South Asian stock market well. Unlike developed economies, emerging economies are characterized by family dominance, political interference and a very high level of corruption (Nahar et al., 2020). Furthermore, the lack of widespread operations of Big-4 auditors in Bangladesh provides an extra edge for our investigation of KAM disclosure by firms listed on the Dhaka Stock Exchange. Big-4 auditors, the largest global auditing firms, hold significant importance in developing countries due to their ability to enhance a company's global credibility, facilitate access to international capital, provide expertise and resources, improve audit quality, promote compliance with international standards, mitigate financial risks, and contribute to the development of local auditing professionals. In addition, whereas there is a provision for mandatory auditor rotation every 5 years in many developed countries such as the UK, the US and Australia, listed firms in Bangladesh are required to rotate auditors every 3 years (Siregar et al., 2012).

As one of the fastest-growing economies, Bangladesh is predicted to become a developing country by 2024 (United Nation, 2018). Bangladesh draws considerable attention from international investors for its immense growth potential and upward growth trends. The growth rate of its GDP was 6.06 % in 2014, it increased every year until 2019, when it recorded an impressive rate of 8.2 % (World Bank, 2023). However, several financial scams in the capital markets of Bangladesh imply the existence of poor governance and a weak regulatory system in the country (Nahar et al., 2020; Karim and Hossain, 2021). Even the level of compliance with disclosure requirements is frustrating (Karim and Riya, 2022). Shariah compliance is negligible in this economy (Karim and Shetu, 2020a), and Shariah audit compliance is burdensome, due to the dual audit and conflicting financial reporting guidelines (Karim and Shetu, 2020b). To improve transparency in financial reporting and protect investors' interests, Bangladesh periodically adopts international standards on accounting and auditing. Along this line, the Institute of Chartered Accountants of Bangladesh (ICAB) recently adopted the new ISA 701, making it effective from the reporting period ended in December 2018. However, demonstrated poor governance, along with a weak regulatory environment, necessitates an investigation of how corporate echelons have influenced the novel regulation regarding KAM disclosure in auditor reports. The upper echelons theory proposed by Hambrick and Mason (1984) suggests that the senior executives of various firms have divergent demographic characteristics (such as gender, age, education, experience and tenure), which causes them to behave differently.

Although many studies focus on KAM disclosures in developed economies from both qualitative and quantitative perspectives, there is a lack of research on the issue in developing or emerging economies. Therefore, this study is among the first to research the determinants of KAM reporting in Bangladesh. The prime objective of the study is to examine board and auditor characteristics as the determinants of KAM disclosure in Bangladesh. Although KAMs are decided on and disclosed in audit reports by auditors, this study focuses on whether the tone at the top of a firm influences the auditor's decision regarding KAM disclosure. Research shows that top executives and directors influence auditors' decisions, including their audit opinions (Beattie

et al., 2000; Guan et al., 2016). Therefore, we investigate the link between board and auditor characteristics and KAM disclosure in the emerging economy context.

The Bangladesh economy differs from a developed economy when viewed through the lens of board and auditor characteristics. Corporate governance in Bangladesh is very weak, and auditor independence is impaired due to issues related to family inheritance and political connections (Karim et al., 2020). Therefore, this study focuses primarily on whether the features of corporate upper echelons and auditors, in an emerging economy characterized by political connections and weak governance and control mechanisms, affect auditors' KAM decisions. Using 534 firm-year observations extracted from firms listed on the Dhaka Stock Exchange, our results show a significant connection between board and auditor attributes and KAM disclosure. Specifically, we find that firms led by female chairs disclose fewer KAMs, with shorter descriptions, than those led by their male counterparts. However, the proportion of women on boards is positively associated with KAM disclosure. Furthermore, auditor tenure is positively associated with KAM disclosure, as measured either by the number of KAMs or the number of words in KAMs. In addition, we find that auditors disclose more KAMs with greater details for their important clients. Our findings are robust when controlling for endogeneity issues, using the entropy balancing (EB) and propensity score matching (PSM) techniques. We contribute to the auditing literature in the context of Bangladesh, a country characterized by a growing stock market, high family ownership, weak investor protection and weak regulatory enforcement.

The rest of the paper is organized as follows. Section 2 presents a literature review and the development of the hypotheses. The research methodology is described in Section 3, and the empirical results are reported in Section 4. Section 5 mitigates endogeneity concerns, and Section 6 concludes the paper.

2. Literature review and hypothesis development

While inadequate and opaque risk reporting has been blamed for stock market scams (Rahaman and Chand, 2021), investigations into such reporting remain scant. Risk reporting has drawn more attention in recent years because of successive corporate governance failures during the last decade (Khandelwal et al., 2020). According to agency theory, corporate risk disclosure serves as an instrument to reduce information asymmetry between managers and investors (Jensen and Meckling, 1976). However, most studies on risk disclosure focus on voluntary risk disclosed by management in their statements in annual reports. Some studies investigate mandatory risk disclosure required by national accounting standards in certain jurisdictions (Khandelwal et al., 2020). Recently, the requirement for KAM disclosure in independent auditors' reports was mandated to ensure better transparency in financial reports. Research on KAM disclosure is limited, but focuses on the causes and consequences of KAM disclosure, primarily based on firms in developed countries (Wei et al., 2019). The present study aims to identify the governance characteristics that influence KAM disclosure.

Among the pioneering studies, Velte's (2020) study on KAM disclosure in the UK is the first to incorporate audit committee (AC) characteristics and to discuss KAM determinants in particular. The findings document a positive association between the percentage of women on the AC and their financial and industry expertise and KAM readability. In an emerging country context, Wuttichindanon and Issarawornrawanich (2020) identify certain factors, such as the number of independent directors, auditor litigation risk, profitability, firm complexity and industry type, that have a significant relationship with KAM disclosure. Suttipun (2020) seeks to determine the factors that impact KAM disclosure in the Thai market, finding a significant positive association between audit fees, auditor type and the level of KAMs reported. However, Velte (2018) argues that diverse corporate governance mechanisms may result in different effects of corporate governance worldwide and, therefore, varied KAM disclosure from country to country. This study is an initiative to assess the situation from a South Asian economic perspective, to address the associated gap in the literature. The main purpose of this paper is to discover the governance and firm-specific determinants of KAM disclosure in the context of an emerging economy, Bangladesh.

Overall, this paper contributes to the auditing literature by identifying characteristics of board members, audit committees, auditors and family firms as determinants of KAM disclosure. Distinguishing between firm-driven and board-driven disclosure factors is crucial because it increases our understanding of the drivers of high-quality financial reporting, enabling regulators to assess the effectiveness of the new standard and identify fallacies, if any. Knowing whether the promulgated standard itself is inadequate, regardless of other fac-

tors, or whether other drivers make the standard inadequate can help standard setters address the deficiency, thereby making the standard more effective and proficient. A sound understanding of the determinants of KAM disclosure can also help regulators take a more dynamic and collaborative approach to improving firms' risk disclosure.

Certain aspects of corporate governance (e.g., chair gender, AC size, presence of women on the AC, Big-4 affiliation) and selected firm characteristics (e.g., firm age, firm size) are scrutinized in the literature to determine their impacts on KAM disclosure. This study incorporates these variables to address the significant gap in the literature concerning the emerging economy context. A developing economy like Bangladesh has a weak governance mechanism due to family control of firms and political connections of business leaders. Therefore, board and auditor characteristics in this economy are different from those in developed economies. This paper links the distinct features of boards and auditors in Bangladesh to KAM disclosure to assess their association. The findings contribute new insights to the literature from a developing economy perspective. The rest of this section is devoted to introducing the independent variables and developing the hypotheses of the study.

2.1. Board characteristics and KAM disclosure

In this section, board characteristics are classified into four categories: board gender diversity, AC characteristics, family members on the board, and political connections of board members.

2.2. Board gender diversity

2.2.1. Chair gender

While prior studies show a scarcity of women among corporate executives, recent studies show an increasing trend of women's representation in leadership positions (Cook and Glass, 2014; Joshi et al., 2015). Due to the practical implications of the presence of women on corporate boards, it has become a central issue in corporate governance (Terjesen et al., 2009), and research focusing on gender diversity has increased and drawn notable attention from policymakers and standard setters. Men and women differ in their experiential, rational and cognitive resources used in firms (Sidhu et al., 2021).

Although gender stereotypes hold men as better equipped for leadership roles, recent studies provide evidence of women outperforming men in developing and implementing corporate strategies. The scenario in emerging economies, however, is not yet adequately researched because women are still lagging behind their counterparts in the corporate race, especially in terms of top management positions. Thus, female incumbency of the chair position is likely to present a role model for other female directors. Studies find that women as role models decrease women's fear of being stereotyped negatively and increase their participation, passion, drive and influence (Latu et al., 2013; Simon and Hoyt, 2013). Women are more ethical than men and are more inclined to detect earnings manipulation to avoid the risk of litigation and reputational damage (Lakhal et al., 2015). Women make better directors because they are prone to take into account the interests of all stakeholders (Bart and McQueen, 2013). Women are also found to be more risk-averse than men (Yang et al., 2019). The role of chair of the board, vested with overt power, differs from that of a director and is of a higher echelon. The board chair exercises significant authority over the board and its subcommittees (Krause et al., 2016). The agenda and deliberations of a female-led board are less likely to be controlled by other directors (Sidhu et al., 2021). A board led by a female chair is likely to ensure improved financial reports with no material misstatements or errors (Palvia et al., 2015). Women restrict earnings management (Kyaw et al., 2015) and improve earnings quality (Francis et al., 2015). Therefore, the female chair may ask for detailed disclosure of KAM to ensure reporting quality. Although KAMs are disclosed by auditors, a female board chair may interact with auditors to ensure the quality of financial reporting, which could indirectly affect KAM disclosure. Therefore, we contend that a board with a female chair will disclose more KAMs. The relevant hypothesis is presented as follows:

H1a. There is a positive association between a female board chair and KAM disclosure.

2.2.2. Proportion of women on the board

Studies assert that female directors can induce the board and its committees to function more effectively (Gul et al., 2013; Green and Homroy, 2018). Female directors tend to enhance the monitoring role of the board (Bøhren and Staubo, 2016). Gender diversity is advocated due to its practicality in terms of accessing a divergent set of resources (Adams and Funk, 2012; Triana et al., 2013). Furthermore, boards with gender diversity raise the level of debate and discussion on critical issues that often garner less attention from all-male boards (e.g., Gul et al., 2011). Because female directors differ from their male counterparts in terms of perspectives, understandings, relational ties and temperaments, the presence of women on a board is expected to influence the board's functions, strategic decisions and, eventually, corporate reporting. Studies document a positive link between boards/committees with gender diversity and corporate social responsibility (CSR) disclosure (e.g., Barako and Brown, 2008). Concerning risk disclosure, two studies find a positive association between boards with diverse genders and risk disclosure (Saggar and Singh, 2017; Saggar et al., 2022). However, little attention is paid to the role of female directors in external auditing (Miglani and Ahmed, 2019). As with board chairs, more female representation on a board ensures financial reporting quality through disclosure of all risk factors, which indirectly affects the KAMs disclosed by the auditors. Based on the above discussion, we predict that a gender-diverse board will disclose more issues and details in KAMs. Therefore, we propose the following hypothesis:

H1b. There is a positive relationship between a board's gender diversity and KAM disclosure.

2.3. AC characteristics

2.3.1. AC size

Since the inception of the corporate governance mechanism, the relationship between board size, committee size and corporate functions has been an empirical issue. The AC is the key mechanism used to enhance the quality of a company's financial reporting, and it offers shareholders the greatest protection through compliance with mandatory disclosures (Mnif and Znazen, 2020). Along this line, many studies attempt to determine the association, if any, between AC size and level of disclosure (Kent and Stewart, 2008; Abdullatif et al., 2015; Mnif Sellami and Borgi Fendri, 2017). Agency theory holds that a large AC contributes to better monitoring, and therefore large ACs with the rich expertise of different directors may yield diverse observations, thereby producing greater disclosure (Anderson et al., 2004). In the same vein, stakeholder theory (Freeman, 1984) posits that large boards (and subcommittees) are representative of a large number of stakeholders and, therefore, predict greater disclosure. Nevertheless, it is also argued that large boards (and subcommittees), with their dispersed viewpoints and opinions, may result in impaired monitoring (Jensen, 1993). Large AC size increases the likelihood of material misstatements (Boo and Sharma, 2008), which could result in more notable observations by auditors.

The literature on the relationship between AC size and corporate disclosure yields inconclusive findings. Li et al. (2012) document a positive effect of AC size on intellectual capital disclosure by UK listed firms. Similarly, Appuhami and Tashakor (2017) find a positive association between AC size and CSR disclosure in Australian firms. In contrast, Kent and Stewart (2008) document a significant negative association between AC size and corporate disclosure. However, Mnif Sellami and Borgi Fendri (2017) and Mnif and Znazen (2020) find no relationship between the two variables. While prior studies examine boards' influence on risk disclosed voluntarily, the present study explores the case of KAMs, i.e., risk disclosed mandatorily in a novel independent auditor's report. Auditors now have the responsibility to discuss significant risks with the AC. Based on prior findings, we assume better monitoring of corporate affairs and better interaction with auditors for firms with larger ACs. Consequently, more issues are expected to be on the agenda of the board. Therefore, we hypothesize the following:

H1c. There is a positive relationship between AC size and KAM disclosure.

2.3.2. AC financial and accounting expertise

The corporate governance guideline (2018) of Bangladesh requires AC members to be financially literate, which means that they must have expertise in understanding and explaining accounting and financial information. The literature on the association between AC expertise and KAM disclosure is quite new, and the results are mixed. Bepari (2022) finds a positive relationship with more specific and readable KAM disclosures. Similar results are found by Velte (2019) in the context of UK companies. However, Zhang and Shailer (2021) find the opposite results in the UK context. Abu and Jaffar (2020) also discover a negative relationship between AC expertise and independence and the number of KAMs disclosed. As a financially savvy and experienced AC will strengthen the board and incorporate more internal control mechanisms, it will ensure optimum disclosures (Sultana et al., 2019). An expert AC will interact with auditors to determine significant transactions/events and influence the auditors in determining the optimum number and extent of KAMs disclosed. In line with this discussion, we develop the following hypothesis:

H1d: AC expertise in finance and accounting is positively associated with KAM disclosure.

2.4. Family CEO and political connection

2.4.1. Family CEO

The CEO and chair positions of family firms are examined in several studies. La Porta et al. (1999) show that family members hold the positions of CEO, chair and vice-chair in approximately 70 % of family businesses. Studies also show that CEO succession is negatively associated with company performance (e.g., Pérez-González, 2006; Cucculelli and Micucci, 2008). CEOs in family firms are appointed without competition, and they reach the top faster than in non-family firms (Blanco et al., 2021). Family member CEOs of family firms (family CEOs) are strongly committed to socioemotional wealth (SEW), as they want to protect their predecessors' wealth. To achieve this objective, family CEOs appoint lower-quality audit firms and pay lower audit fees, giving them significant influence over auditors (Khan et al., 2015). Consequently, they will be reluctant to disclose KAMs (negative disclosure) to protect their families' wealth. Therefore, the following hypothesis is proposed:

H1e: Family CEOs are negatively correlated with KAM disclosure.

2.4.2. Board members' political connections

The literature shows that political companies disclose more positive information than negative information (Cheng et al., 2017). Also, political firms are found to report better-quality forward-looking disclosures than non-political firms (Al Lawati, 2022). In the case of voluntary disclosure, political firms make more voluntary disclosures than non-political firms (Dicko et al., 2020). In contrast, political firms tend to hide negative environmental information (Cheng et al., 2017). Additionally, information asymmetry is exacerbated by political means (Chen et al., 2010). As KAMs represent risk factors disclosed by auditors, political firms are not interested in disclosing these material issues. Therefore, politically connected boards influence their auditors to reduce the number of KAMs disclosed. Accordingly, we develop the following hypothesis:

H1f: The board's political connections are negatively associated with KAM disclosure.

2.5. Auditor characteristics and KAM disclosure

2.5.1. Auditor tenure

The literature shows that long-term audits foster long-term relationships between companies and auditors that create a rapport between them and hamper auditor independence, due to familiarity threats (Arel et al., 2005). Long audit tenure is a threat to audit quality (Dattin, 2017). Because of such enduring relationships, auditors may disclose less information in KAMs at the request of management and/or to placate their client's management. However, a competing argument is also made. Specifically, long tenure provides auditors with

the opportunity to gain more knowledge about their clients (Myers et al., 2003). In-depth knowledge of clients' business and associated risks allows auditors to identify more significant issues as KAMs. This, in turn, leads these auditors to disclose more information in KAM communication. Additionally, examining the relationship between audit firm tenure and audit quality (proxied by the propensity to issue a going concern opinion), Jackson et al. (2008) find that better audit quality is associated with longer tenure in Australia. Lennox and Wu (2018) claim that a long tenure may lead to a high-quality audit because a partner can gradually learn more about a client and its industry, resulting in an optimum number of KAMs. Furthermore, long-tenured auditors, due to their reputational concern, are expected to furnish more issues with extensive details in the new KAM section of the audit report. Auditors near the expiration of their tenure may feel the threat of reputational damage if errors are identified or fraudulent reporting is discovered after handing over their audit responsibilities to a new auditor. To protect their reputation and firms' image, long-tenured auditors may make more audit efforts to ensure better audit quality, which in turn could yield more KAMs. Departing auditors tend to improve audit quality because they believe that a new employer firm will review their previous audits and uncover any oversight (Arel et al., 2005). A recent study finds that an audit span of more than 4 years is associated with a higher number of KAMs and a greater extent of KAM reporting (Shao, 2020). Overall, the positive association between audit tenure and KAM disclosure outweighs the negative correlation. Given the above discussion, we anticipate the following for long-term audit relationships:

H2a. There is a positive association between audit tenure and KAM disclosure.

2.5.2. Client's importance to auditor

We measure a client's importance to an auditor as the ratio of audit fees from the client to the auditor's total audit fees earned for that year. A client that is complex in nature and pays more in audit fees is important to its auditor. From this perspective, audit fees and client complexity are related. The disclosure of KAMs requires a cost–benefit analysis that has implications for audit fees (Mock et al., 2013). The incorporation of KAM disclosure has led to increased audit fees in many economies (Li et al., 2019). In a cross-country study, Pinto and Morais (2019) find a positive relationship between audit fees and KAM disclosure. Furthermore, Hussin et al. (2022) find positive relationships between KAM disclosure and both audit fees and client complexity. In the context of Australian firms, Bepari et al. (2022) obtain similar results. In line with recent research, we propose the following hypothesis:

H2b. There is a positive relationship between the importance of audit clients and KAM disclosure.

3. Data collection and research methodology

Our sample is composed of all of the firms listed on the Dhaka Stock Exchange from 2018 to 2020, as KAM disclosures came into effect in 2018. Table 1 (Panel A) presents the sample selection process. Data are obtained from the annual reports of the sampled companies, available on the website of the Dhaka Stock Exchange. The data on corporate governance are coded from the corporate governance reports, and firms' characteristics and financial variables are collected from their financial statements. For the reliability of our coding, we rely on simple and α coefficients of agreement. For our sample, the computed simple coefficient of agreement is 0.90 and the α coefficient of agreement is 0.87. The results, being much higher than the threshold level of 0.75 proposed by Milne and Adler (1999), suggest that our coding is sufficiently reliable. Our initial sample comprises 1,767 firm-year observations, the entire population of the economy. We exclude 882 observations because of the distinctive nature of the associated operations and regulations, i.e., mutual funds, bonds and debentures. Furthermore, 351 observations are excluded because of missing values for one or more of the variables of interest. Our final sample thus stands at 534 firm-years, which represents more than 80 % of market capitalization.

Panel B of Table 1 presents the sample distribution by industry and Panel C divides the sample observations by year. The sample is dominated by the Textile industry, which accounts for 18.16 % of the total sam-

Table 1
Sample selection.

Panel A: Sample selection	Companies	Observations
Initial sample of observations from firms listed in the Dhaka Stock Exchange during the 2018–2021 period	589	1,767
Less: Firm-year observations excluded due to the distinctive nature of operations such as mutual funds, bonds and debentures.	–294	–882
Less: Companies and observations excluded due to missing data	–95	–351
Final sample (unbalanced panel)	201	534
Panel B: Sample distribution by industry	*N*	*%*
Bank	65	12.17
Cement	17	3.18
Ceramic	10	1.87
Engineering	67	12.55
Financial Institutions	52	9.74
Food & Allied	20	3.75
Fuel and Power	46	8.61
Insurance	70	13.11
IT Sector	15	2.81
Pharmaceuticals & Chemicals	53	9.93
Textile	97	18.16
Others	22	4.12
Total	534	100
Panel C: Sample distribution by year		
T_1	201	37.64
T_2	190	35.58
T_3	143	26.78
Total	534	100

ple, followed by Insurance, Engineering and Bank at 13.11 %, 12.55 % and 12.17 %, respectively. Among others, Financial Institutions (9.74 %), Pharmaceuticals & Chemicals (9.93 %), Fuel and Power (8.61 %), Food & Allied (3.75 %), Cement (3.18 %), Ceramics (1.87 %) and the IT Sector (2.81 %) account for about 40 % of the sample. The number of observations for years 1, 2 and 3 is 201, 190 and 143, respectively.

3.1. Regression model

This study applies regression analysis to investigate the influence of the predictor variables on the dependent variables. The regression equations used are as follows::

$$\begin{aligned}\mathrm{NumKAM}_{it} = {} & \alpha 0 + \beta_1 \mathrm{CHAIRGEN}_{it} + \beta_2 \mathrm{WBOD}_{it} + \beta_3 \mathrm{ACSIZE}_{it} + \beta_4 \mathrm{ACFE}_{it} + \beta_5 \mathrm{FCEO}_{it} \\ & + \beta_6 \mathrm{AUDT}_{it} + \beta_7 \mathrm{CIMP}_{it} + \beta_8 \mathrm{PCON}_{it} + \sum \mathrm{CONTROLS}_{it} \\ & + \sum YEAR_{it} + \sum INDUSTRY_{it} + \varepsilon_{it}\end{aligned} \tag{1a}$$

$$\begin{aligned}\mathrm{WordKAM}_{it} = {} & \alpha 0 + \beta_1 \mathrm{CHAIRGEN}_{it} + \beta_2 \mathrm{WBOD}_{it} + \beta_3 \mathrm{ACSIZE}_{it} + \beta_4 \mathrm{ACFE}_{it} \\ & + \beta_5 \mathrm{FCEO}_{it} + \beta_6 \mathrm{AUDT}_{it} + \beta_7 \mathrm{CIMP}_{it} + \beta_8 \mathrm{PCON}_{it} + \sum \mathrm{CONTROLS}_{it} + \sum \mathrm{YEAR}_{it} \\ & + \sum INDUSTRY_{it} + \varepsilon_{it}\end{aligned} \tag{1b}$$

where NUMKAM is the number of issues disclosed as KAMs, WordKAM is the extent of KAM disclosure, CHAIRGEN is the gender of the chair of the board, WBOD is the percentage of women on the board, ACSIZE is the number of members on the AC, ACFE is the AC's financial expertise, FCEO represents a family CEO, AUDT is audit tenure, CIMP is the client's importance to the auditor, PCON is the political connections of the board, BIG4 represents the audit firm's Big-4 status, CONTROLS represents the control variables, YEAR represents year fixed effects and INDUSTRY represents industry fixed effects.

The dependent variable in Model 1a is the number of issues disclosed in the independent auditor's report, and in Model 1b it is the number of words disclosed as KAMs. Based on prior studies, we control for firm age, firm size, return on assets (ROA), audit fee, board independence, board political connection, year effects and industry effects.

Contemporary studies calculate the extent of KAM disclosure as the natural logarithm of the number of issues disclosed and the number of words used therein. Our study also includes the log form of the variables to run the main models. The following models are used:

$$\begin{aligned} \mathrm{LnNumKAM_{it}} = {} & \alpha 0 + \beta_1 \mathrm{CHAIRGEN_{it}} + \beta_2 \mathrm{WBOD_{it}} + \beta_3 \mathrm{ACSIZE_{it}} + \beta_4 \mathrm{ACFE_{it}} + \beta_5 \mathrm{FCEO_{it}} \\ & + \beta_6 \mathrm{AUDT_{it}} + \beta_7 \mathrm{CIMP_{it}} + \beta_8 \mathrm{PCON_{it}} + \sum \mathrm{CONTROLS_{it}} + \sum \mathrm{YEAR_{it}} \\ & + \sum \mathrm{INDUSTRY_{it}} + \varepsilon_{it} \end{aligned} \tag{2a}$$

$$\begin{aligned} \mathrm{LnWordKAM_{it}} = {} & \alpha 0 + \beta_1 \mathrm{CHAIRGEN_{it}} + \beta_2 \mathrm{WBOD_{it}} + \beta_3 \mathrm{ACSIZE_{it}} + \beta_4 \mathrm{ACFE_{it}} + \beta_5 \mathrm{FCEO_{it}} \\ & + \beta_6 AUDT_{it} + \beta_7 CIMP_{it} + \beta_8 PCON_{it} + \sum CONTROLS_{it} + \sum YEAR_{it} \\ & + \sum \mathrm{INDUSTRY_{it}} + \varepsilon_{it} \end{aligned} \tag{2b}$$

The dependent variable for Model 2a is the natural logarithm of several issues disclosed in the independent auditor's report, and in Model 2b it is the natural logarithm of the number of words disclosed as KAMs. The definitions of the variables are presented in Table 2.

Table 2
Variable definitions.

Variable	Definition	Data Source
$\mathrm{NumKAM_{it}}$	Number of items disclosed in the KAM section for firm i in year t	Annual reports of companies
$\mathrm{WordKAM_{it}}$	Number of words used to describe KAMs for firm i in year t	
$\mathrm{CHAIRGEN_{it}}$	Chair gender, coded as 1 if the chair of the board is a woman and 0 otherwise	
$\mathrm{WBOD_{it}}$	Proportion (%) of women on the board of directors	
$\mathrm{ACSIZE_{it}}$	AC size, measured as the log of the number of members on the AC	
$\mathrm{ACFE_{it}}$	AC financial and accounting expertise, coded as 1 if auditors have professional degrees such as CA, CMA, CPA and CFA and 0 otherwise	
$\mathrm{FCEO_{it}}$	Family CEO, coded as 1 if the CEO is a member of the family in a family firm and 0 otherwise. A firm is considered to be a family firm if family members hold more than 20 % the firm's shares (Bjuggren et al., 2011; Blanco et al., 2021).	
$\mathrm{PCON_{it}}$	Political connections of the firm, coded as 1 if the firm is politically connected and 0 otherwise. This study considers a firm to be politically connected if its board members hold any position in the current ruling or opposition political group of the country.	
$\mathrm{AUDT_{it}}$	Audit tenure, measured as the natural logarithm of auditor tenure, in years	
$\mathrm{CIMP_{it}}$	Client importance, measured in terms of audit fees (clients paying higher audit fees are more important to an auditor); specifically, audit fees from firm i scaled by the total audit fees earned by the auditor in year t	
$\mathrm{BIG4_{it}}$	Big-4 affiliation, coded as 1 if the firm is audited by a Big-4 auditor and 0 otherwise	
$\mathrm{BODIND_{it}}$	Board independence, measured as the proportion of independent directors on the board for firm i in year t	
$\mathrm{AFEE_{it}}$	Audit fees, the amount paid by the company to the audit firm measured in currency BDT	
$\mathrm{FAGE_{it}}$	Firm age, measured as the log of the number of years since firm i's incorporation, as of year t	
$\mathrm{FSIZE_{it}}$	Firm size, measured as the natural logarithm of total assets for firm i in year t	
$\mathrm{ROA_{it}}$	Return on assets, indicating the firm's profitability, measured as net profit divided by total assets	
$\mathrm{YEAR_{it}}$	Year effects for the sample period	
$\mathrm{INDUSTRY_{it}}$	Industry effects for the number of industries covered	

4. Empirical results and discussion

4.1. Descriptive statistics and univariate analysis

Table 3 presents the descriptive statistics of the variables used in the regression. The results indicate that the number of KAMs reported by the sample firms in Bangladesh ranges from 0 to 10. On average, auditors use 939 words to describe KAMs, with the lowest and highest numbers of words being 0 and 3,615, respectively. In our study sample, about 85 % (15 %) of the board chairs are men (women), and the average representation of women on the board is only 16 %. The proportion of independent directors on the board is only 23 %. The mean size of the AC is 1.39, and around 50 % of AC members have expertise in finance and accounting. Family CEOs account for 32 % of all CEOs, with a standard deviation of 47 %, and, on average, 20 % of the sample firms are politically connected. Among the 534 firm-year observations, about 19 % involve Big-4 auditors, while about 81 % involve auditors not affiliated with any of the Big-4 firms. The average tenure of an auditor is 2.28 years, and around 16 % of the clients are important to the auditors. The mean firm size (log form) is 16, with a standard deviation of 1.95 and a median of 15.66. The average firm age (in logarithm) is 3.20 years, with the youngest firm being in operation for 1.61 years (in logarithms) and the oldest firm being 4.19 years old (in logarithm).

As we have multiple variables in our model, we apply two tests to check for multicollinearity problems: the correlation matrix and the variance inflation factor (VIF). The correlation matrix gives insight into the relationship between independent variables. Although there is no hard rule regarding the correlation cut-off, experts agree that a correlation greater than 80 % may indicate multicollinearity (Hair et al., 2009). Concerning VIF values, while some scholars argue that a multicollinearity problem may arise at a VIF value of 10 or greater, others recommend an average VIF value of 1 or less for an unbiased regression (Bowerman and O'Connell, 1990). Our analyses find no collinearity issues, as no correlations between the independent variables and the VIF values of the independent variables exceed 0.70, with an average VIF value of less than 5.

Table 3
Descriptive statistics.

Variable	Mean	SD	Median	Minimum	Maximum
Dependent Variables					
NumKAM	3.66	1.74	3.00	0.00	10.00
LnNumKam	1.47	0.39	1.39	0.00	2.40
WordKAM	938.82	481.91	859.50	0.00	3,615.00
LnWordKAM	6.69	0.65	6.76	0.00	8.19
Independent Variables					
CHAIRGEN	0.15	0.35	0.00	0.00	1.00
WBOD	0.16	0.14	0.14	0.00	0.63
ACSIZE	1.39	0.26	1.39	0.69	3.76
ACFE	0.50	0.72	0.00	0.00	4.00
FCEO	0.32	0.47	0.00	0.00	1.00
AUDT	2.28	1.08	2.00	1.00	6.00
CIMP	0.16	0.20	0.10	0.00	1.00
BIG4	0.19	0.39	0.00	0.00	1.00
BODIND	0.23	0.11	0.22	0.00	0.89
PCON	0.20	0.40	0.00	0.00	1.00
AFEE	6.07	0.96	5.97	2.30	10.74
FAGE	3.21	0.42	3.18	1.61	4.19
FSIZE	16.00	1.95	15.66	11.37	20.86
ROA	0.02	0.19	0.02	–0.62	0.44
YEAR	0.37	0.48	0.00	0.00	1.00
Consolidation	0.32	0.47	0.00	0.00	1.00

4.2. Multiple regression results

Table 4 presents the results of the multiple regression. The results show that the model applied is significant ($p > F = 0.000$). The model's R^2 value of 0.2582 indicates that the predictor variables explain nearly 26 % of the variance in KAM disclosure. Below is a detailed discussion of the regression results.

First, we examine whether chair gender affects KAM disclosure, as measured by the number of issues and the number of words used to describe the KAMs. The results reveal a negative association between chair gender and KAM disclosure ($p < 0.05$). This suggests that a female chair influences auditors to provide less detail in the new KAM section of independent audit reports, as women serving as the board chair are more skeptical and risk-averse to disclosing negative information (Palvia et al., 2015). Therefore, the number of KAMs and the extent of KAM disclosure in the audit reports of female-led firms are lower than those of male-led firms; the results are robust to the logarithm form of the number and length of KAM disclosures. This observation is consistent with the argument that a female chair ensures the quality of financial reports (Abbot et al., 2012).

Our second hypothesis (H1b) is that board gender diversity is positively related to KAM disclosure. The regression results show a significant positive relationship with the length (significant at the 1 % level) and number (significant at the 5 % level) of KAM disclosures. Thus, our hypothesis is supported, with significant results. As a higher proportion of female directors on the board strengthens the board's effectiveness and governance, such a board requires more KAM disclosures to ensure the transparency of auditors' reports, which is consistent with the results of Gul et al. (2013) and Green and Homroy (2018), among others.

Next, we investigate the relationship between AC size and KAM disclosure. Incongruent with our hypothesis (H1c), AC size is not found to be a significant factor of KAM disclosure in the main models; however, a significant positive relationship is observed in the robust model with the logarithm form of KAM disclosure (significant at the 10 % level). This implies that the number of issues disclosed and the extent of KAM disclo-

Table 4
Regression results.

Variable	Expected Sign	Coefficient (*p*-value) Model 1a NumKAM	Coefficient (*p*-value) Model 1b WordKAM	Coefficient (*p*-value) Model 2a LnNumKAM	Coefficient (*p*-value) Model 2b LnWordKAM
CHAIRGEN	+	–0.383(1.88)**	–152.80(2.60)***	–0.079(1.70)*	–0.170(2.12)**
WBOD	+	1.248(2.36)**	452.83(2.97)***	0.269(2.22)**	0.541(2.60)***
ACSIZE	+	–0.307(1.17)	–118.00(1.56)	–0.097(1.62)*	–0.202(1.95)**
ACFE	+	–0.074(0.75)	9.80(0.35)	–0.017(0.74)	0.017(0.45)
FCEO	–	–0.149(0.90)	–63.88(1.34)	–0.043(1.14)	–0.086(1.31)
AUDT	+	0.245(2.63)***	53.29(1.99)**	0.063(2.96)***	0.086(2.33)**
CIMP	+	0.821(2.03)**	216.07(1.86)**	0.197(2.14)**	0.282(1.77)**
PCON	–	–0.065(0.35)	3.61(0.07)	0.007(0.15)	0.007(0.10)
BIG4		0.104(0.51)	170.23(2.90)***	0.041(0.87)	0.208(2.59)**
BODIND		–0.029(0.04)	36.15(0.18)	0.044(0.28)	0.048(0.18)
AFEE		–0.036(0.35)	–27.94(0.93)	–0.024–(1.01)	–0.064(1.57)
FAGE		0.383(2.27)**	92.28(1.91)**	0.064(1.67)**	0.061(0.92)
FSIZE		0.125(1.86)**	70.95(3.66)***	0.033(2.17)**	0.082(3.08)***
ROA		–0.205(0.18)	–311.03(0.93)	–0.037(0.14)	–0.329(0.72)
YEAR		–1.478(3.16)***	–240.67(1.79)**	–0.384(3.60)***	–0.705(3.84)***
Consolidation		0.259(1.33)	137.57(2.47)	0.047(1.05)	0.095(1.25)
Constant		2.76(1.92)**	226.94(0.55)	1.33(4.07)***	6.22(10.99)***
Controls		Yes	Yes	Yes	Yes
Year/industry effects		Yes	Yes	Yes	Yes
Observations		534	534	534	534
R-squared		0.2582	0.2283	0.2231	0.1900
Prob > F		0.000	0.000	0.000	0.000

***significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

sure is influenced by the number of members on the AC. This result is congruent with the findings of Appuhami and Tashakor (2017) that a larger AC has better control over the audit.

The fourth hypothesis (H1d) posits that there is a positive association between AC expertise in finance and accounting and KAM disclosure, and the results show that whether AC members have professional accounting degrees such as CA or CMA has no significant association with the number and length of KAM disclosures. However, a negative relationship is observed between AC expertise and the number of KAMs disclosed, and a positive association is observed between AC expertise and the length of KAM disclosures, consistent with Zhang and Shailer (2021) and Abu and Jaffar (2020), as professional accountants ask for a specific number and length of disclosures and avoid unnecessary or insignificant KAM disclosures (Zhang and Shailer, 2021).

The fifth hypothesis (H1e) predicts a negative correlation between KAM disclosure and family CEOs on the board, and the regression results confirm this relationship, although the result is not significant. The underlying reason for this is that family succession harms firm performance and board governance (Pérez-González, 2006; Cucculelli and Micucci, 2008). This is explained by the family CEO seeking fewer/less elaborate KAM disclosures to protect family wealth. The last hypothesis (H1f), related to board features, predicts a negative association between board political connections and KAM disclosure, and the results show no significant association between these variables. This indicates that politically connected firms are not concerned about KAM disclosure.

In the second phase, this paper develops hypotheses concerning the relationships between KAM disclosure and auditor characteristics. The first of these hypotheses predicts a positive relationship between auditor tenure and KAM disclosure (H2a), and the regression results support the association. Auditor tenure has a significant positive association with the number (at the 1 % significance level) and length (at the 5 % significance level) of KAM disclosures. The robustness of the results is also demonstrated. A long tenure allows an auditor to understand a client's internal control and risk factors. This helps the auditor improve audit quality (Arel et al., 2005), requiring more KAM disclosures. The second hypothesis assumes a positive correlation between auditor–client affiliation and KAM disclosure (H2b), and our regression results demonstrate a significant positive relationship through the robustness test. The relationship between the auditor and the client is measured in terms of audit fees and client complexity. Large and complex clients tend to have more risky items to disclose (Hussin et al., 2022). Furthermore, a cost–benefit analysis may increase the likelihood of more KAMs disclosed (Li et al., 2019). Therefore, important clients of auditors have a positive association with the number and length of KAM disclosures.

We control for the impacts of board independence, boards' political connections, audit fees, firm size, profitability and firm age on the number of KAMs disclosed and their details. We find a significant positive coefficient for both firm size and firm age impacting KAM disclosure, measured either in terms of the number of KAMs disclosed or the number of words used. Wuttichindanon and Issarawornrawanich (2021) find a positive connection between KAM disclosure and firm size, as measured by market capitalization. Our findings are partly consistent with Suttipun (2020), who documents a positive influence of firm size on KAMs but finds no significant influence of firm age. Our results also align with the findings of Choi (1999), who finds no relationship between firm age and information disclosure.

5. Additional analysis

In this section, we expand our analyses to investigate the interaction effects of our explanatory variables on the explained variables. Key findings are enumerated as we proceed. In the main model, auditor tenure is found to be a significant determinant of KAM disclosure, but family CEO is not significant. However, studies show that CEO succession is negatively associated with firm performance (e.g., Pérez-González, 2006; Cucculelli and Micucci, 2008). CEOs in family firms are appointed without competition, and they reach the top faster than in non-family firms (Blanco et al., 2021). Family CEOs are highly attached to Socio Emotional Wealth (SEW), as they want to protect their predecessors' wealth. Consequently, they have an incentive not to disclose KAMs, to protect the family's wealth. Therefore, the interaction between family CEOs and long-tenured auditors may moderate KAM disclosure.

Table 5 presents the regression results with the interaction term of Family CEO and Auditor Tenure. The results show that a family CEO with a long-tenured auditor has a significant negative association with the number of items and the extent of KAM disclosures. In this setting, similar results are observed concerning the hypothesized variables. Thus, it can be concluded that a long-term relationship between the family CEO and the auditor reduces the number of KAMs. This result signals the impairment of an auditor's independence when working with a family CEO, particularly given the weak governance that persists in emerging countries like Bangladesh.

Additionally, political companies disclose more positive information than negative information (Cheng et al., 2017). Political firms are found to report better-quality forward-looking disclosures compared to non-connected firms (Al Lawati, 2022). In the case of voluntary disclosure, political firms make more voluntary disclosures than non-political firms (Dicko et al., 2020). However, political firms tend to hide negative environmental information (Cheng et al., 2017). Additionally, information asymmetry is exacerbated by political means (Chen et al., 2010). As family CEOs are politically connected, the relationship between KAM and FCEO may be moderated by political means.

Table 6 shows the regression results of the model with the interaction term of FCEO and PCON. Family CEOs with political connections have a significant positive association with the number and length of KAM disclosures. This result indicates that politically connected family firms have more irregularities in their reporting practices than other firms, resulting in a positive relationship with KAM disclosure. This result is consistent with the findings of Sucahyati et al. (2022), showing that politically connected family firms disclose more positive information to appeal to the media, regulators and the government. However, our finding contradicts the findings of Mehjabeen and Bukth (2022), showing that family firms with political means try to avoid disclosing risk factors such as KAMs.

Furthermore, the literature shows mixed outcomes regarding the relationship between auditors' Big-4 status and KAM disclosure. According to Wuttichindanon and Issarawornrawanich (2020), companies with Big-4 audit firms disclose a higher number of KAMs. Suttipun (2021) also documents a positive association between Big-4 auditors and KAMs in terms of both the number of issues disclosed and the number of words in each KAM. In the Malaysian context, Özcan (2021) shows that non-Big-4 firms are associated with more KAM disclosures.

According to Hussin et al. (2022), the number of KAMs in audit reports does not significantly differ between Big-4 and non-Big-4 firms. Sierra-García et al. (2019) and Velte (2020) also find no significant impact of Big-4 auditors on KAMs. As the Big-4 status of audit firms relates to the quality of their audits, Big-4 audi-

Table 5
Regression results of interaction variables (FCEO*AUDT).

Variable	Expected Sign	Coefficient (*p*-value)Model 1aNumKAM	Coefficient (*p*-value)Model 1bWordKAM	Coefficient (*p*-value)Model 2aLnNumKAM	Coefficient (*p*-value)Model 2bLnWordKAM
FCEO*AUDT		–0.330(2.36)**	–65.87(1.63)*	–0.067(2.10)**	–0.071(1.28)
CHAIRGEN	+	–0.410(2.02)**	–158.32(2.70)***	–0.085(1.82)*	–0.176(2.19)**
WBOD	+	1.240(2.35)**	451.26(2.97)***	0.267(2.22)**	0.540(2.59)***
ACSIZE	+	–0.307(1.17)	–118.05(1.56)*	–0.097(1.63)	–0.202(1.95)**
ACFE	+	–0.101(1.02)	4.44(0.16)	–0.022(0.98)	0.012(0.30)
FCEO	–	0.586(1.66)	83.09(0.81)	0.106(1.32)	0.072(0.52)
AUDT	+	0.330(3.31)**	70.13(2.44)**	0.080(3.53)***	0.104(2.63)***
CIMP	+	0.893(2.21)**	230.43(1.98)**	0.212(2.30)**	0.297(1.87)**
Constant		2.36(1.64)*	–307.46(0.74)	1.25(3.80)***	6.13(10.77)
Controls		Yes	Yes	Yes	Yes
Year/industry FE		Yes	Yes	Yes	Yes
Observations		534	534	534	534
R-squared		0.2663	0.2323	0.2298	0.1927
Prob > F		0.000	0.000	0.000	0.000

***significance at the 1% level, **significance at the 5% level, *significance at the 10% level.

Table 6
Regression results of interaction variables (FCEO*PCON).

Variable	Expected Sign	Coefficient (*p*-value)Model 1aNumKAM	Coefficient (*p*-value)Model 1bWordKAM	Coefficient (*p*-value)Model 2aLnNumKAM	Coefficient (*p*-value)Model 2bLnWordKAM
FCEO*PCON		0.605(1.51)*	277.36(2.45)**	0.185(2.05)**	0.354(2.83)***
CHAIRGEN	–	–0.421(2.04)**	–163.86(2.79)***	–0.089(1.91)**	–0.155(2.39)**
WBOD	+	1.176(2.22)**	463.15(3.07)***	0.237(1.98)**	0.497(2.99)***
ACSIZE	+	–0.214(0.80)	–61.74(0.82)	–0.064(1.05)	–0.035(0.42)
ACFE	+	–0.091(0.92)	13.73(0.49)	–0.023(1.03)	0.025(0.79)
FCEO	–	–0.244(1.38)	–119.58(2.39)**	–0.073(1.82)*	–0.183(3.31)***
AUDT	–	0.241(2.58)***	43.77(1.66)*	0.061(2.91)***	0.057(1.94)**
CIMP	+	0.830(2.06)**	212.41(1.86)**	0.198(2.17)**	0.240(1.90)**
Constant		2.66(1.48)*	–231.84(0.56)	1.25(3.84)***	5.71(12.52)***
Controls		Yes	Yes	Yes	Yes
Year/industry FE		Yes	Yes	Yes	Yes
Observations		534	534	534	534
R-squared		0.2583	0.2989	0.2230	0.2399
Prob > F		0.000	0.000	0.000	0.000

***significance at the 1% level, ** significance at the 5% level, *significance at the 10% level.

tors strive for quality and good governance (Carlin et al., 2009; Eshleman and Guo, 2014). From a governance standpoint, we can expect that a Big-4 auditor moderates the relationship between the auditor–client relationship and KAM disclosure. We add the interaction term CIMP*BIG4 to the model to test our anticipation. As shown in Table 7, we find significant results for the number of words used in KAM descriptions. This finding implies that the importance of clients differs between Big-4 and non-Big-4 auditors. Non-Big-4 auditors perhaps expend more focus and effort on their important clients than their Big-4 counterparts. Indeed, studies show that Big-4 auditors are less concerned about losing clients than non-Big-4 auditors. Our finding lessens the concern expressed by Blokdijk et al. (2006) that there is little to no evidence regarding the underlying production differences between Big-4 and non-Big-4 audits.

Table 7
Regression results of interaction variables (CIMP*BIG4).

Variable	Expected Sign	Coefficient (*p*-value)Model 1aNumKAM	Coefficient (*p*-value)Model 1bWordKAM	Coefficient (*p*-value)Model 2aLnNumKAM	Coefficient (*p*-value)Model 2bLnWordKAM
CIMP*BIG4	+/–	–0.175(0.11)	–871.05(1.99)**	–0.210(0.48)	–1.019(2.09)**
CHAIRGEN	+	–0.306(1.50)*	–148.59(2.52)**	–0.074(1.27)	–0.133(2.03)**
WBOD	+	1.397(2.64)***	527.51(3.47)***	0.437(2.89)***	0.567(3.35)***
ACSIZE	+	–0.372(1.40)	–115.43(1.51)	–0.117(1.54)	–0.094(1.11)
ACFE	+	–0.037(0.38)	21.83(0.78)	0.001(0.05)	0.035(1.11)
FCEO	–	–0.234(1.42)	–84.20(1.78)*	–0.112(2.37)**	–0.143(2.72)***
AUDT	–	0.235(2.54)**	47.50(1.78)*	0.074(2.78)***	0.060(2.02)**
CIMP	+	0.785(1.98)**	242.50(2.12)**	0.242(2.12)**	0.273(2.15)**
BIG4		0.019(0.08)	241.33(3.42)***	0.041(0.58)	0.277(3.54)***
Constant		2.947(1.43)***	–113.62(0.28)	1.044(2.55)**	5.775(12.59)***
Controls		Yes	Yes	Yes	Yes
Year/industry FE		Yes	Yes	Yes	Yes
Observations		534	534	534	534
R-squared		0.2757	0.2989	0.2393	0.2399
Prob > F		0.000	0.000	0.000	0.000

*** significance at the 1% level, **significance at the 5% level, *significance at the 10% level.

5.1. Endogeneity concerns

To ensure the generalization of our main results, endogeneity concerns should be taken into account. The results may suffer from endogeneity concerns because firms have the choice to select chairs, form boards and subcommittees with gender diversity and engage certain auditors, and auditors may continue to audit firms for some time. Similarly, auditors may make their own choices in deciding what to disclose in their reports. To mitigate potential endogeneity issues, we use techniques widely used in the contemporary literature, namely EB and PSM.

A commonly used matching approach, EB involves creating a control group of companies as similar as possible to the treatment group, by reweighting covariates (Hainmueller, 2012). It eliminates systematic and random discrepancies in variable distributions between the treatment and control groups. EB addresses endogeneity concerns with respect to observable characteristics (Dunn et al., 2021) and omitted variable bias (Hendricks et al., 2022). In contrast, PSM corrects for the endogeneity inherent in client and auditor selection (Höglund and Sundvik, 2019). PSM also controls for potential omitted variables that may arise due to sample selection bias (Xu et al., 2022). While EB retains the full sample, with PSM, unmatched observations are discarded (Bauckloh et al., 2021). PSM reduces the imbalance between the treatment and control groups. The greater the dissimilarity between the treatment and control companies, the greater the potential for biased estimation due to misspecification (Shipman et al., 2016).

Table 8 presents our regression results for CHAIRGEN using EB. The displayed results are fully consistent with our main results. We use EB so that the first and second moments of all of the covariates are the same between female and male chairs. For brevity, we do not report the descriptive statistics before and after EB reweighting.

To implement PSM, we use 1:1 nearest-neighbor matching. Table 9 reports our regression results for CHAIRGEN using PSM. The coefficients for CHAIRGEN are significant and negative for all of our dependent variables, suggesting that female chairs provide fewer KAMs with shorter descriptions than male chairs. The regression results fully support our main results. However, when using the EB and PSM approaches, we need separate tables for each of our independent variables to report the results. Therefore, for the sake of brevity, we do not report them. Our untabulated results support our baseline results. In summary, our main results hold after controlling for potential endogeneity issues.

Table 8
Regression results for CHAIRGEN using EB.

Variable	Expected Sign	Coefficient (*p*-value)Model 1aNumKAM	Coefficient (*p*-value)Model 1bWordKAM	Coefficient (*p*-value)Model 2aLnNumKAM	Coefficient (*p*-value)Model 2bLnWordKAM
CHAIRGEN	+	–0.393(3.402)***	–144.159(4.451)***	–0.084(2.476)**	–0.128(3.215)***
WBOD	+	1.984 (4.833)***	502.400(4.364)***	0.564(4.671)***	0.662 (4.669)***
ACSIZE	+	0.061(0.216)	–195.336(2.463) **	–0.017(0.202)	–0.177(1.816)*
ACFE	+	0.022(0.224)	40.783(1.472)	0.015(0.503)	0.069(2.009)**
FCEO	–	0.064(0.426)	–27.185(0.651)	–0.043(0.972)	–0.071(1.384)
AUDT	+	0.271 (2.781) ***	101.339(3.707)***	0.079 (2.746)***	0.121(3.589)***
CIMP	+	0.851 (2.677) ***	305.911(3.430) ***	0.285 (3.047)***	0.359(3.267)***
PCON	–	0.065(0.355)	24.836(0.486)	0.096 (1.791)*	0.069(1.089)
Constant		0.780(0.417)	–602.363(1.147)	0.358(0.650)	5.499(8.499)***
Observations		534	534	534	534
R-squared		0.354	0.370	0.313	0.347
Year FE		YES	YES	YES	YES
Industry FE		YES	YES	YES	YES
Controls		YES	YES	YES	YES
Prob > F		0.000	0.000	0.000	0.000

Table 9
Regression results for CHAIRGEN using PSM.

Variable	Expt. Sign	Coefficient (*p*-value)Model 1aNumKAM	Coefficient (*p*-value)Model 1bWordKAM	Coefficient (*p*-value)Model 2aLnNumKAM	Coefficient (*p*-value)Model 2bLnWordKAM
CHAIRGEN	+	–0.419(3.228)***	–153.740(4.457)***	–0.128(3.605)***	–0.173(4.335)***
Constant		2.085(1.899)*	855.351(2.933)***	1.005(3.351)***	7.085(20.93)***
Observations		515	515	515	515
R-squared		0.787	0.740	0.772	0.752
Year FE		YES	YES	YES	YES
Industry FE		YES	YES	YES	YES
Controls		YES	YES	YES	YES
Prob > F		0.000	0.000	0.000	0.000

6. Conclusion

This study provides first-hand empirical evidence on whether board and auditor characteristics determine KAM disclosure in the emerging economy of Bangladesh. This paper is based on independent auditors' reports of listed firms in Bangladesh. We propose that board characteristics, such as chair gender, family CEO, political connections, gender diversity, AC size, and AC expertise, and audit features, such as auditor tenure, auditor expertise and clients' importance to auditors, influence KAM disclosure. Our regression results show that board gender diversity, auditor tenure and client–auditor relationships have a significant positive association with the number of disclosed KAMs and the number words used to describe them; whereas chair gender and audit committee size have significant negative correlations with KAM disclosure.

The robustness tests also support our main results. Additionally, our robustness checks after modifying the dependent and independent variables confirm our main results. Furthermore, the interaction term of family CEO and auditor tenure has a significant negative association with the number and detail of disclosed KAMs, and family CEOs with political connections have a significant negative association with the same elements of KAM disclosure. Our additional analysis shows that there is no association between KAM disclosure and audit delay.

Overall, this study fills the relevant gap in the literature by unraveling the association between board and audit features and KAM disclosure in a globally important emerging market. Prior studies largely focus on developed markets and primarily investigate voluntary risk information disclosure, yet the results are inconclusive. No studies investigate board characteristics in association with KAM disclosure. This study contributes to the literature by documenting an interplay between corporate governance features, namely board size, gender diversity, chair gender, family CEO, board political affiliation, AC size, expertise in finance and accounting, large and complex clients, auditor tenure, Big-4 auditor status and KAM disclosure in Bangladesh. The study also expands the risk disclosure lens to include the emerging economy perspective. The study further provides empirical evidence from a market where the visibility of women in corporate leadership positions is low. The findings of the study have important policy implications for regulators, auditors and company management in terms of KAM disclosure policy. Policymakers can use the results to decide on the appropriate number and length of KAM disclosures, to mitigate audit risk and ensure the quality of audit services.

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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Stock market liberalization and financial reporting quality

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ABSTRACT

This study employs the Mainland-Hong Kong Stock Connect pilot program in China to investigate the influence of stock market liberalization on firm-level financial reporting quality (FRQ). First, through a staggered difference-in-difference specification strategy, we find that eligible firms experience a significant improvement in FRQ, as measured by a composite proxy of accrual earnings management, real activities manipulation, and financial report restatement. Second, cross-sectional analyses suggest that the effect is stronger when firms are headquartered in regions with weaker institutional environments, characterized by lower judicial efficiency and less developed financial markets. We also show that the impact is more pronounced when firms face less external pressure and possess more effective corporate governance before stock market liberalization. Third, further evidence highlights that augmented FRQ is associated with a reduction in regulatory compliance costs, an improvement in stock price efficiency, and a mitigation of financing constraints. Collectively, we shed new light on the role of stock market liberalization in shaping firms' financial reporting behavior.

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1. Introduction

High-quality, accountable financial reporting has always been a central concern for regulators, standard setters, and policymakers in both developed (e.g., White, 2015) and emerging economies[1]. Capital markets hold high expectations for public firms' financial reporting, as this is essential for maintaining the market's stability and efficiency. The quality of financial reporting also matters for firms' business activities (Roychowdhury et al., 2019) and economic growth (Li and Shroff, 2010). Although both developed and developing economies have implemented many measures to improve financial reporting quality (hereafter, FRQ), Isidro et al. (2020) indicate that FRQ is an endogenous outcome of country attributes and institutional development and can hardly be established by a standalone policy. Emerging economies have weaker institutions and thus will find it more difficult to improve FRQ.

Unlike other standalone policies or regulations, stock market liberalization is one form of comprehensive institutional reform that, if effectively implemented, can lead to improvement in both the financial and real sectors by integrating a country's economy with global capital markets (Bekaert et al., 2003). Since the 1980s, developing countries have attempted to liberalize their capital markets to improve their economic development and upgrade their economic structure with the help of developed financial markets (Bekaert et al., 2005). Previous studies show that stock market liberalization can enhance market efficiency (Balakrishnan et al., 2019), improve firms' operating performance (Mitton, 2006), and stimulate economic growth (Bekaert, 1995). However, far less research attention has been paid to firms' FRQ after this institutional reform even though FRQ has been shown to significantly influence the cost of capital (Dechow et al., 2010), firms' investment (Roychowdhury et al., 2019), market efficiency (Hung et al., 2015), and even real GDP growth (Li and Shroff, 2010). Consequently, whether and how stock market liberalization influences FRQ remains an empirical question of great research value and practical significance.

In this study, we utilize China's Mainland–Hong Kong Stock Connect pilot program (*Lu Gang Tong*; hereafter, the Liberalization or the Stock Connect) to answer this question. Despite its global economic impact, China is characterized by a weak institutional environment and remains relatively isolated from the global capital market (Allen et al., 2005), which has hampered its long-term policy efforts to increase FRQ. Anecdotally, investors' confidence in disclosure quality[2] (see Fig. 1) is much lower in China than in developed markets, and even ranks below the global average. To bolster the domestic stock market, China has lifted restrictions on cross-border security trading, facilitating foreign investment in the domestic equity market through the Stock Connect, a policy that affects more than 2,000 public firms.

The Stock Connect mainly involves two mechanisms[3]: the Shanghai–Hong Kong Stock Connect (hereafter, *SHHK*), governed by the Shanghai Stock Exchange (SSE), or the Shenzhen–Hong Kong Stock Connect (hereafter, *SZHK*), governed by the Shenzhen Stock Exchange (SZSE). One primary goal of this policy is to improve corporate governance and, in turn, the development of the capital market as a whole,[4] which also echoes the mission of the 14th Five-Year Plan. Bushman et al. (2004) point out that high FRQ is one key sign of a developed market; however, a series of accounting scandals have plagued China's efforts. For example, Kangmei Pharmaceutical Co., Ltd., a company specializing in Chinese medicine, was once a star company in *SHHK*. In 2020, the China Securities Regulatory Commission (CSRC) found that Kangmei engaged in intentional and systematic fraudulent financial reporting to the tune of 30 billion RMB yuan ($4.60 billion) between 2016 and 2018. Another example is Kangde Xin Composite Material Group Co. Ltd., a former eligible firm in *SZHK* that fabricated bank deposits of 12.2 billion RMB yuan ($1.80 billion), a calculated finan-

[1] See the 2020 government annual report of China Securities Regulatory Commission (CSRC): http://www.csrc.gov.cn/csrc/c100028/c8390c4e9d1bb4202b66e431fbb1d07cb/content.shtml.

[2] We thank Henry Friedman for making the data used in Friedman (2019) available on his personal website: https://sites.google.com/view/hfriedmanprof/.

[3] Another stock market mutual access program, the Shanghai–London Stock Connect (*SLSC*), was jointly launched by the Shanghai Stock Exchange and London Stock Exchange in 2019 and later broadened to include Shenzhen-listed companies and capital markets in Germany and Switzerland. However, this mechanism is far less active in trading volume than *SHHK* and *SZHK*; hence, we do not consider the impact of *SLSC*.

[4] See this article on People.com that discusses the purpose of stock market liberalization: http://theory.people.com.cn/n/2014/1121/c49154-26066801.html.

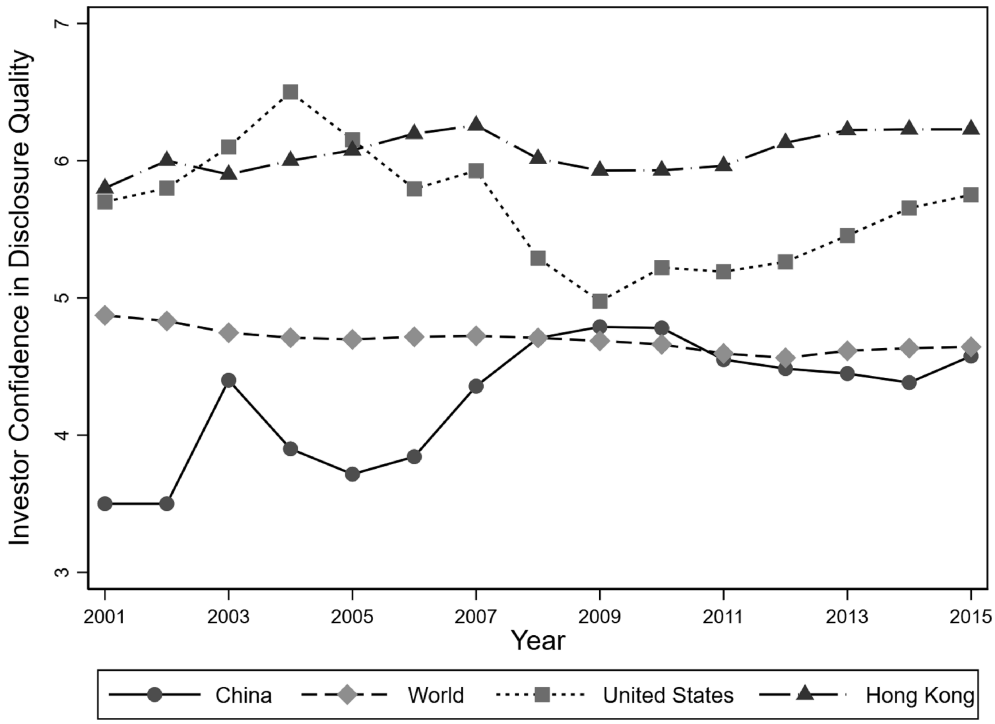

Fig. 1. Investor Confidence in Disclosure Quality: A Global Comparison. *Notes*: This figure compares investors' confidence in public firms' disclosure quality in China and other countries or regions. We thank Henry L. Friedman for making the data available on his official website. Friedman uses a survey-based measure that directly captures beliefs about disclosure quality in a panel with over 1,000 country-year observations (Friedman, 2019). The dashed line that represents the world in the figure is based on the mean value of countries or regions excluding mainland China, Hong Kong SAR, and the United States.

cial fraud that took place over four years. Those scandals cast doubt on whether China's policy of stock market liberalization really achieved its intended purposes, especially in terms of reliable financial reporting. As stated in Lennox and Wu (2022), China's process of market liberalization still has a long way to go.

We take the Liberalization as a quasi-natural experiment to empirically examine whether and how allowing foreign investors to trade eligible A-share stocks will influence firm-level FRQ. The Stock Connect adjusts eligible firms every six months, and we present such changes in Fig. 2. Unlike prior research on China's liberalization policy (e.g., Yoon, 2021), most of which takes the launch of *SHHK* as a single exogenous shock, we utilize the dynamic adjustment of eligible firms to construct a staggered difference-in-differences (DID) empirical model with firm and year fixed effects to study the influence of availability to foreign capital on firm-level FRQ. Following extant studies (e.g., Dou et al., 2018; He, 2015; Hope et al., 2020), we operationalize FRQ with a composite proxy based on accrual earnings management, real activities manipulation, and financial report restatement. We find that the Liberalization significantly improves eligible firms' FRQ by about 6.21 to 8.84% of the standard deviation. Moreover, our analysis of the dynamic effects supports the parallel trend assumption, lending strong support for our causal inferences.

Next, we explore the influence of regional institutional background. The reliability and accountability of financial reporting relies on economic, legal, and political infrastructure (Ball, 2001; Bushman et al., 2004), and Bekaert (1995) suggests that investment in emerging equity markets faces barriers from weak legal institutions and financial development. Thus, we conjecture that firms headquartered in regions with weaker institutional background would benefit more from the Liberalization. We trisect our eligible firms based on the judicial efficiency and financial marketization of their headquarters' regions (Hope et al., 2020). The results suggest that the improvement in FRQ is much more evident in firms headquartered in regions with a less efficient judicial system and less developed financial market.

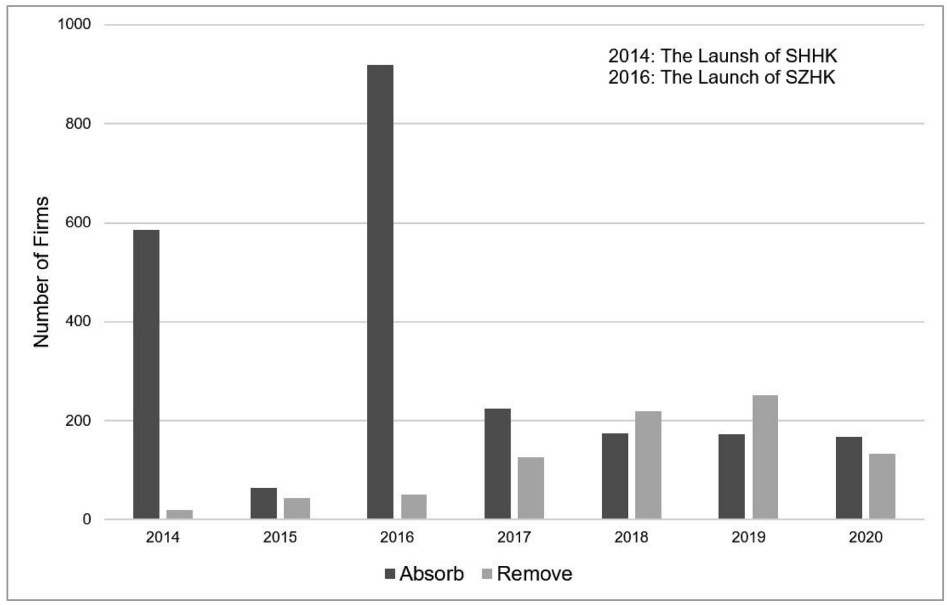

Fig. 2. Dynamic Adjustment of Mainland–Hong Kong Stock Connect. *Notes*: This figure shows how the regulatory department periodically adjusts investible firms in the Mainland–Hong Kong Stock Connect Mechanism from 2014 to 2020. Stock exchanges maintain a dynamic balance for the mechanism by adding qualified firms and removing unqualified firms every six months. We only consider the first time of absorption in or removal from this mechanism and combine those adjustments to construct annual data for this figure. 2014 and 2016 witnessed two peaks in the number of newly absorbed firms because of the launch of *SHHK* and *SZHK*, respectively. The number of firms removed has been increasing despite a noticable decrease in 2020.

We then turn our attention to how external pressure and internal governance moderate the effects of stock market liberalization on FRQ. We find that the Liberalization will improve eligible firms' media exposure, thereby increasing their visibility in the market and external pressure. Consistent with the notion that firms that receive less attention from the market increase their FRQ more in response to greater external pressure, we verify that the improvement in FRQ is more pronounced when firms are covered by fewer analyst reports, have a lower internet search index, and receive less attention from the online financial community before becoming eligible for foreign investment. As to internal governance, prior studies also suggest that foreign investors prefer firms with more effective corporate governance scheme (Bae and Goyal, 2010) *ex ante*. Our partition analyses based on corporate governance reveal that firms with better internal governance before the Liberalization (i.e., less separation of ownership and control, more executive shareholding, no CEO duality, and a less concentrated ownership structure) respond to the arrival of foreign investors with higher FRQ, which is consistent with the findings in Kim et al. (2020).

Additionally, We also study the FRQ-related economic consequences of the Liberalization and find that higher FRQ is associated with lower regulatory compliance costs, higher stock price efficiency, and eased financial constraints. Our findings echo prior research on the real effects of the Stock Connect and suggest an important channel for revealed outcomes (e.g, Chen et al., 2022; Pang et al., 2020; Yoon, 2021), given that high-quality financial reporting is essential for the capital market.

Considering Stock Connect's explicit selection criteria for eligible firms based on industry representation, turnover, and market capitalization (Yoon, 2021), we use Entropy Balanced Matching (EBM) and Propensity Score Matching (PSM) to alleviate selection bias. Even when we address potential endogeneity concerns, the positive impact of stock market liberalization on FRQ remains statistically and economically significant. We also conduct a series of robustness tests to check our main findings. First, we delete the firms removed from the Liberalization to construct a sample and find that the positive impact still holds. Second, we separate our sample based on the trading stock exchange to study the effects of *SHHK* and *SZHK*. The results suggest that

the impact of Liberalization on FRQ is significant in both mechanisms. Lastly, we create "pseudo-event" years to conduct placebo test; however, we do not find significant differences between eligible and ineligible firms.

One concurrent study, Ruan et al. (2021), is closely related to our research. They apply textual analysis and find that *SHHK* improves the disclosure quality of public firms' annual reports. Ruan et al. (2021) focus on qualitative aspects of annual reports. In contrast, we emphasize quality metrics in quantitative financial reporting.[5] Hence, our work differs from Ruan et al. (2021) because of two major differences between financial reporting and corporate disclosures: first, financial reporting receives more stringent external monitoring than disclosures (e.g., from regulators and auditors); second, it is subject to less managerial discretion (Tucker, 2015). Although Ruan et al. (2021) and our study examine different aspects of firms' annual reports, our findings complement each other and together enhance our understanding of how stock market liberalization can improve public firms' information quality and contribute to market-wide prosperity.

Our work makes the following contributions to the literature. First, our findings complement the rich literature on FRQ and relate to the real effects of China's stock market liberalization policy. This large-scale financial reform has attracted considerable attention from academics. Prior studies suggest that this policy has altered public firms' disclosure behavior (Yoon, 2021), enhanced audit quality (Deng et al., 2021), and improved stock price efficiency (Chen et al., 2022). The Chinese literature on the Stock Connect finds that this policy increases stock price informativeness (Zhong and Lu, 2018), restrains controlling shareholders' share pledging (Lu et al., 2022), and lowers the cost of equity (Pang et al., 2020). Our results show the dynamic shaping of FRQ during stock market liberalization and highlight the role of institutional background, external pressure, and internal governance in this process. More importantly, we establish a causal relationship between market liberalization and FRQ. Countries endogenously choose the scale, timing, and method of market liberalization. Studies based on international settings (e.g., Beuselinck et al., 2017) suffer from the confounding factors of other determinants of FRQ at the country level. In contrast, we exploit an economically significant financial reform in China and avoid needing to consider differences in institutional attributes, thereby providing a more focused analysis and adding to the broader evidence concerning international financial reporting practices.

Second, stock market liberalization is a critical issue for transitional economies in the context of globalization. Prior studies of the effects of market liberalization typically focus on economic activities and market efficiency (e.g., Henry, 2000a; Henry, 2000b). However, whether greater openness of the capital market will contribute to its high-quality development is still a matter of dispute. The Liberalization in China provides a unique research laboratory in which to examine the influence of market liberalization on FRQ, which captures economic consequences undocumented in the existing literature. Since FRQ contributes to corporate investment efficiency (Roychowdhury et al., 2019), capital market development (e.g., Hung et al., 2015), and even economic growth (Li and Shroff, 2010), our evidence of increased FRQ in China after the Stock Connect indicates a new channel through which market liberalization can benefit the national economy. This paper also has policy implications for financial reform in as-yet-immature economies.

The remaining parts of this study proceed as follows. The next section reviews the institutional background and develops our hypothesis. Section 3 discusses the sample construction, empirical measure of FRQ, and research design. Section 4 reports our baseline empirical results. Section 5 and 6 show our cross-sectional analyses and additional analyses, respectively. Finally, Section 7 concludes the research.

2. Institutional background and empirical predictions

2.1. Stock market liberalization in China Mainland

China has gone through several rounds of market liberalization in recent history. Before the Stock Connect in 2014, foreign access to Chinese A-share stocks was subject to tight control. Only qualified, government-approved foreign institutional investors were allowed to invest in stocks listed on the China mainland capital

[5] Specifically, Ruan et al. (2021) exclude numbers and English words to construct disclosure quality proxies, while we focus on quality metrics of financial reporting, such as earnings management and financial restatements.

market (A-shares) through two mechanisms: the Qualified Foreign Institutional Investor (QFII) program in 2002 and the RMB Qualified Foreign Institutional Investor (RQFII) program in 2006.

Drawing on the experience of QFII and RQFII, the implementation of *SHHK* in November 2014 provided mutual market access between the SSE and HKEX (Hong Kong Stock Exchange) by giving investors outside mainland China access to the Shanghai stock market (i.e., northbound trading) and allowing qualified mainland investors to tap the Hong Kong stock market (i.e., southbound trading). *SZHK*, a follow-up market liberalization program to *SHHK*, was launched in December 2016 and expanded mutual market access even further. Altogether, the Stock Connect confirmed Hong Kong's evolving role in China's opening up, accelerated the liberalization of the Chinese market, and quickened the pace of integration between the mainland and global markets.

In addition to market capitalization, industry representation, and turnover (Yoon, 2021), SSE and SZSE have slightly different standards for stocks that are eligible for the Stock Connect. Eligible stocks in SSE include all the constituent stocks of the SSE 180 Index and SSE 380 Index and all the SSE-listed A-shares that are not included as constituent stocks of the relevant indices but have corresponding H-shares listed on HKEX. Regarding Shenzhen's northbound trading, eligible shares refer to any constituent stock of the SZSE Component Index and SZSE Small/Mid-Cap Innovation Index, which has a market capitalization of 6 billion (in RMB) or above, and all SZSE-listed shares of companies that have issued both A- and H-shares. Moreover, the Stock Connect adjusts the list of eligible firms twice a year according to firms' eligibility, as shown in Fig. 2 on an annual basis. In 2021, there were 593 and 898 eligible stocks from SSE and SZSE, respectively.

2.2. Empirical predictions

Although Chinese authorities have set high expectations for the Stock Connect pilot program as a crucial step in building a more mature capital market, whether and how the Liberalization will influence firm-level FRQ remains unclear and a matter of some controversy.

On the one hand, the Liberalization could improve eligible firms' FRQ, as expected by China authorities. First, this policy introduces more foreign investors, who are more active and sophisticated monitors, into the nascent domestic stock market and, in turn, enhances domestic firms' corporate governance (e.g., Aggarwal et al., 2011; Ferreira and Matos, 2008). As shown in Fig. 3, the Stock Connect has witnessed a dramatic increase in the number of international investors entering the top 10 shareholders of eligible firms. Such an improvement in corporate governance because of foreign shareholding plays a disciplining role in financial reporting (Beuselinck et al., 2017). Second, the Stock Connect has energized the mainland stock market. Henry (2000a, b) show that foreign investors, especially those from developed capital markets, demand more high-quality accounting information. Gul et al. (2010) find that more trading activities increases the demand for information. In response, eligible firms should improve the quality of their financial reporting. Third, Chinese authorities also attach considerable importance to the regulation of the Stock Connect. When launching *SHHK* and *SZHK*, both the Shanghai and Shenzhen exchanges issued guidelines for enhanced disclosure quality[6], revealing China's commitment to providing a high-quality and reliable information environment for the Liberalization.

On the other hand, Isidro et al. (2020) argue that it is essential to consider institutional attributes when analyzing financial reporting. China remains characterized by a weak institutional environment (Allen et al., 2005), which may limit the effectiveness of its market liberalization policy. First, the Stock Connect has a foreign liquidity quota and restricts foreign investors' shareholding. For example, as of 2021, total net capital inflows have surpassed $219 billion since the implementation of the Liberalization, 1.7% of the total market capitalization of Shanghai and Shenzhen exchanges. Although foreign investors are among the top 10 share-

[6] See the announcements by the SSE (http://www.sse.com.cn/lawandrules/sserules/trading/hkexsc/c/c_20150912_3985932.shtml) and SZSE (http://www.szse.cn/aboutus/trends/news/t20161010_518793.html) for more details. It should be noted that regulators do not enforce extra requirements on eligible firms involved in the Stock Connect. Instead, they publicly state their preference and expectation for high-quality information from these firms.

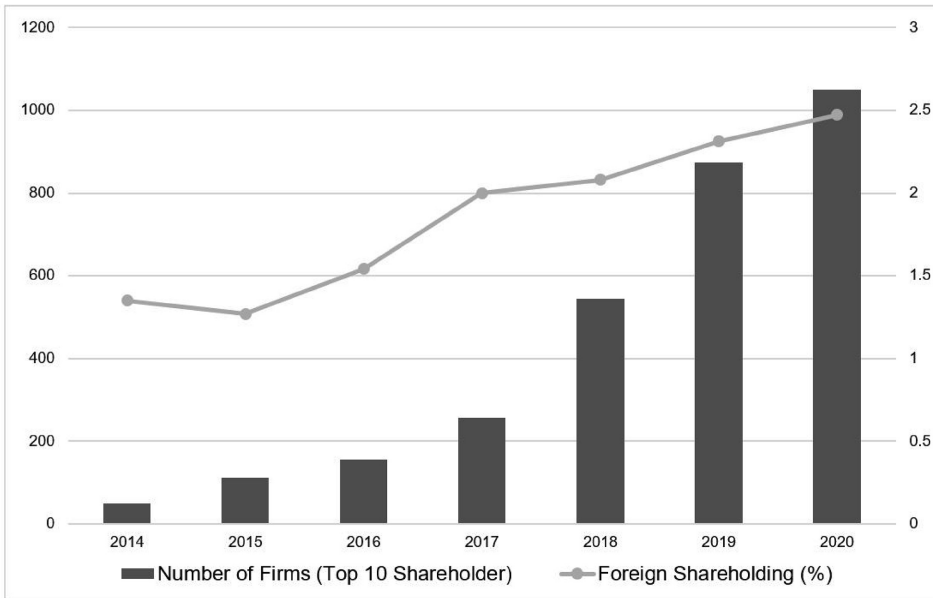

Fig. 3. The Number of Eligible Firms and Average Ownership Held by the Hong Kong Securities Clearing Company Limited (HKSCC) (Top 10 Shareholder). *Notes*: This figure shows the number of firms that have Hong Kong Securities Clearing Company Limited (HKSCC) among their top 10 shareholders and HKSCC's average ownership in eligible firms from 2014 to 2020. Due to the Liberalization, the top 10 shareholders of eligible firms include an increasing number of foreign investors. Foreign investors' ownership also increases steadily from 0.35% in 2014 to 2.5% in 2020.

holders, their ownership is rather small[7] (see Fig. 3) and and far smaller than that documented in Beuselinck et al. (2017); this might negate their hypothetical disciplining role. Second, Yoon (2021) finds that eligible firms in the Stock Connect use private disclosure to communicate with foreign brokers and endow them with an information advantage. Therefore, firms do not necessarily respond to greater information demand with increased FRQ when this involves a cost. Third, Grinblatt and Keloharju (2001) find that distance, language, and culture could explain why investors shun foreign stocks. In a similar vein, Kim et al. (2020) argue that institutional distance exacerbates the difficulty faced by foreign investors in monitoring local firms, thus diminishing their disciplinary role. Consequently, the Liberalization might be ineffective in improving firms' FRQ.

Since the impact of the Liberalization on firm-level FRQ is difficult to ascertain *ex ante*, we refrain from making a directional prediction. We propose and empirically test the following main hypothesis, stated in the null form.

Hypothesis 1 (*H*1). The Mainland–Hong Kong Stock Connect program does not influence firm-level FRQ.

3. Sample construction and research design

3.1. Sample construction

Unless otherwise stated, we obtain our data from the China Security Market and Accounting Research (CSMAR) database. Our initial sample consists of all A-share companies listed on the SSE and SZSE from 2009 to 2018. We perform data cleaning on our sample as follows. First, we exclude companies operating in the finance industry, as they are subject to different regulations. Second, all ST (Special Treatment) and PT (Particular Transfer) firms are eliminated. Next, we drop any firm-year observations that have missing

[7] As Fig. 3 indicates, the average foreign shareholding was around 2.5% as of 2020, quite similar to the 3% documented in Carpenter et al. (2021).

individual FRQ variables (i.e., *REM*, *MJDA*, and *RES*). Fourth, we exclude firm-year observations that are missing the necessary data for the variables used in our empirical analysis. Finally, we require all eligible firms to have at least one observation before and after the year when they become investible to foreign investors through the Stock Connect. The above procedures yield a final sample of 16,471 firm-year observations from 2,072 firms. Our sample construction and distribution are almost identical to those in prior studies (e.g., Lu et al., 2022). We present the detailed steps of our sample construction in Panel A of Table 1.

3.2. FRQ measures

There are various types of FRQ measures in the literature, and even within each type, there is considerable variation in the variable measurement and estimation. Inspired by Dou et al. (2018) and Hope et al. (2020), we do not attempt to examine each variation; instead, we create a comprehensive measure based on proxies frequently used in the FRQ literature. First, we use *MJDA*, the absolute value of discretionary accruals from the modified Jones model (Dechow et al., 1995), to measure FRQ. Second, following prior studies (e.g., Choi et al., 2018; Roychowdhury, 2006), we capture firms' FRQ with real activities manipulation related to abnormal discretionary expenses, production costs, and operating cash flows (*REM*). The third proxy pertains to financial report restatements, as numerous studies (e.g, Desai et al., 2006; He, 2015) identify restatement as a potent indicator of low financial reporting quality. We use the frequencies of financial report restatements (*RES*) in each fiscal year. For *MJDA* and *REM*, each variable is ranked from 0 to 9 each year and scaled by 9 to range from 0 to 1. For financial report restatement, we scale *RES* by the maximum frequency each year (the maximum number in our sample is 4) to obtain a range from 0 to 1. The weighted average measure for FRQ is multiplied by minus one so that higher values represent higher quality. Suppose Company A ranked 3rd and 6th in terms of *MJDA* and *REM*, respectively, in 2018 and restated its financial reports twice; its *FRQ* should be calculated as $(3/9 + 6/9 + 2/4) \times (-1) \times (1/3)$ and equal -0.5. Please see Appendix A for detailed variable definitions. We also provide the detailed construction procedures of *MJDA* and *REM* in Appendix B and C, respectively.

3.3. Research design: staggered DID model

The Stock Connect is a dynamic process, and eligible companies are adjusted periodically, which provides us with an ideal quasi-natural experiment for the staggered DID method. We use the following model to evaluate how the Liberalization influences FRQ:

$$FRQ_{i,t} = \alpha + \beta \times LIB_{i,t} + \sum \gamma_j \times Control_{j,i,t} + Firm\,FE + Year\,FE + \varepsilon_{i,t} \quad (1)$$

The variable of interest, ***LIB***, is a dummy variable that equals one if the firm *i* is listed in the Stock Connect in year *t* and zero otherwise. This panel regression includes both firm and year fixed effects to construct a staggered DID setting. The firm fixed effects take away the average value of the dependent variable of the firms, and the year fixed effects control the time trend of the dependent variable, eliminating the impact of common shocks to all firms. We also use another two forms of year fixed effects (i.e., Year × Industry FE and Year × Province[8] FE) for robustness. Moreover, we cluster standard errors at the firm level to alleviate auto-correlation within the same firm across years (Petersen, 2009).

To eliminate the confounding effect of underlying business processes and other fundamental drivers of FRQ, we also include several control variables based on the literature (e.g., Dechow and Dichev, 2002; Dechow et al., 2010; Dou et al., 2018; He, 2015; Hope et al., 2020): firm size (*SIZE*), leverage ratio (*LEV*), annual sales growth rate (*REVGROWTH*), fixed assets intensity (*PPE*), and firm age (*AGE*). We also control for a series of corporate governance variables that previous research suggests can affect financial reporting. Specifically, we include the shareholding of the largest shareholder (*TOPHOLD*), board size (*BOARDSIZE*), an indicator of CEO–chairman duality (*DUAL*), and total compensation of the top three executives (*COMP*).

[8] Province is the provincial area where firms' headquarters are located. The sample firms come from 31 mainland provinces and municipalities in total.

Table 1
Sample Construction and distribution.

Panel A: Sample Construction

	Number of Observations	
	Firm-Year	Firm
Observations during the sample period (i.e., 2009 to 2018)	26,839	3,627
Less: Observations in the finance industry	(529)	(73)
Less: ST & PT Observations	(3,855)	(397)
Less: Observations with missing values in individual FRQ measures	(4,457)	(498)
Less: Observations with missing values in control variables	(522)	(4)
Less: Firms without enough years of observations	(1,005)	(583)
Final Sample	16,471	2,072

Panel B: Sample Distribution by Fiscal Year

	Sample			CSMAR		
	Freq.	**Percent**	**Cum.**	**Freq.**	**Percent**	**Cum.**
2009	1065	6.47	6.47	1751	6.52	6.52
2010	1099	6.67	13.14	2106	7.85	14.37
2011	1232	7.48	20.62	2341	8.72	23.09
2012	1602	9.73	30.35	2470	9.20	32.29
2013	1798	10.92	41.27	2515	9.37	41.66
2014	1880	11.41	52.68	2631	9.80	51.46
2015	1891	11.48	64.16	2823	10.52	61.98
2016	1976	12.00	76.16	3118	11.62	73.60
2017	1931	11.72	87.88	3494	13.02	86.62
2018	1997	12.12	100.00	3590	13.38	100.00
Total	**16471**	**100.00**		**26839**	**100.00**	

Panel C: Sample Distribution by CSRC Industry Classification

	Sample			CSMAR		
	Freq.	**Percent**	**Cum.**	**Freq.**	**Percent**	**Cum.**
Accommodation and food	32	0.19	0.19	109	0.41	0.41
Conglomerate	226	1.37	1.57	335	1.25	1.65
Construction	468	2.84	4.41	681	2.54	4.19
Cultural, physical and entertainment	145	0.88	5.29	314	1.17	5.36
Education	0	0.00	5.29	13	0.05	5.41
Farming, forestry, animal husbandry and fishery	249	1.51	6.80	411	1.53	6.94
Finance	0	0.00	6.80	529	1.97	8.91
Information transfer, computer service and software	958	5.82	12.62	1587	5.91	14.83
Leasehold and business service	173	1.05	13.67	307	1.14	15.97
Manufacturing	10408	63.19	76.86	16961	63.20	79.17
Mining	393	2.39	79.24	650	2.42	81.59
Neighborhood services and other service	0	0.00	79.24	31	0.12	81.71
Production and supply of electric power, gas and water	618	3.75	82.99	857	3.19	84.90
Realty	843	5.12	88.11	47	0.18	85.07
Public health and social work	0	0.00	88.11	1267	4.72	89.79
Scientific research, technical service and geologic examination	66	0.40	88.51	212	0.79	90.58
Traffic, storage and mail business	638	3.87	92.39	835	3.11	93.70
Water conservancy, environment and public institution management	144	0.87	93.26	262	0.98	94.67
Wholesale and retail trades	1110	6.74	100.00	1430	5.33	100.00
Total	**16471**	**100.00**		**26839**	**100.00**	

Notes: This table reports the construction procedures and distribution pattern of our sample. Panel A describes the sample selection process. Panel B presents the sample distribution by fiscal year. Panel C shows the distribution across CSRC industries. We also compare our sample with the CSMAR database to show the representativeness.

External governance mechanisms also influence how firms deliver financial reporting, and we include indicators for Big four accounting firms as auditors (*BIG4*), analyst coverage (*ANALYST*), and institutional shareholding (*INSTHOLD*) in our model. Previous research shows that firms' performance also affects FRQ; hence,

we include return on assets (*ROA*), annual stock returns (*RETURN*), and market-to-book ratio (*MTB*). Accounting for the Chinese context, we also control whether the firm is a state-owned enterprise (*SOE*). All the variables are defined in Appendix A.

4. Empirical results

4.1. Sample distribution and descriptive statistics

Our sample covers Chinese nonfinancial A-share companies for the fiscal years 2009–2018 and includes 16,471 firm-year observations. To guarantee the representativeness of our sample observations, we compare cross-year and cross-industry distributions of the sample with the CSMAR database. Panels B and C of Table 1 present the comparison. As shown in Panel B, the firm-year observations are generally evenly distributed over the sample period and exhibit a similar pattern to CSMAR. Panel C indicates that the sample firms operate in a variety of industries and are consistent with the full records of CSMAR, whereas about 63.19% of the observations come from the manufacturing industry. The dominance of manufacturing makes sense because China has the most complete industrial system across the world. Among more than 500 major industrial products worldwide, China ranks first in output at over 220.

Table 2 provides the descriptive statistics of the main variables in this study. We winsorize the extreme values of the distribution for continuous variables (except *FRQ*) at the 1st and 99th percentiles. As shown in Panel A, the mean value of *FRQ* is −0.363 with a standard deviation of 0.174. Panels B, C, and D present

Table 2
Descriptive Statistics of the main testing variables.

Variable	N	Mean	SD	Min	P10	P25	Median	P75	P90	Max
Panel A: Variables for Financial Reporting Quality										
REM	16471	0.148	0.155	0.002	0.018	0.047	0.102	0.192	0.328	0.87
MJDA	16471	0.059	0.062	0.001	0.007	0.018	0.040	0.077	0.128	0.37
RES	16471	0.366	0.621	0.000	0.000	0.000	0.000	1.000	1.000	4.000
FRQ	16471	−0.363	0.174	−1.000	−0.602	−0.481	−0.370	−0.222	−0.148	0.000
Panel B: Staggered DID Method Variable										
LIB	16471	0.253	0.435	0.000	0.000	0.000	0.000	1.000	1.000	1.000
Panel C: Control Variables										
SIZE	16471	22.290	1.269	20.030	20.790	21.370	22.100	23.020	23.990	26.180
LEV	16471	0.443	0.201	0.056	0.168	0.285	0.444	0.599	0.712	0.859
REVGROWTH	16471	0.423	1.116	−0.662	−0.177	−0.022	0.143	0.443	1.063	7.946
PPE	16471	0.257	0.190	0.003	0.042	0.111	0.219	0.366	0.529	0.851
AGE	16471	2.281	0.624	0.693	1.386	1.792	2.398	2.833	3.045	3.219
TOPHOLD	16471	34.860	14.910	8.810	16.940	23.020	32.910	45.090	55.450	74.300
BOARDSIZE	16471	2.153	0.202	1.609	1.946	2.079	2.197	2.197	2.398	2.708
DUAL	16471	0.226	0.418	0.000	0.000	0.000	0.000	0.000	1.000	1.000
COMP	16471	14.860	0.788	12.920	13.880	14.350	14.840	15.360	15.870	16.950
BIG4	16471	0.065	0.247	0.000	0.000	0.000	0.000	0.000	0.000	1.000
ANALYST	16471	8.148	9.574	0.000	0.000	1.000	4.000	12.000	22.000	42.000
INSTHOLD	16471	45.940	23.500	0.439	9.808	28.800	48.350	64.220	75.460	90.440
ROA	16471	0.040	0.048	−0.154	0.003	0.015	0.035	0.063	0.097	0.188
RETURN	16471	0.184	0.615	−0.579	−0.388	−0.245	0.004	0.423	1.016	2.578
MTB	16471	2.060	1.237	0.885	1.060	1.256	1.657	2.393	3.551	7.767
SOE	16471	0.441	0.496	0.000	0.000	0.000	0.000	1.000	1.000	1.000
Panel D: Matching Variables										
TREAT	16471	0.708	0.455	0.000	0.000	0.000	1.000	1.000	1.000	1.000
MVE	16471	22.89	1.119	20.08	21.6	22.12	22.75	23.5	24.33	28.73
TURNOVER	16471	0.244	0.188	0.001	0.064	0.108	0.191	0.33	0.498	1.569

Notes: Panels A to D report the descriptive statistics of the variables for financial reporting quality, staggered DID method variables, control variables in the baseline regression models, and matching variables in entropy balancing and propensity score matching, respectively. The statistics are computed from all firm-years in the full sample. See Appendix A for details about the variable definitions.

the descriptive statistics for the staggered DID method variable, control variables, and matching variables. Moreover, 661 firms have never been incorporated into the Stock Connect, accounting for 31.9% of total firms and 29.22% of firm-year observations. Our empirical analysis relies on the composition of the test sample, as a higher percentage of never-treated observations leads to more accurate estimations through our staggered DID identification (Baker et al., 2022).

4.2. The effect of stock market liberalization on FRQ

4.2.1. Baseline results

Models (1) to (4) in Table 3 provide our main results using the aggregate measure of *FRQ* as the dependent variable. In model (1), we present the DID estimation without the inclusion of covariates. We include all the control variables and firm fixed effects in models (2) to (4), but we adjust the year fixed effects by using Year, Year × Province, and Year × Industry fixed effects, respectively. Our focus is on the incremental effect for the treatment sample. The estimated coefficients from the first four models on (***LIB***) are 0.0137, 0.0149, 0.0152, and 0.0108, respectively, and all are significant at the 5% level or better (using two-sided tests). These results suggest that from the pre- to post-liberalization period, FRQ increases by about 6.21 to 8.74% of the standard deviation among eligible firms, relative to ineligible firms. This positive effect is economically significant, indicating the strong impact of the China's stock market liberalization policy on firms' real decisions concerning financial reporting.

In addition, we use three individual measures of FRQ as dependent variables and include both firm and year fixed effects in models (5) to (7). The estimated coefficients on ***LIB*** are all negative and significant at the 5% level or better. Specifically, from the pre- to the post-liberalization period, firms decrease their *REM*, *MJDA*, and *RES* by 10.45, 8.71, and 6.71% of the standard deviation, respectively. Table 3 thus consistently suggests that the firms improve their FRQ after their stocks become available to foreign investors through the Stock Connect.

4.2.2. Dynamic effects of stock market liberalization

The staggered DID methodology assumes that treated and control firms have similar pretrends. Consequently, we examine the dynamic effect on FRQ in the years before and after the first absorption in the Stock Connect, relative to control firms, to test the validity of this parallel trend assumption. Fig. 4 plots the coefficients and their 90% confidence intervals for a series of dummy variables that indicate each of the five years prior to the Liberalization (that is, years T-5 through T-1), the year of the Liberalization (that is, year T), and the subsequent years (that is, years T + 1 through T + 4), as specified in the following equation:

$$FRQ_{i,t} = \alpha + \sum_{\tau=T-5}^{\tau=T+4} \beta_\tau \times LIB[\tau]_{i,t} + \sum \gamma_j \times Control_{j,i,t} + Firm\,FE + Year\,FE + \varepsilon_{i,t} \quad (2)$$

Fig. 4 shows that FRQ does not change significantly in the five years prior to the Liberalization, supporting the parallel trend assumption. Once firms have been included in the Stock Connect, their FRQ significantly improves, as reflected by the positive coefficient on ***LIB*** (0.0182 with a standard error of 0.01). In subsequent years, FRQ increases further. The estimated coefficients on ***LIB***[T + 1], ***LIB***[T + 2], ***LIB***[T + 3], and ***LIB***[T + 4] are 0.0149, 0.0193, 0.0219, and 0.0345, respectively, and remain significantly different from zero, which suggests a persistent increase in FRQ due to the stock market liberalization policy. Altogether, our dynamic effects analysis provides support for our causal inference on how stock market liberalization influences Chinese firms' FRQ.

5. Cross-sectional analyses

In this section, we explore the firm-level heterogeneity through regional institutional development, external pressure, and internal governance. We separate our sample firms into the highest and lowest terciles based on

Table 3
Effects of stock market liberalization on financial reporting quality.

	Dependent Variable = *FRQ*				Disaggregation of *FRQ*		
					REM	*MJDA*	*RES*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
LIB	**0.0137*** **	**0.0149*** **	**0.0152*** **	**0.0108** **	**−0.0162*** **	**−0.0054*** **	**−0.0417** **
	(2.99)	**(3.18)**	**(3.18)**	**(2.27)**	**(−4.32)**	**(−3.06)**	**(−2.39)**
SIZE		−0.0159***	−0.0147**	−0.0156***	0.0230***	−0.0003	0.0535***
		(−2.83)	(−2.57)	(−2.73)	(4.59)	(−0.13)	(2.71)
LEV		−0.1031***	−0.0989***	−0.1122***	0.0687***	0.0524***	0.1771**
		(−5.46)	(−5.16)	(−6.09)	(3.97)	(6.35)	(2.36)
REVGROWTH		−0.0074***	−0.0071***	−0.0062***	0.0078***	0.0027***	0.0047
		(−3.88)	(−3.69)	(−3.24)	(3.55)	(2.92)	(0.86)
PPE		−0.0422**	−0.0446**	−0.0639***	0.0996***	0.0122	−0.0088
		(−2.31)	(−2.46)	(−3.54)	(5.34)	(1.52)	(−0.14)
AGE		0.0235**	0.0254**	0.0327***	−0.0040	0.0007	−0.0914**
		(2.27)	(2.38)	(2.93)	(−0.46)	(0.19)	(−2.34)
TOPHOLD		0.0007**	0.0006**	0.0007**	−0.0004	−0.0003**	−0.0011
		(2.37)	(1.99)	(2.29)	(−1.41)	(−2.44)	(−1.10)
BOARDSIZE		0.0045	0.0096	−0.0026	−0.0115	−0.0106*	0.0337
		(0.30)	(0.65)	(−0.18)	(−0.83)	(−1.84)	(0.63)
DUAL		−0.0030	−0.0026	−0.0010	0.0036	−0.0004	0.0046
		(−0.55)	(−0.48)	(−0.18)	(0.78)	(−0.18)	(0.21)
COMP		0.0085**	0.0071*	0.0111***	−0.0075*	−0.0002	−0.0434***
		(2.04)	(1.67)	(2.68)	(−1.90)	(−0.13)	(−2.67)
BIG4		−0.0242	−0.0216	−0.0284*	−0.0099	0.0054	−0.0297
		(−1.56)	(−1.39)	(−1.75)	(−0.56)	(0.99)	(−0.51)
ANALYST		−0.0007***	−0.0008***	−0.0007***	0.0003	0.0003***	0.0000
		(−2.84)	(−2.88)	(−2.66)	(1.32)	(2.96)	(0.01)
INSTHOLD		−0.0007***	−0.0007***	−0.0006***	0.0007***	0.0003***	0.0011
		(−3.58)	(−3.55)	(−2.91)	(4.09)	(4.28)	(1.51)
ROA		−0.1166**	−0.1092**	−0.0930*	0.4166***	−0.0833***	−0.2087
		(−2.42)	(−2.25)	(−1.88)	(9.24)	(−3.20)	(−1.13)
RETURN		0.0032	0.0020	0.0023	0.0042	0.0011	−0.0120
		(0.96)	(0.61)	(0.65)	(1.33)	(0.75)	(−0.94)
MTB		−0.0074***	−0.0068***	−0.0077***	0.0057***	−0.0001	−0.0042
		(−3.45)	(−3.11)	(−3.40)	(2.61)	(−0.09)	(−0.54)
SOE		0.0169	0.0220*	0.0206*	0.0074	−0.0045	−0.1161**
		(1.41)	(1.82)	(1.79)	(0.65)	(−0.94)	(−2.34)
Constant	−0.3669***	−0.1162	−0.1377	−0.1630	−0.3286***	0.0615	−0.0520
	(−317.84)	(−0.93)	(−1.08)	(−1.29)	(−2.84)	(1.12)	(−0.12)
Company FE	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y			Y	Y	Y
Year × Province FE			Y				
Year × Industry FE				Y			
Observations	16,471	16,471	16,471	16,439	16,471	16,471	16,471
Adj. R-squared	0.2373	0.2480	0.2483	0.2809	0.3975	0.1530	0.1581

Notes: This table reports our main results for the impact of stock market liberalization on *FRQ*. Model (1) reports the result without control variables. Models (2) to (4) use the aggregate measure of *FRQ* and models (5) to (6) use the disaggregated measure of *FRQ* (i.e., *REM*, *MJDA*, and *RES*) as the dependent variable. All the models include firm and year fixed effects, while models (3) and (4) replace year fixed effects with Year × Province FE and Year × Industry fixed effects, respectively. The regression coefficients on the independent variables are reported, followed by robust t-statistics (in parentheses) based on standard errors adjusted for heteroskedasticity. *, **, and *** indicate statistical significance at the 10, 5, and 1% levels using two-tailed tests, respectively. See Appendix A for details about the variable definitions.

partition variables and compare the estimated coefficients on ***LIB***. We employ this approach because Lys and Sabino (1992) show that a tercile approach is close to a power-maximizing grouping, which has also been frequently adopted in finance and accounting research (e.g., Naughton et al., 2019).

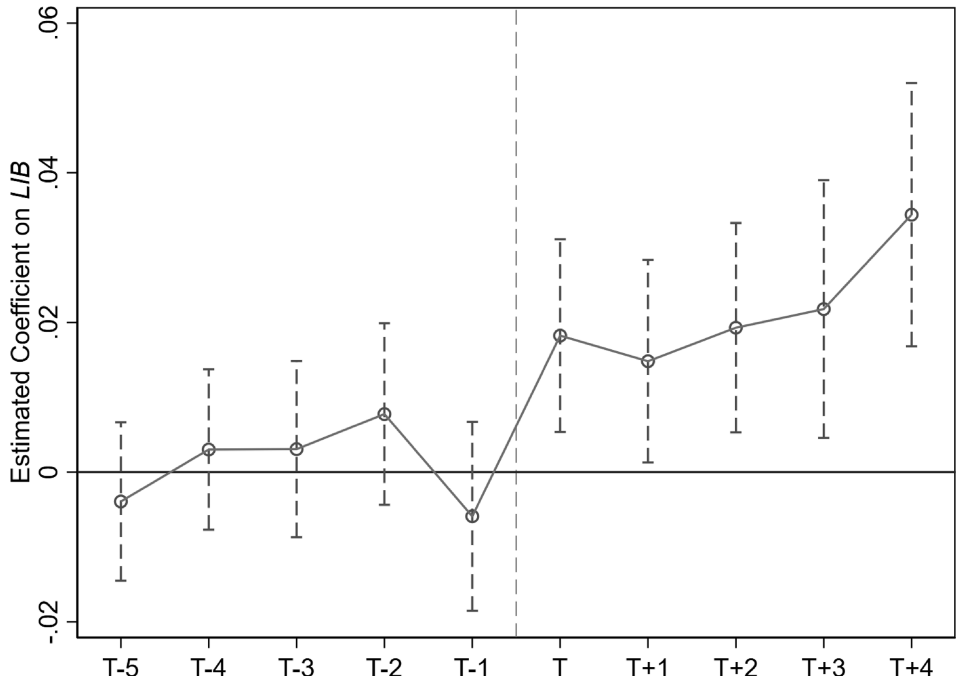

Fig. 4. Stock Market Liberalization's Dynamic Impact on Financial Reporting Quality. *Notes*: This figure plots the dynamic effect of stock market liberalization on *FRQ* using the entire sample. We plot the coefficients on a set of dummy variables indicating the event years relative to the year of first entrance into the Stock Connect and the corresponding 90% confidence intervals based on robust standard errors clustered by firm. Year T is the year when the target firm is included in the Stock Connect for the first time. The vertical dashed line splits the event years into before and after the exogenous shock.

5.1. The role of institutional development

Ball (2001) and Bushman et al. (2004) argue that a country's financial reporting and disclosure system is contingent on its economic, legal, and political infrastructure. Bekaert (1995) also suggests that weak financial development and legal institutions are the main barriers to investing in the emerging equity market. Hence, we conjecture that institutional background influences how stock market liberalization increases firm-level FRQ. Since China requires foreigners to invest through Hong Kong rather than making a direct equity investment in domestic firms, the Liberalization does not depend on local institutional conditions *per se* but rather acts on firm-level FRQ as a complement to the institutional environment where the firm operates. To further investigate the impact of stock market liberalization, we use within-China regional variations (Wang et al., 2008) to investigate the role of institutional background. We expect that firms located in regions with weaker legal institutions and less developed financial markets would benefit more from foreign investment.

Following Hope et al. (2020) and Zhong and Lu (2018), we use the judiciary efficiency index from the World Bank to measure the effectiveness of law enforcement and the financial marketization index from Fan et al. (2011). First, we partition eligible firms into three groups based on their headquarters' province-level judicial-efficiency index rank.[9] We compare the difference between the coefficients on ***LIB*** in the highest and lowest groups. The results in Table 4 suggest that the coefficients on ***LIB*** are significant at the 1% level in both groups, with values of 0.0379 and 0.0151, respectively. The *Z*-statistic shows that the difference between the two groups is significant at the 5% level. The results are consistent with the argument that the effects of market liberalization are sensitive to judicial efficiency. Second, we similarly trisect eligible firms by the province-level financial marketization index rank in the year of liberalization. The results in Table 4 show that

[9] The judicial efficiency index rankings can be obtained from the *Doing Business in China* report by World Bank: https://subnational.doingbusiness.org/en/reports/subnational-reports/china.

Table 4
Cross-sectional analyses: the role of local institutional development.

	Judicial Efficiency		Financing Marketization	
	Low	High	Low	High
LIB	**0.0379*** **	**0.0151*** **	**0.0392*** **	**0.0134** **
	(3.97)	**(2.73)**	**(3.35)**	**(2.45)**
Control	Y	Y	Y	Y
Company FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	6,976	12,691	6,441	13,079
Adj. R-squared	0.2345	0.2603	0.2366	0.2564
Difference	0.0228**		0.0258**	
Z-statistic		2.0696		1.9994

Notes: This table reports the results for the influence of institutional development on stock market liberalization effects, following Hope et al. (2020). In the first two columns, the eligible firms are partitioned into three subsamples based on their judicial efficiency ranking, as developed by the World Bank in *Doing Business in China*. In the next two columns, the eligible firms are partitioned into three subsamples based on the yearly financing marketization rankings compiled by Fan et al. (2011). We run the regression with the highest and lowest subsamples and compare the coefficients on ***LIB*** between them. Standard errors are clustered at the firm level. T-statistics are presented in parentheses. For the regression coefficients (the difference between coefficients on ***LIB***), *, **, and *** indicate statistical significance at the 10, 5, and 1% levels, respectively, using two-tailed (one-tailed) tests.

the coefficient on ***LIB*** in the group with lower financial marketization is significant at the 1% level (with a value of 0.0392), whereas that in the group with higher financial marketization is significant at the 5% level (with a value of 0.0134). The *Z*-statistic shows that the difference between the two groups is significant at the 5% level. Those results demonstrate that the positive impact of the Liberalization is also sensitive to financial institutions.

To sum up, we find that local institutional development influences the effects of stock market liberalization on FRQ. Foreign investors' monitoring roles work as a crucial complement to weak local institutions and encourage eligible firms in those regions to provide high-quality financial reporting.

5.2. The role of external pressure

One critical channel for the real effects of stock market liberalization might be increased external pressure. We find that eligible firms receive more media coverage and get into the spotlight after being listed in the Stock Connect (Appendix D shows the empirical estimations). In general, the frequency of Internet media coverage for firms included in the Stock Connect increases by about 8.94%. Therefore, we explore how external pressure influences the effects of stock market liberalization. First, once firms are included in the Stock Connect, they will be under heightened public scrutiny and may improve their FRQ to boost their public image and appear attractive in the capital market. Second, when external parties such as media and analysts disseminate their opinions about the eligible firms to the public, managers might lose some control over their information environment (e.g., Miller and Skinner, 2015). To regain their voice in the market, the managers might respond by increasing FRQ. Thus, we hypothesize that the increase in FRQ will be more pronounced in firms that previously had a lower profile in the capital market.

We first partition eligible firms by the number of analysts' reports (*REPORT*). Analysts play a vital role in reducing opacity, shaping the information environment, and improving market efficiency (Healy and Palepu, 2001). Firms with fewer analyst reports tend to be less transparent to external stakeholders. After becoming eligible for foreign capital, they will be under more pressure and respond with a greater increase in FRQ. In addition, Barber and Odean (2008) find that individual investors are inclined to buy attention-grabbing stocks, namely, the eligible firms in the Stock Connect in our study. Chau et al. (2020) show that in China, individual investors assist in monitoring firms' behavior and financial reporting. We use the Internet search index (*SEARCH*) to measure individual investors' attention to firms and expect that firms with a lower search index will experience a higher increase in FRQ, as they previously received little monitoring from individual inves-

Table 5
Cross-sectional analyses: the role of external pressure.

	Analyst Report Coverage		Internet Search Index		Stock Forum User Views		Stock Forum User Comments	
	Low	High	Low	High	Low	High	Low	High
LIB	**0.0252*** **	**0.0110**	**0.0247*** **	**0.0101**	**0.0223*** **	**0.0116**	**0.0237*** **	**0.0117**
	(3.71)	**(1.41)**	**(3.25)**	**(1.45)**	**(2.96)**	**(1.59)**	**(3.15)**	**(1.63)**
Control	Y	Y	Y	Y	Y	Y	Y	Y
Company FE	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Observations	9,192	8,798	8,780	9,144	8,837	9,066	8,863	9,034
Adj. R-squared	0.2526	0.2523	0.2408	0.2487	0.2484	0.2425	0.2460	0.2387
Difference	0.0142*		0.0146*		0.0107		0.0120	
Z-statistic	1.3684		1.4124		1.0228		1.1518	

Notes: This table reports the influence of firm-level characteristics on stock market liberalization effects. The eligible firms are partitioned into three subsamples based on proxies for external pressure in the year of liberalization. To measure external pressure, we use analysts' report coverage (*REPORT*), the internal search index (*SEARCH*), and stock forum posts' views (*VIEW*) in addition to the number of comments (*COMMENT*). We only run the regression for the highest and lowest subsamples, and we compare the coefficients on ***LIB*** between them. Standard errors are clustered at the firm level. T-statistics are presented in parentheses. For regression coefficients (the difference between coefficients on **LIB**) *, **, and *** indicate statistical significance at the 10, 5, and 1% levels, respectively, using two-tailed (one-tailed) tests.

tors. Moreover, the literature has documented the monitoring role of media (e.g., Liu and McConnell, 2013). In particular, social media plays an important role in corporate governance and curb firms' irresponsible behavior (e.g., Dube and Zhu, 2021). We use data from Eastmoney Guba,[10] one of the largest online financial communities in China, to measure the influence of social media. Millions of investors gather there to discuss firms, convey criticism, and exchange information. We divide the sample based on the number of firm-level views (*VIEW*) and comments (*COMMENT*) and expect that firms that used to receive less attention from the Guba community will enhance their FRQ more due to increased external pressure. As for the data sources, *REPORT* comes from CSMAR, while *SEARCH*, *VIEW*, and *COMMENT* come from CNRDS.[11]

We trisect the eligible firms based on the aforementioned four proxies in the year the firm becomes eligible for foreign investment, run regressions in the highest and lowest subsamples, and compare the difference between the coefficients on ***LIB***. We report the results in Table 5. In the first two columns, we partition the sample based on the number of analyst reports. The coefficient on ***LIB*** is statistically significant in the group with less report coverage and insignificant in the group with more coverage. The *Z*-statistic shows that the difference between the two groups is significant at the 10% level. The results suggest that firms with less coverage from analysts before the Liberalization are more incentivized to increase their FRQ. In the second two columns, the eligible firms are partitioned based on the Internet search index. Similarly, the estimated coefficient on ***LIB*** is significant (insignificant) in the group with a lower (higher) Internet search index. According to the *Z*-statistic, the difference between the two groups is significant at the 10% level. These two columns indicate that firms that receive less attention from individual investors before the Liberalization are more likely to increase their FRQ. In the third and fourth columns, we trisect the sample firms based on the number of views of the posts related to them and the number of comments on the posts. The estimated coefficient on ***LIB*** is significant in the group with fewer views and comments but insignificant in the group with more views and comments. These four columns suggest that firms under less intense scrutiny from social media tend to have increased FRQ. Collectively, our partition analyses based on external pressure indicate that firms with less external pressure before the Stock Connect will increase FRQ more.

[10] Eastmoney Guba can be reached at this link: http://guba.eastmoney.com/.
[11] CNRDS, the Chinese Research Data Services Platform, is a comprehensive Web-based business data management system that provides high-quality Chinese business research data. The website link is https://www.cnrds.com.

5.3. The role of internal governance

While foreign investors may be more important when the corporate governance of local firms is weak (e.g., Aggarwal et al., 2011), other institutional factors may affect their impact. For instance, Fang et al. (2015) contend that whether external monitors can bring about significant changes in local firms ultimately depends on the difficulty of overcoming existing institutional arrangements, which insulate controlling shareholders from external disciplinary forces. Kho et al. (2009) conjecture that weak investor protection in emerging markets leads to a higher level of insider ownership in general, constraining the influence of foreign investors. Similarly, Bae and Goyal (2010) find that foreign ownership in South Korean firms with strong corporate governance is significantly higher than in their counterparts with poor corporate governance after that country's equity market liberalization. Therefore, in emerging markets, foreign investors may be better able to exert their influence when the existing corporate governance system in local firms is relatively effective and external oversight is thus not being severely hampered.

We utilize four firm-level proxies to capture corporate governance. The first is the separation of ownership and control (*SEPARATION*). Claessens et al. (2000) show that voting rights usually exceed cash-flow rights through pyramid structures in East Asian countries, which creates agency problems between controlling owners and outside investors while reducing earnings informativeness (Fan and Wong, 2002). When there is lower level of separation, eligible firms possess value-enhancing internal governance structures, and can attract more foreign capital, thereby facilitating the improvement of FRQ. The second proxy is executives' shareholding (*EXEHOLDING*). Jensen and Meckling (1976) propose that executives' shareholding could help ease agency problems and align executives' interests with the company's long-term development. When firms have higher executive shareholding and less severe agency problems, they are more incentivized to increase FRQ in response to the entry of foreign investors. The third proxy we use to partition our sample is CEO duality (*DUAL*). In this situation, a single individual serves as both CEO and board chairman (Krause et al., 2014), which tends to increase earnings management (Davidson et al., 2004) and fraudulent reporting (Jr et al., 2006). We predict that foreign investors will prefer firms without CEO duality and will improve their financial reporting practice. Finally, we use the largest shareholder's ownership to distinguish eligible firms' corporate governance. According to Gul et al. (2010), corporate ownership is highly concentrated in the hands of a single investor in many cases in China, where entrenched controlling shareholders camouflage their self-serving behavior and divert firm resources at the expense of outside shareholders (e.g., Fan and Wong, 2002).

Table 6
Cross-sectional analyses: the role of internal governance.

	Separation of Ownership and Control		**Executive Shareholding**		**CEO Duality**		**Ownership Share of Largest Shareholder**	
	Low	High	Low	High	Yes	No	Low	High
LIB	**0.0214*** **	**0.0060**	**0.0122***	**0.0292*** **	**0.0096**	**0.0191*** **	**0.0173** **	**0.0102**
	(3.70)	**(0.81)**	**(1.76)**	**(4.04)**	**(1.10)**	**(3.67)**	**(2.37)**	**(1.40)**
Control	Y	Y	Y	Y	Y	Y	Y	Y
Company FE	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Observations	11,564	8,924	10,017	8,593	7,718	13,945	8,977	8,963
Adj. R-squared	0.2504	0.2484	0.2515	0.2530	0.2437	0.2477	0.2375	0.2619
Difference		0.0154*		0.0171**		0.0095		0.0071
Z-statistic		1.6324		1.7055		0.9359		0.6853

Notes: This table reports the influence of firm-level characteristics on stock market liberalization effects. We partition the eligible firms based on proxies for internal governance in the year of liberalization. These measures are the separation of ownership and control (*SEPARATION*), executives' shareholding (*EXEHOLDING*), CEO duality (*DUAL*), and the shareholding of the largest blockholder (*TOPHOLD*). We only run the regression for the highest and lowest subsamples, and we compare the coefficients on ***LIB*** between them. Standard errors are clustered at the firm level. T-statistics are presented in parentheses. For regression coefficients (the difference between coefficients on ***LIB***) *, **, and *** indicate statistical significance at the 10, 5, and 1% levels, respectively, using two-tailed (one-tailed) tests.

Therefore, foreign investors tend to invest in firms with less concentrated shareholding (*TOPHOLD*) so that they can exert their influence on the production of financial information.

We use the same methodology in Section 5.2 to examine how internal governance influences the effects of stock market liberalization. Table 6 presents our results. In the first two columns, we partition the eligible firms into three groups based on the separation of ownership and control. The estimated coefficient on ***LIB*** is significant in the group with lower level of separation and insignificant in the group with higher separation. The *Z*-statistic shows that the difference is significant at the 10% level. The next two columns report the partition analysis based on executive shareholding. We find that ***LIB*** is significant in both groups, but with a higher significance level in the group with more executive shareholding. The difference between the two estimated coefficients is also significant at the 5% level. We partition the eligible firms based on CEO duality in the third pair of columns. We can see that ***LIB*** is significant in the group with no CEO duality but insignificant in the group with CEO duality. In the last two columns, the eligible firms are partitioned based on the ownership of the largest shareholder. The estimated coefficient on ***LIB*** is significant in the group with lower ownership

Table 7
FRQ-related benefits of stock market liberalization.

Panel A: Cost of Regulatory Compliance

	Comment Letters	**Administrative Punishments**
	(1)	(2)
LIB	**−0.0278****	**−0.0168***
	(−2.00)	**(−1.75)**
Control	Y	Y
Company FE	Y	Y
Year FE	Y	Y
Observations	7,778	16,471
Adj. R-squared	0.2461	0.1127

Panel B: Stock Price Efficiency

	NONSYN	***NCSKEW***	***DUVOL***
	(1)	(2)	(3)
LIB	**0.0806*****	**−0.0383***	**−0.0464*****
	(2.95)	**(−1.88)**	**(−3.53)**
Control	Y	Y	Y
Company FE	Y	Y	Y
Year FE	Y	Y	Y
Observations	16,459	16,142	16,142
Adj. R-squared	0.4415	0.1169	0.1282

Panel C: Financing Constraints

	FC Index	**Cost of Equity**
	(1)	(2)
LIB	**−0.0328*****	**−0.3560*****
	(−12.06)	**(−8.47)**
Control	Y	Y
Company FE	Y	Y
Year FE	Y	Y
Observations	16,471	16,332
Adj. R-squared	0.9053	0.5158

Notes: This table reports the effects of stock market liberalization on regulatory compliance costs, stock price efficiency, and firms' financing constraints. In Panel A, the dependent variables are the natural logarithm of the number of comment letters (CL) and administrative punishment (PUNISHMENT) plus one. In Panel B, we use stock price nonsynchronicity (*NONSYN*) and stock crash risks (*NCSKEW* and *DUVOL*). In Panel C, we measure financing constraints using the financing constraints index (FC) developed by Hadlock and Pierce (2010) and cost of equity (COE) based on CAPM model. Standard errors are clustered at the firm level. T-statistics are presented in parentheses. For the regression coefficients, *, **, and *** indicate statistical significance at the 10, 5, and 1% levels, respectively, using two-tailed tests.

concentration and insignificant in the group with higher ownership concentration. These results suggest that the favorable impact of stock market liberalization is more pronounced in firms with better internal corporate governance, namely, less separation of ownership and control, higher executive shareholding, no CEO duality, and lower ownership concentration. Overall, when eligible firms' corporate governance is more effective before being listed in the Stock Connect, foreign investors can more effectively play an external monitoring role and make a greater improvement in the firm's FRQ.

6. Further analyses

6.1. FRQ-related benefits of stock market liberalization

In this section, we provide further evidence on the FRQ-related economic consequences of the Liberalization. First, eligible firms might reduce their regulatory compliance costs because of high-quality financial reporting. To investigate how regulators perceive firms' financial reporting, we regress the natural logarithm of one plus the number of comment letters and administrative punishments issued by the CSRC and stock exchanges on ***LIB*** and the control variables used in the main empirical model. Panel A in Table 7 presents our results. Consistent with our predictions, the estimated coefficient on ***LIB*** is significantly negative at the 10% level (or better), suggesting that eligible firms face less severe regulatory costs. Because the dependent variable is the natural logarithm, we find that the frequencies of receiving comment letters and administrative punishment decrease by 2.78% and 1.68%, respectively.

Table 8
Robustness tests.

Panel A: Addressing Endogeneity Concerns

	Entropy Balancing		**Propensity Score Matching**	
	EBM Sample 1	EBM Sample 2	PSM Sample 1	PSM Sample 2
	(1)	(2)	(3)	(4)
LIB	**0.0134***	**0.0149****	**0.0116****	**0.0126****
	(1.95)	**(2.09)**	**(2.24)**	**(2.41)**
Control	Y	Y	Y	Y
Company FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	16,471	16,471	13,923	13,007
Adj. R-squared	0.2699	0.3445	0.2619	0.2563

Panel B: Additional Robustness Tests

	Exclude Delisted Firms	*SHHK*	**SZHK**	**Placebo Test**
	(1)	(2)	(3)	(4)
LIB	**0.0198*****	**0.0119***	**0.0243*****	
	(3.40)	**(1.68)**	**(3.37)**	
Pesudo-LIB				**0.0014**
				(0.31)
Control	Y	Y	Y	Y
Company FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	13,571	6,528	9,943	16,471
Adj. R-squared	0.2498	0.2724	0.2281	0.2473

Notes: This table shows three sets of robustness tests. In column (1), we delete firms that are removed from the Stock Connect. Standard errors are clustered at the firm level. In addition, we examine the effects of *SHHK* and *SZHK* separately. Columns (2) and (3) present the results for SSE and SZSE firms, respectively. Lastly, in column (4), we assume that the "pseudo-event" years are one year before the actual liberalization year. All models in this table use the same set of control variables as the main regression specification in Table 3. T-statistics are presented in parentheses. For the regression coefficients, *, **, and *** indicate statistical significance at the 10, 5, and 1% levels, respectively, using two-tailed tests.

Second, the literature suggests that higher FRQ improves market efficiency (e.g., Hung et al., 2015), which motivates us to examine the capital market consequences of increased FRQ. Following previous studies of stock price efficiency (Hutton et al., 2009; Kim et al., 2011a; Kim et al., 2011b), we measure market efficiency by stock price nonsynchronicity (*NONSYN*) and crash risks (*NCSKEW* and *DUVOL*). We report our results in Panel B of Table 7. The dependent variables are market efficiency measures, and the key independent variable is ***LIB***. Control variables are based on prior studies (Hutton et al., 2009; Kim et al., 2011a; Kim et al., 2011b). The estimated coefficients are statistically significant, and their signs are consistent with our predictions. Eligible firms experience higher price nonsynchronicity and lower crash risks, indicating an enhanced stock price efficiency after the Liberalization.

Finally, higher FRQ also helps firms obtain external financing (e.g, Dechow et al., 2010; Hope et al., 2020). For example, Yoon (2021) reveals that eligible firms can receive capital from foreign brokers through private disclosures induced by *SHHK*. Through enhanced FRQ, public firms can communicate valuable information to a broader range of capital provider, leading to mitigated financial constraints after the Liberalization. We measure financing constraints by proxies developed in Hadlock and Pierce (2010) and the cost of equity calculated through the CAPM model (Dechow et al., 2010). The results are reported in Panel C of Table 7. Consistent with our expectation, the key variable of interest, ***LIB***, has positively significant coefficients at the 1% level, indicating that eligible firms have less severe financing constraints after the Liberalization.

Collectively, our evidence suggests that a rise in FRQ following the Liberalization is associated with decreased regulatory compliance costs, improved stock price efficiency, and mitigated financing constraints. Those findings echo prior studies on the economic consequences of stock market liberalization in China and highlight the important role of improved firm-level FRQ.

6.2. Addressing endogeneity concerns

The Stock Connect chooses eligible stocks based on industry representation, market capitalization, and turnover (Yoon, 2021). Therefore, we use Entropy Balanced Matching (EBM) and Propensity Score Matching (PSM) to alleviate potential selection bias.

Since the treatment and control firms in our sample are not perfectly balanced (i.e., 68.1% of our sample is treatment firms), we use EBM to assign weights to the control firms so that the moments of the distribution of the matching variables are similar to those of the treatment firms (Yoon, 2021). We conduct two sets of matching procedures: 1) we match the sample firms by industry, turnover, and market capitalization (EBM Sample 1), and 2) we add all the control variables to the three aforementioned matching variables (EBW Sample 2). Appendix E shows the summary statistics before and after the EBM. As shown in Panel A, after matching, the *TURNOVER* of both groups has a mean of 0.23, a variance of 0.03, and a skewness of 1.75. *MVE* for eligible (ineligible) firms has a mean of 23.18 (23.18), a variance of 1.26 (1.27), and a skewness of 0.80 (0.79). In addition, we eliminate the significant differences in *IND*, *TURNOVER*, *MVE*, and all other control variables up to the third moment (i.e., skewness) and present the summary statistics in Panel B.

We then rerun the regressions with the reweighted samples and report our results in Panel A of Table 8. Models (1) uses EBM Sample 1, whereas models (2) uses EBM Sample 2. The variable of interest, ***LIB***, has a positively significant coefficient at the 10% level (or better) across all the models. The results from the EBM samples suggest that the Liberalization increases FRQ in eligible firms by about 5.44–10.92% of the standard deviation.

Furthermore, we adopt PSM to address potential endogeneity concerns. We match treatment firms with control firms that have never been included in the Stock Connect *year by year*. The matching procedure is based on the closest propensity score calculated from the following two Logit models, which are estimated by cross-sectional data each year.

$$TREAT_i = \beta_0 + \beta_1 TURNOVER_i + \beta_2 MVE_i + Industry\,Dummy \tag{3a}$$

$$TREAT_i = \beta_0 + \beta_1 TURNOVER_i + \beta_2 MVE_i + \sum \gamma_j \times Control_{i,j} + Industry\,Dummy \quad (3b)$$

After obtaining the propensity score, we require one-to-one matching *with replacement*[12] and a maximum caliper distance of 1%. Eqs. 3a and 3b yield PSM Samples 1 and 2, respectively. We report the covariate comparison in Appendix F. Panel A suggests that the differences in *TURNOVER* and *MVE* have been reduced dramatically in PSM Sample 1, although they remain statistically significant. Panel B presents our matching outcome (PSM Sample 2) after we introduce all the control variables into the matching procedure. We find that many significant differences in the matching covariate are removed. For those variables still with significant differences, the differences between the treatment and control groups decrease substantially. Combined, our PSM procedures yield acceptable matching quality.

We then estimate our main model based on PSM Samples 1 and 2 and report the results in columns (3) and (4) of Panel A in Table 8, respectively. All the estimated coefficients on ***LIB*** are positive and significant at the 5% level. The Liberalization improves eligible firms' FRQ by around 6.03–7.70% of the standard deviation relative to ineligible firms.

To conclude, we use EBM and PSM to mitigate potential selection bias. The favorable influence of the Liberalization remains unchanged, suggesting that our main findings do not suffer from endogeneity concerns deriving from the selection criterion.

6.3. Additional robustness tests

We conduct several robustness tests to confirm our findings further. First, the eligible firms are adjusted semiannually, and many of them engage in irresponsible financial reporting or even financial misconduct. Typical examples are Kangmei and Kangde Xin, as discussed in Introduction. We exclude those removed firms in the Stock Connect from our sample to reexamine the effects of the Liberalization. Column (1) in Table 8 shows that the coefficient on ***LIB*** is negatively significant at the 1% level, which is consistent with our main findings and proves that our analysis is free from sample selection bias. Second, the Liberalization involves two mechanisms, *SHHK* and *SZHK*. The latter was announced in 2016, after the enactment of *SHHK* in 2014. Besides the openness time, SSE and SZSE have distinguishable differences for the eligible firms because SZSE firms primarily operate in the technology sector (Yoon, 2021). Consequently, we separate the sample into two subsamples according to their trading exchanges and report the regression results in Table 8. Columns (2) and (3) suggest that the beneficial impact of market liberalization is statistically significant in both mechanisms. Third, to confirm that stock market liberalization causes the increase in FRQ, we also conduct a series of placebo tests. To address the possibility that unobservable shocks unrelated to the Stock Connect could drive the results, we artificially move the actual firm-level liberalization year backward by one year to create "pseudo-event" years. We do not find a significant difference in FRQ between the eligible and ineligible firms around these pseudo-event years. The results are shown in column (4) in Panel B of Table 8. Altogether, our main findings are not altered and remain robust in these tests.

7. Conclusion

Numerous countries have attempted to enhance public companies' FEQ, yet various obstacles have hindered their efforts. In our study, we shed new light on the positive impact of stock market liberalization, a significant institutional reform, on firm-level FRQ. Leveraging a quasi-natural experiment in China, we use a staggered DID specification to empirically examine how the Liberalization affects public firms' FRQ. We demonstrate that eligible firms exhibit improved FRQ upon becoming accessible to foreign investors. Our findings withstand a battery of robustness tests, and we establish a causal link between stock market liberalization and firms' financial reporting behavior.

Regarding cross-sectional analyses, we examine how the effect of the Liberalization is influenced by institutional development. The enhancement in FRQ is stronger in firms headquartered in regions with weaker

[12] Because treatment firm-year observations represent around 70% share of our sample, one-to-one matching without replacement yields unsatisfactory matching outcomes.

judicial and financial systems. We further find that firms with a lower profile in the capital market before the Liberalization experience more pronounced increased FRQ. We also observe that the role of stock market liberalization in improving FRQ is more evident when eligible firms have more effective internal governance *ex ante*. Moreover, our study reveals that enhanced FRQ is linked to lower regulatory compliance costs, higher stock price efficiency, and reduced financing constraints. Altogether, this research provides valuable insights into the benefits of China's financial sector's increased openness and clarify the impact of stock market liberalization on firm-level financial reporting for other yet-to-mature economies.

Declaration of Competing Interest

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

Appendix A. Variable definitions

Variable	Definition
Panel A: Variables for Financial Reporting Quality	
MJDA	Absolute value of discretionary accruals, measuring the degree of accrual-based earnings management without signs (Dechow et al., 1995). Detailed calculation procedures are reported in Appendix B.
REM	An aggregate measure of real earnings management following Roychowdhury (2006) and Choi et al. (2018), which is the sum of *abCFO*, *abPROD*, and *abDIXEXP* with *abCFO* and *abDISEXP* multiplied by minus one. We take the absolute value to measure the degree of Real Earnings Management without signs. Detailed calculation procedures are reported in Appendix C.
RES	The frequency of financial report restatements in year *t*.
FRQ	The average of the above three financial reporting quality variables, multiplied by minus one so that higher values represent higher quality. *MJDA* and *REM* are ranked from 0 to 9 each year, and scaled by 9 to range from 0 to 1. *RES* is scaled by the largest number of restatements each year (4 in our sample) to range from 0 to 1. Suppose that Company A ranked 3rd and 6th in terms of *MJDA* and *REM*, respectively, in 2018 and restated its financial reports twice; its *FRQ* should be calculated as $(3/9 + 6/9 + 2/4) \times (-1) \times (1/3)$ and equal -0.5.
Panel B: Staggered DID Method Variable	
LIB	An indicator variable that equals one if firm *i* was listed in the Mainland–Hong Kong Stock Connect in year *t*, and zero otherwise.
Panel C: Control Variables	
SIZE	The natural logarithm of total assets (in RMB yuan) at the end of the year.
LEV	Total liabilities divided by total assets.
REVGROWTH	Revenues of the current period minus those of the previous period deflated by those of the previous period.
PPE	Fixed assets intensity, calculated as property, plant, and equipment divided by total assets at the beginning of the year.
BOARDSIZE	The natural logarithm of total number of directors on the board.
AGE	The natural logarithm of number of years that a firm has been a public firm.
TOPHOLD	The percentage of shares owned by the largest shareholder.

(*continued on next page*)

(*continued*)

Variable	Definition
DUAL	An indicator variable that equals one if the chairman of the company serves as the CEO, and zero otherwise.
COMP	The natural logarithm of top executives' compensation.
BIG4	An indicator variable that equals one if the company is audited by a Big 4 accounting firm, and zero otherwise.
ANALYST	The number of analysts following the firm at the end of the year.
INSTHOLD	The percentage of shares owned by institutional investors.
ROA	Income before extraordinary items divided by lagged total assets.
RETURN	Stock return, which represents the annual stock return of the firm.
MTB	The market-to-book ratio.
SOE	An indicator variable that equals one if the company is state-owned, and zero otherwise
Panel D: Matching Variables	
TREAT	An indicator variable that equals one if the company is listed in the Stock Connect, and zero otherwise.
TURNOVER	Annual average shares traded divided by the shares outstanding.
MVE	The natural logarithm of market capitalization (in RMB yuan) at the end of the year.

Appendix B. Modified jones model

One of our primary measures of *MJDA* is discretionary accruals. The procedures follow Dechow et al. (1995) and the models are given below.

$$\frac{TA_{i,t}}{Asset_{i,t-1}} = \beta_0 \frac{1}{Asset_{i,t-1}} + \beta_1 \frac{\Delta REV_{i,t}}{Asset_{i,t-1}} + \beta_2 \frac{PPE_{i,t-1}}{Asset_{i,t}} + \varepsilon_{i,t} \tag{4a}$$

$$\frac{NDA_{i,t}}{Asset_{i,t-1}} = \hat{\beta}_0 \frac{1}{Asset_{i,t-1}} + \hat{\beta}_1 \frac{\Delta REV_{i,t} - \Delta REC_{i,t}}{Asset_{i,t}} + \hat{\beta}_2 \frac{PPE_{i,t}}{Asset_{i,t}} \tag{4b}$$

$$DA_{i,t} = \frac{TA_{i,t}}{Asset_{i,t-1}} - NDA_{i,t} \tag{4c}$$

where, for firm i in year t, TA is the total accruals (i.e., operating income minus cash flow from operations), *Asset* refers to the total assets, ΔREV and ΔREC denote the changes in revenues and accounts receivable, respectively, and PPE refers to the property, plant, and equipment. After regressions by industry and year using model (4a), we use the estimators to obtain the fitted values of non-discretionary accruals deflated by lagged assets through Eq. (4b). Lastly, we use model (4c) to calculate discretionary accruals with signs, which capture the intensity and direction of firms' *MJDA*.

Appendix C. Real activities manipulation

Using the methodology from Roychowdhury (2006), we estimate Abnormal CFO, Abnormal PROD, and Abnormal DISEXP, denoted by *abCFO*, *abPROD*, and *abDISEXP*, respectively. The estimation models are shown as follows:

$$\frac{CFO_{i,t}}{Asset_{i,t-1}} = \alpha_0 + \alpha_1 \frac{1}{Asset_{i,t-1}} + \alpha_2 \frac{REV_{i,t}}{Asset_{i,t-1}} + \alpha_3 \frac{\Delta REV_{i,t}}{Asset_{i,t-1}} + \varepsilon_{i,t} \tag{5a}$$

$$\frac{PROD_{i,t}}{Asset_{i,t-1}} = \alpha_0 + \alpha_1 \frac{1}{Asset_{i,t-1}} + \alpha_2 \frac{REV_{i,t}}{Asset_{i,t-1}} + \alpha_3 \frac{\Delta REV_{i,t}}{Asset_{i,t-1}} + \alpha_4 \frac{\Delta REV_{i,t-1}}{Asset_{i,t-1}} + \varepsilon_{i,t} \tag{5b}$$

$$\frac{DISEXP_{i,t}}{Asset_{i,t-1}} = \alpha_0 + \alpha_1 \frac{1}{Asset_{i,t-1}} + \alpha_2 \frac{REV_{i,t-1}}{Asset_{i,t-1}} + \varepsilon_{i,t} \quad (5c)$$

where, for each firm i and year t, REV refers to the total revenues of the firm and $Asset$ denotes total assets, CFO refers to the cash flow from operating activities, $PROD$ refers to production costs, which sums up the cost of goods sold and the change in inventory, and $DISEXP$ denotes discretionary expenses, computed by the sum of sales and administrative expenses. $abCFO$, $abPROD$, and $abDISEXP$ are the differences between the actual values of cash flow from operating activities, production costs, and discretionary expenses (all scaled by lagged total assets, $Asset_{i,t-1}$) and their normal levels (i.e., the fitted values of Eqs. (5a)–(5c), respectively).

Following prior studies (e.g., Choi et al., 2018), we multiply $abDISEXP$ and $abCFO$ to make them consistent with the direction of earnings management of $abPROD$ and sum those three variables to obtain an aggregate variable, REM.

Appendix D. Increase in internet media coverage

See Table A.1.

Table A.1
Effects of stock market liberalization on internet media coverage.

	Dependent Variable = log(1 + Internet Media Coverage)			
	(1)	(2)	(3)	(4)
LIB	**0.1222*** **	**0.0894** **	**0.0971*** **	**0.1009*** **
	(3.31)	**(2.50)**	**(2.67)**	**(2.74)**
SIZE		0.3748***	0.3698***	0.3776***
		(9.45)	(9.26)	(9.18)
LEV		−0.0816	−0.0893	−0.0519
		(−0.59)	(−0.64)	(−0.38)
REVGROWTH		0.0232**	0.0223**	0.0190*
		(2.04)	(2.01)	(1.75)
PPE		0.1135	0.1450	0.1061
		(0.97)	(1.22)	(0.90)
AGE		−0.1418*	−0.1244	−0.1638*
		(−1.70)	(−1.42)	(−1.82)
TOPHOLD		−0.0044*	−0.0036	−0.0036
		(−1.93)	(−1.60)	(−1.60)
BOARDSIZE		−0.0205	−0.0232	−0.0150
		(−0.19)	(−0.21)	(−0.14)
DUAL		0.0001	−0.0181	0.0025
		(0.00)	(−0.46)	(0.06)
COMP		0.0786**	0.0882***	0.0863***
		(2.46)	(2.76)	(2.75)
BIG4		0.0024	−0.0159	−0.0051
		(0.02)	(−0.16)	(−0.05)
ANALYST		0.0266***	0.0269***	0.0270***
		(15.36)	(15.25)	(14.94)
INSTHOLD		0.0004	0.0000	0.0001
		(0.24)	(0.01)	(0.09)
ROA		−1.0182***	−1.0313***	−1.3578***
		(−3.15)	(−3.17)	(−4.03)
RETURN		0.2094***	0.2143***	0.2126***
		(9.57)	(9.57)	(8.75)
MTB		0.1889***	0.1852***	0.1877***
		(11.94)	(11.50)	(11.32)

(*continued on next page*)

Table A.1 (*continued*)

	Dependent Variable = log(1 + Internet Media Coverage)			
	(1)	(2)	(3)	(4)
SOE		−0.0711	−0.0650	−0.0390
		(−0.66)	(−0.59)	(−0.36)
Constant	4.9099***	−4.6742***	−4.7478***	−4.8435***
	(526.81)	(−5.11)	(−5.15)	(−5.09)
Company FE	Y	Y	Y	Y
Year FE	Y	Y		
Year*Province FE			Y	
Year*Industry FE				Y
Observations	16,471	16,471	16,471	16,439
Adj. R-squared	0.5092	0.5409	0.5417	0.5522

Notes: This table reports the impact of stock market liberalization on Internet media coverage. Model (1) reports the result without control variables. All the models include firm and year fixed effects, while models (3) and (4) replace year fixed effects with Year × Province FE and Year × Industry fixed effects, respectively. The regression coefficients on the independent variables are reported, followed by robust t-statistics (in parentheses) based on standard errors adjusted for heteroskedasticity. *, **, and *** indicate statistical significance at the 10, 5, and 1% levels, respectively, using two-tailed tests. See Appendix A for details about the variable definitions.

Appendix E. Entropy balancing

See Table A.2.

Table A.2
Summary statistics after entropy balanced matching.

	Treatment			Control: Before Matching			Control: After Matching		
	Mean	Variance	Skewness	Mean	Variance	Skewness	Mean	Variance	Skewness
Panel A: Matching Based on Industry, Turnover, and Market Capitalization (EBM Sample 1)									
IND									
TURNOVER	0.23	0.03	1.75	0.28	0.04	1.40	0.23	0.03	1.75
MVE	23.18	1.26	0.80	22.18	0.51	0.59	23.18	1.27	0.79
Panel B: Matching Based on Industry, Turnover, Market Capitalization, and Control Variables (EBM Sample 2)									
IND									
TURNOVER	0.23	0.03	1.75	0.28	0.04	1.40	0.23	0.03	1.75
MVE	23.18	1.26	0.80	22.18	0.51	0.59	23.18	1.26	0.80
SIZE	22.58	1.65	0.59	21.57	0.79	0.71	22.58	1.65	0.59
LEV	0.45	0.04	−0.06	0.42	0.04	0.23	0.45	0.04	−0.06
REVGROWTH	0.42	1.14	4.63	0.43	1.50	4.46	0.42	1.14	4.63
PPE	0.26	0.04	0.96	0.26	0.03	0.82	0.26	0.04	0.96
AGE	2.32	0.37	−0.55	2.19	0.43	−0.28	2.32	0.37	−0.55
TOPHOLD	35.89	240.10	0.43	32.36	170.70	0.55	35.89	240.10	0.43
BOARDSIZE	2.17	0.04	−0.12	2.12	0.04	−0.53	2.17	0.04	−0.12
DUAL	0.21	0.17	1.40	0.25	0.19	1.13	0.21	0.17	1.40
COMP	14.99	0.64	0.04	14.54	0.44	−0.09	14.99	0.64	0.04
BIG4	0.08	0.08	3.03	0.02	0.02	6.32	0.08	0.08	3.03
ANALYST	10.02	105.40	1.23	3.61	29.36	2.43	10.02	105.40	1.23
INSTHOLD	49.15	547.60	−0.33	38.17	479.00	−0.12	49.15	547.60	−0.33
ROA	0.05	0.00	−0.09	0.03	0.00	−0.95	0.05	0.00	−0.09
RETURN	0.20	0.39	1.61	0.15	0.35	1.57	0.20	0.39	1.61
MTB	2.05	1.54	2.26	2.08	1.50	2.28	2.05	1.54	2.26
SOE	0.46	0.25	0.16	0.39	0.24	0.44	0.46	0.25	0.16

Notes: This table reports the comparison of the treatment and control samples before and after Entropy Balanced Matching (EBM). Panel A reports the matching outcome based on industry, turnover, and market capitalization. Panel B presents the matching outcome based on industry, turnover, market capitalization, and all the control variables. See Appendix A for details about the variable definitions.

Appendix F. Propensity score matching

See Table A.3.

Table A.3
Summary statistics after entropy balanced matching.

	Before Matching			After Matching		
	Treatment	Control	Difference	Treatment	Contorl	Difference
Panel A: Matching Based on Industry, Turnover, and Market Capitalization (PSM Sample 1)						
IND						
TURNOVER	0.23	0.28	0.06***	0.24	0.28	0.04***
MVE	23.18	22.18	−1.00***	23.02	22.4	−0.62***
Panel B: Matching Based on Industry, Turnover, Market Capitalization, and Control Variables (PSM Sample 2)						
IND						
TURNOVER	0.23	0.28	0.06***	0.25	0.28	0.03***
MVE	23.18	22.18	−1.00***	22.96	22.39	−0.57***
SIZE	22.58	21.57	−1.01***	22.36	21.8	−0.56***
LEV	0.45	0.42	−0.03***	0.45	0.45	0
REVGROWTH	0.42	0.43	0.01	0.43	0.44	0.01
PPE	0.26	0.26	0.26	0.26	0.26	0.01
AGE	2.32	2.19	−0.13***	2.31	2.24	−0.07***
TOPHOLD	35.89	32.36	−3.53***	35.24	33.49	−1.75***
BOARDSIZE	2.17	2.12	−0.05***	2.16	2.14	−0.02***
DUAL	0.21	0.25	0.04***	0.22	0.23	0.01
COMP	14.99	14.54	−0.46***	14.89	14.58	−0.30***
BIG4	0.08	0.02	−0.06***	0.06	0.03	−0.03***
ANALYST	10.02	3.61	−6.41***	8.52	4.58	−3.93***
INSTHOLD	49.15	38.17	−10.98***	47.31	41.73	−5.58***
ROA	0.05	0.03	−0.02***	0.04	0.03	−0.01***
RETURN	0.2	0.15	−0.05***	0.27	0.27	0.01
MTB	2.05	2.08	0.03	2.05	2.02	−0.02
SOE	0.46	0.39	−0.07***	0.45	0.44	−0.01

Notes: This table reports the comparison of means between the treatment and control samples before and after Propensity Score Matching (PSM). Panel A reports the matching outcome based on industry, turnover, and market capitalization. Panel B presents the matching outcome based on industry, turnover, market capitalization, and all the control variables. See Appendix A for details about the variable definitions.

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Supplier concentration and analyst forecast bias

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ABSTRACT

This study examines the relationship between analyst forecast dispersion or accuracy and supplier concentration of listed firms in China from 2008 to 2019. Our findings suggest that higher supplier concentration is associated with lower analyst forecast dispersion, which can be attributed to the increased attention from analysts. Moreover, this effect is more pronounced when firms have less bargaining power and higher institutional ownership, indicating a greater reliance on the supply chain. Our study highlights the importance of disclosing supply chain information, which provides insights beyond those of traditional financial information.

1. Introduction

In the past decade, academic research has paid increasing attention to the supply chain relationship of firms, recognizing the critical role of external stakeholders such as suppliers and customers in production and operations. Studies demonstrate that corporate performance can be affected by other partners in the supply chain (Hertzel et al., 2008; Pandit et al., 2011; Patatoukas, 2012). In addition, Dhaliwal et al. (2016) find that the financial status of customers can influence the asset structure of their suppliers. Furthermore, studies find that the geographic proximity of suppliers and customers positively affects suppliers' innovation (e.g., Chu et al., 2019), particularly when the firm has a higher purchasing ratio than its customers and a strong capability for critical innovation. In addition, research explores the effects of the supply chain on a range

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of topics, such as earnings management (Raman and Shahrur, 2008), asset structure (Banerjee et al., 2008), bank loans (Campello and Gao, 2017) and financing cost (Dhaliwal et al., 2016).

Studies mainly focus on the supply chain's impact on firms, while few explore the information contained within the chain. The supplier–customer relationship is a key contractual element between upstream and downstream firms, and it represents a type of non-financial information that can be captured and analyzed by external investors, especially analysts. Owing to the technological advances of the Internet, this information is increasingly accessible and processing costs are decreasing. Analysts are now paying increasing attention to non-financial data, such as environmental performance disclosure and political uncertainty, in addition to standard financial data and stock prices. A supply chain is a form of relational non-financial information that is distributed across multiple subjects. As Guan et al. (2015) and Luo and Nagarajan (2015) suggest, tracking the information disclosed by leading suppliers and customers can improve analyst accuracy and provide more accurate capital signals to the capital market.

In this study, we expand research in this field by exploring the value of information in the supply chain. We examine this issue from the perspective of analyst forecast behavior. Specifically, we investigate the influence of supplier concentration on analyst forecast dispersion, or error, and the role of information in the supply chain on the capital market. Current proxies for corporate information transparency may have limited reliability and validity, as they mainly reflect a firm's financial and stock price information, such as accrued earnings management (Bhattacharya et al., 2003) and accounting information quality (Kim and Verrecchia, 2001), without fully considering supply chain information. We determine whether supply chain information is beneficial to analyst forecasts, thus broadening understanding in this field.

We construct a panel dataset of Chinese listed firms from 2007 to 2019, containing information on supplier concentration and proxies for analyst forecast behavior. The China Securities Regulatory Commission's (CSRC) requirement that listed firms disclose their top five suppliers and purchasing ratios in 2007 enables us to establish this dataset. Compared with the developed markets of Europe and America, the Chinese market is a late starter and has a relatively poor information environment (Piotroski et al., 2015). Our study highlights the potential for information discovery in the supply chain, which could help refine and improve the Chinese market.

We estimate a panel regression in which analyst forecast dispersion is regressed on supplier concentration and other firm characteristics. We find that analyst forecast dispersion is negatively associated with supplier concentration. We test the hypothesis that supplier concentration could reduce financial information transparency, and obtain consistent results. Our analysis suggests that a firm with a higher supplier concentration has lower information transparency due to more severe agency problems. Low financial transparency has a negative impact on analyst forecasts, but the positive effect of centralized suppliers is more pronounced. In addition, we find that high financial transparency helps alleviate the negative relationship between supplier concentration and analyst forecast dispersion. Our findings indicate that supply chain information and traditional financial information are two different sources that impact analyst forecasts and that supplier concentration plays a significant role in promoting analyst forecasts for firms with high institutional shareholding ratios and strong industry competition. Furthermore, we address endogeneity problems (e.g., omitted variable bias and reverse causality problems) using an instrumental variable (IV) regression and propensity score matching (PSM). Our primary findings remain intact after conducting various robustness tests, including substituting our proxies for supplier concentration and analyst forecast behavior and changing the model specifications by adding control variables. Our results are robust and significant.

Our study contributes to three strands of literature. First, we explore the types of non-financial information that analysts can mine, a key research direction in recent years (Griffin et al., 2020; Yu et al., 2020). We demonstrate the value of supply chain information and its importance in disclosure, and provide empirical evidence of the association between supplier concentration and analyst forecast behavior.

Second, our study contributes to research on the impact of contractual relationships between upstream and downstream firms in the supply chain. Studies focus mainly on how the supply chain can affect the firm itself, such as the effects on corporate decision-making (Chu et al., 2019) and asset structure (Banerjee et al., 2008). However, the influence of the supply chain on external stakeholders (such as analysts) receives limited attention in the literature. Thus, in this study, we seek to expand the exploration of the information contained in the supply chain and provide a valuable supplement to this field.

Finally, our study adds to the body of literature on the factors that affect the spread and accuracy of analyst forecasts and firms' supply chain information. We find that analysts' increased tracking of supply chains can improve their forecasts of firm performance (Guan et al., 2015; Luo and Nagarajan, 2015). A centralized supply chain decreases the barriers to analyst tracking and thus, by attracting additional analysts to access information in the supply chain, it improves information efficiency. Our research provides new evidence for the inclusion of supply chain information in decision-making and forecasts. The results encourage the market to pay more attention to enterprise supply chain information and improve market efficiency.

The remainder of the study is structured as follows. In Section 2, we review the relevant literature and present our hypotheses. Section 3 outlines the data sources and empirical design. Section 4 evaluates the influence of supplier concentration, explores the financial information transparency effect and discusses the potential mechanism. In addition, we examine the heterogeneous effect of transparency, competitive concentration and the institutional shareholding ratio. In Section 5, we conduct a series of robustness checks. Section 6 further examines some of our findings. Finally, Section 7 concludes this study.

2. Literature review and hypothesis development

Analysts are the external stakeholders of a firm and their primary goal is to predict information accurately (Hong and Kubik, 2003). The more precise the information they possess, the more likely they are to make accurate predictions. However, Zhang (2006a) finds that professional investment intermediaries and sell-side analysts are prone to behavioral biases under high information uncertainty. The effect of an increasingly centralized supply chain on firms' information transparency remains a matter of debate. Academic evidence suggests that supplier/customer concentration can positively or negatively affect information transparency.

Firms tend to maintain long-term cooperative relationships with fixed suppliers, which can benefit their operations and cooperation. According to Dyer (1996), firms can gain higher value-added from the supply chain if they maintain longer supplier–customer relationships. Conversely, if the contractual relationship is broken, reconstructing a similar relationship will require cost inputs (Titman and Trueman, 1986). This gives firms an incentive to sustain their existing supply chains. To develop a long-term cooperative relationship and ensure its longevity, it is important to reduce information asymmetry (Costello, 2013), which requires information exchange between firms. Consequently, firms are likely to disclose some information to other firms in the supply chain to maintain cooperation.

Furthermore, Hui et al. (2012) and Cen et al. (2016) demonstrate that major customers have incentives to monitor their suppliers. Cen et al. (2016) prove that major customers tend to screen and monitor their suppliers to ensure the stability of the supply chain. Suppliers have the same incentive to promote information exchange and reduce information asymmetry in the supply chain.

Conversely, a firm with a high level of supplier concentration will rely on a few major suppliers. According to bargaining power theory (Nagarajan and Bassok, 2008), this could place the firm in an unfavorable position, as suppliers may have more power than the firm does. To meet the expectations of large suppliers, firms with market weaknesses may increase their core earnings through classified transfers, a type of earnings management activity (McVay, 2006; see also Barua et al., 2010). Baumol (1986) finds that relational transactions in the supply chain can promote specific investments between firms and suppliers or customers, which can negatively affect the quality of accounting information.

The cooperative relationship between suppliers and customers can promote supply chain integration, reducing the information asymmetry between the parties. Research shows that analysts tracking the supply chain can make better firm forecasts and improve their forecast accuracy than analysts who overlook or ignore supply chain information (Guan et al., 2015; Luo and Nagarajan, 2015). The structural information of the supply chain plays a critical role in analyst forecast behavior. First, the supply chain structure itself is an incremental and essential source of non-financial information, which augments analysts' analytical capabilities. The impact stems directly from analysts' acquisition of supply chain structure information pertaining to their focal firms. Second, by leveraging supply chain structure information and tracking other firms within the supply chain, analysts can improve their forecast accuracy and mitigate forecast dispersion. The effect is particularly pronounced when close business ties exist among the firms operating within the supply chain because their information is likely to be complementary (Guan et al., 2011). Sustaining the supply chain facilitates informa-

tion exchange among firms and promotes long-term collaboration. Intensified business interdependencies often manifest as correlated financial information. For instance, a supplier's profitability may be related to the performance of its customer. Therefore, by scrutinizing the circumstances of closely connected firms in the supply chain, analysts can derive abundant and precise insights concerning firm performance and potential risks. Moreover, firms in the same supply chain are likely to be influenced by shared macroeconomic conditions or external shocks. Consequently, monitoring primary firms along the supply chain enables analysts to better capture these dynamics (Pandit et al., 2011).

In conclusion, we show that high supplier concentration, a sign of close business ties between suppliers and customers, may help analysts to obtain a greater volume of information with improved disclosure quality, thereby improving their forecast accuracy.

H1a: Firms with higher supplier concentration experience lower dispersion in analyst forecasts and more accurate results.
H1b: Firms with lower supplier concentration experience greater dispersion in analyst forecasts and less accurate results.

Research shows that a firm's performance can influence the performance of other firms in its supply chain. Olsen and Dietrich (1985) demonstrate that a firm's monthly sales announcements can affect its suppliers' stock prices. Hertzel et al. (2008) propose that when a firm files for bankruptcy, its suppliers experience negative stock returns. Shahrur et al. (2010) observe that changes in the returns of customer industries often precede those of supplier industries, suggesting that there is a sequence of information transmission between suppliers and customers. Moreover, Guan et al. (2015) suggest that the effect of information transfer in the supply chain is related to relationship strength, with a closer economic connection leading to stronger information transfer and greater complementarity.

When an industry is characterized by fierce competition, a firm's competitive advantages are low. This increases its exposure to supply chain risks, as suppliers can easily find alternative partners (Han et al., 2012). To counter this, firms must take proactive steps to strengthen their economic ties with their suppliers. Our prediction is that information externalities in the supply chain will be more substantial for firms in competitive industries, and that the association between analyst forecast behavior and supplier concentration will be more pronounced in this situation.

The increase in institutional ownership has profound implications for the availability of information to analysts. According to Yan and Zhang (2009), institutional investors can increase their knowledge before an announcement, thereby improving disclosure. Mitra and Cready (2005) find that a high institutional shareholding ratio can effectively reduce the use of accounting discretion and improve information effectiveness. We hypothesize that a high institutional ownership ratio will benefit analyst forecasts and enhance the strength of our findings.

H2: For firms with high institutional ownership and intense industry competition, the correlation between supplier concentration and analyst forecast behavior is stronger.

3. Data and methodology

3.1. Data and sample

We obtain data on accounting, suppliers and analyst forecast behavior from the China Stock Market & Accounting Research (CSMAR) database. In this study, all industry classifications follow the Guidelines for the Industry Classification of Listed Firms issued by the CSRC in 2012. Under this industry classification, every industry is represented by a capital letter. Considering the large number of firms in the manufacturing industry, the classification standard is further subdivided and represented by a capital letter and a number.

Since 2007, the CSRC has required listed firms to disclose their top five suppliers and the proportion of their total purchases from each. Our sample consists of all listed firms in China, with the exception of those

in the finance and utility industries, for the 2008–2019 period, resulting in 9,912 firm-year observations from 1,965 unique firms. To mitigate the impact of outliers, we winsorize all continuous variables at the 1st and 99th percentiles.

3.2. Variable construction

3.2.1. Supplier concentration

Owing to a lack of detailed data on suppliers, many studies use the purchasing ratio of major suppliers to measure supplier concentration (Itkowitz, 2013; Dhaliwal et al., 2016). In comparison, customer data are much more readily available, such that the literature concerning the measurement of customer concentration is much richer. Following Dhaliwal et al. (2016) and Itkowitz (2013), we choose three methods to construct proxy variables for supplier concentration. As noted, the CSMAR database includes only the top five suppliers of each listed firm. Thus, when calculating supplier concentration, we use these five major suppliers to represent the entire supply chain for each firm. As a first measure, we adopt the Herfindahl–Hirschman index (HHI), which is a common approach in the literature, to capture customer concentration (Patatoukas, 2012; Campello and Gao, 2017). Specifically, the HHI is formulated as follows:

$$SupC5_{it} = \sum_{j=1}^{5} \left(\frac{Sales_{ijt}}{Sales_{it}} \right)^2,$$

where $Sales_{ijt}$ represents the amount purchased by firm i from supplier j in year t and $Sales_{it}$ represents firm i's total amount purchased in year t. This variable ranges from zero to one, with a higher value corresponding to a more concentrated supplier base. If the value is zero, the firm has no supplier disclosure, whereas a value of one means that the firm has only one major supplier.

For robustness, we construct two other measures of supplier concentration. For our second measure, we construct *SupC*3 using data on the top three major suppliers. Then, our third method uses the sum of the purchasing ratio of the top five suppliers to proxy supplier concentration, which is a classical method frequently used in the literature (Pearson and Trompeter, 1994; Steven et al., 2014). Specifically, it is formulated as follows:

$$T5_{it} = \sum_{j=1}^{5} \frac{Sales_{ijt}}{Sales_{it}},$$

where the specific meaning of each variable is consistent with the previous formula. This measure is used in the robustness checks.

3.2.2. Analyst opinion divergence

We follow the literature and use the analyst forecast dispersion variable, *FDISP*, as a proxy for analyst opinion divergence. For additional robustness, we use analyst forecast error (*FERROR*) and optimism (*Optimism*) as alternative measures. We measure *FDISP* in three ways. Following Hope (2003a), Zhang (2006b) and Thomas (2002), we use the variance of analyst forecast values to measure *FDISP* in all three cases, but our three measurement methods are normalized differently. First, we construct *FDISP*1 using the method developed in the literature (Hope, 2003a; Johnson, 2004), which uses the average stock price of firm i over a year to reduce the influence of abnormal stock prices at a certain point. Thus, analyst forecast dispersion can be measured as

$$FDISP1_{it} = \frac{Std(Feps_{it})}{Mean(Price_{it})},$$

where $Std(Feps_{it})$ denotes the variance of analyst forecasts for firm i in year t and $Mean(Price_{it})$ denotes the average stock price of firm i over a fiscal year. A higher value for this variable indicates greater analyst forecast dispersion.

Second, following the classic approach adopted by Zhang (2006b), who uses the stock price of firm i at the end of year t to measure analyst forecast dispersion, we build *FDISP*2. Third, following Papakroni (2013), we

define *FDISP*3, which is normalized by the actual value of firm i in year t. The three variables are calculated similarly to each other; among them, *FDISP*1 and *FDISP*2 are more widely used methods than *FDISP*3. Thus, we use *FDISP*1 and *FDISP*2 as the main explained variables, while *FDISP*3 is used to test the robustness of this study.

In line with the literature, in addition to *FDISP*, we adopt analyst forecast error (*FERROR*) as a second metric to measure analyst opinion divergence. We follow Brown and Kim (1991) and Lys and Soo (1995) and measure analyst forecast error as the difference between the average analyst forecast value and the actual value, and we scale it by the stock price at the beginning of year t, as follows:

$$FERROR_{it} = \frac{Abs[Mean(Feps_{it}) - Meps_{it}]}{BeginPrice_{it}},$$

where $Feps_{it}$ represents the analyst's forecast earnings per share of firm i in year t and $Mean(Feps_{it})$ is the mean of all analysts' forecast. $Meps_{it}$ denotes the actual earnings per share of firm i in year t. $BeginPrice_{it}$ denotes the share price at the beginning of year t. A larger value for this variable means that analysts are more inaccurate in their opinions.

3.3. Empirical model

We examine the association between analyst forecast dispersion and supplier concentration for the firm on which analysts focus by estimating the following panel regression model:

$$FDISP_{it} = \alpha_0 + \alpha_1 T5_{it} + \lambda X_{it} + \mu_i + \theta_t + \varepsilon_{it},$$

where $FDISP_{it}$ denotes analyst forecast dispersion for firm i in year t. It can be replaced with any proxy method discussed above, including *FERROR* and *Optimism*. Following Dhaliwal et al. (2016) and Itkowitz (2013), as our main explanatory variables, we select $T5_{it}$ and $T3_{it}$, which represent supplier concentration based on purchasing ratios. The vector X includes several control variables and we include firm and year fixed effects to control for firm factors and general business cycles.

The vector X includes some firm variables that impact analyst forecasts. We first include earnings per share volatility, *MepsVol*, because it is difficult for analysts to predict volatile earnings (Dichev and Tang, 2009). Hope (2003b) argues that losses can destabilize earnings, making earnings prediction complex for the analyst. Therefore, we add the variable *Loss* to our vector to control for this effect. Following Bae et al. (2008), we include a state ownership variable (*SOE*) to control for the effect of firm ownership (i.e., whether a firm is a state-owned enterprise [SOE]) on information disclosure. In addition, we add ownership concentration (*OwnCon*) to the control vector X, which is the sum of the shares held by the top 10 shareholders of the firm. Fidrmuc et al. (2006) and Jiang et al. (2011) find that ownership concentration has a U-shaped effect on the degree of information symmetry, thus affecting analyst forecasts. Furthermore, we include some firm fundamental variables to control for the firm's impact on analyst forecasts, including firm size (*Size*), leverage (*Lev*), return on assets (*ROA*) and firm age (*Age*). The specific variable definitions are reported in the Appendix.

3.4. Summary statistics

Panel A of Table 1 reports the descriptive statistics of the variables. The mean values of *FDISP*1, *FDISP*2 and *FDISP*3 are 0.022, 0.025 and 1.762, respectively. There is no significant difference between the first two variables because both are normalized by the share price. *FDISP*3, which is normalized with the actual value, is larger than the other proxy variables, as expected. The mean value of *FERROR* is 0.037. The mean value of the top five supplier concentration using the HHI method (*SupC*5) is 0.053, whereas that for the top three suppliers (*SupC*3) is 0.050. The average value of the purchasing ratio of the top five suppliers is 33.6%. In addition for firm characteristics, we find that *Size*, expressed as the average natural logarithm, is 22.163; *Lev* is 41.5%; *ROA* is 3.6%; *Age*, expressed as a natural logarithm. is 2.795; *MepsVol* is 0.252; and *OwnCon* is 58.7%. About 9.6% of the observations in the sample have a loss, and SOEs account for about 27.9% of the firms in the sample.

Table 1
Descriptive Statistics. Panel A of this table shows the sample's supplier concentration, analyst forecast dispersion or accuracy, and descriptive statistical results of other control variables. In contrast, Panel B shows the correlation coefficient matrix among variables. Specifically, supplier concentration variables are *SupC*5, *SupC*3, and *T*5, while analyst prediction dispersion or accuracy variables are *FDISP*1, *FDISP*2, *FDISP*3 and *FERROR*. The others are all control variables. Definitions of the variables are provided in the Appendix. ***, **, and * denote the significance at the 1%, 5%, and 10% levels, respectively.

Panel A. Summary Statistics

	Mean	S.D.	Q5	Q25	Median	Q75	Q95	N
FDISP1	0.022	0.019	0.002	0.008	0.016	0.031	0.069	11,642
FDISP2	0.025	0.021	0.002	0.008	0.018	0.034	0.078	11,642
FDISP3	1.762	3.432	0.091	0.293	0.660	1.540	7.466	11,642
FERROR	0.037	0.051	0.002	0.008	0.019	0.043	0.136	11,642
SupC5	0.053	0.083	0.002	0.009	0.022	0.058	0.220	11,642
SupC3	0.050	0.083	0.001	0.007	0.019	0.052	0.217	11,642
T5	0.336	0.194	0.090	0.193	0.294	0.445	0.732	11,642
Size	22.163	1.158	20.551	21.352	22.014	22.801	24.406	11,642
Lev	0.415	0.202	0.108	0.252	0.406	0.561	0.759	11,642
ROA	0.036	0.071	−0.059	0.016	0.038	0.068	0.127	11,642
Age	2.795	0.356	2.079	2.565	2.833	3.045	3.296	11,642
MepsVol	0.252	0.260	0.030	0.090	0.169	0.313	0.774	11,642
Loss	0.096	0.294	0.000	0.000	0.000	0.000	1.000	11,642
SOE	0.279	0.448	0.000	0.000	0.000	1.000	1.000	11,642
OwnCon	0.587	0.142	0.340	0.487	0.597	0.693	0.799	11,642

Panel B. Correlation Matrix

	SupC5	Size	Lev	ROA	Age	MepsVol	Loss	SOE	OwnCon	FDISP1
SupC5	1.00									
Size	−0.12***	1.00								
Lev	−0.02***	0.40***	1.00							
ROA	−0.05***	0.03***	−0.39***	1.00						
Age	0.03***	0.17***	0.18***	−0.11***	1.00					
MepsVol	0.01	0.09***	0.14***	−0.25***	0.00	1.00				
Loss	0.06***	−0.09***	0.24***	−0.68***	0.07***	0.31***	1.00			
SOE	0.03***	0.30***	0.31***	−0.09***	0.18***	−0.01**	0.06***	1.00		
OwnCon	−0.05***	0.15***	−0.17***	0.25***	−0.23***	0.04***	−0.18***	−0.12***	1.00	
FDISP1	−0.01	0.24***	0.24***	−0.26***	0.06***	0.30***	0.19***	0.04***	−0.12***	1.00

Panel B presents the Spearman correlation matrix for the main variables. As a result of the strong correlation between *FDISP* and *FERROR*, only one variable is included in the report. It can be seen that the correlation between *Loss* and *ROA* is relatively strong, with a correlation coefficient of –0.68. A higher value for *ROA* indicates stronger profitability. *Loss* is a dummy variable representing whether the firm's profit is negative. Thus, it is reasonable to observe a strong negative correlation between *Loss* and *ROA*. The correlations of the other control variables are modest, with correlation coefficients below 0.4, suggesting that the multicollinearity problem is relatively mild.

4. Empirical results

4.1. Baseline regression

Table 2 presents the associations between two measures of supplier concentration (*SupC*5 and *SupC*3) and two proxies for analyst opinion divergence (*FDISP*1 and *FDISP*2). The regression coefficients of *SupC*5 and *SupC*3 remain negative across all columns, indicating that analyst opinion dispersion decreases significantly as supplier concentration increases. This is consistent with H1a and is statistically significant at the 1% level.

Our results show that as *SupC*5 increases by one standard deviation, *FDISP1* and *FDISP2* decrease by 4.63% and 5.81%, respectively. The corresponding figures for *SupC*3 are 4.58% and 5.85%, respectively. These results are consistent with research indicating that a more concentrated supply chain can reduce information

Table 2
Supplier Concentration and Analyst Forecast Accuracy. This table presents the effect of supplier concentration on analysts' forecast behavior for a sample of China-listed firms from 2008 to 2019. The dependent variables are *FDISP*1 (the dispersion in analyst forecasts calculated by monthly average stock prices) and *FDISP*2 (the dispersion in analyst forecasts calculated by year-end stock prices) in year t. The main explanatory variables *SupC*5 and *SupC*3 are the supplier concentrations calculated as the sum of the squared sales-based purchasing ratios of the top five and three suppliers, following Campello and Gao (2017) and Patatoukas (2012). The control variables include *Size* (the natural logarithm of total assets), *Lev* (total liabilities to total assets), *ROA* (net income over total assets), *Age* (the natural logarithm of the age of the firm), *MepsVol* (the volatility of Meps), *Loss* (a dummy variable that is 1 when net profit is negative and 0 otherwise), *SOE* (a dummy variable, 1 for state-owned enterprises and 0 for others), and *OwnCon* (the total shareholding ratio of the top ten shareholders of the firm). The detailed variable definitions are presented in Table A1. All regressions include firm and year fixed effects. The robust t-statistics clustered by the firm are reported in parentheses. ***, **, and * denote the significance at the 1%, 5%, and 10% levels, respectively.

	SupC5		SupC3	
	(1) FDISP1	(2) FDISP2	(3) FDISP1	(4) FDISP2
SupC5	−0.0106***	−0.0147***		
	(−3.16)	(−3.89)		
SupC3			−0.0105***	−0.0148***
			(−3.15)	(−3.87)
Size	0.0054***	0.0075***	0.0054***	0.0075***
	(8.93)	(10.51)	(8.94)	(10.53)
Lev	−0.0048**	−0.0081***	−0.0048**	−0.0081***
	(−2.19)	(−3.18)	(−2.19)	(−3.18)
ROA	−0.0426***	−0.0508***	−0.0426***	−0.0508***
	(−8.66)	(−9.07)	(−8.67)	(−9.08)
Age	−0.0148***	−0.0186***	−0.0148***	−0.0186***
	(−3.92)	(−4.14)	(−3.92)	(−4.14)
MepsVol	0.0160***	0.0203***	0.0160***	0.0203***
	(12.54)	(13.63)	(12.54)	(13.64)
Loss	−0.0011	−0.0002	−0.0011	−0.0002
	(−1.27)	(−0.18)	(−1.27)	(−0.18)
SOE	−0.0016	−0.0026	−0.0016	−0.0026
OwnCon	(−0.33)	(−0.45)	(−0.33)	(−0.45)
	−0.0291***	−0.0357***	−0.0291***	−0.0357***
	(−(−8.80)	(−9.29)	(−8.81)	(−9.29)
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	11,456	11,456	11,456	11,456
Number of Firms	2,134	2,134	2,134	2,134
Adjusted R^2	0.39	0.41	0.39	0.41

asymmetry and improve information exchange between firms (Hui et al., 2012; Costello, 2013; Cen et al., 2016). Our findings further suggest that viewing firms from the supply chain perspective can reduce analyst forecast dispersion.

The coefficient of *Size* is significant and positive, indicating that larger firms may have higher analyst forecast dispersion. The coefficients of *Lev*, *ROA* and *Age* are all negative, suggesting that analyst forecasts may be more consistent for firms with high leverage and high ROA, and for older firms. In addition, the coefficients of *MepsVol* are positive, which aligns with our prediction that analyst opinion divergence is greater for firms with higher earnings volatility. The coefficients of *OwnCon* are negative and significant in Columns (1)–(4), indicating that higher ownership concentration is associated with lower analyst forecast dispersion. Finally, the coefficients of *SOE* are negative for both *FDISP1* and *FDISP2*, suggesting that analyst forecasts are more consistent for SOEs than for non-SOEs.

4.2. Supplier concentration and information transparency

We explore the relationship between supplier concentration and firm information transparency by adopting four transparency indicators. As noted previously, we use two main proxy variables for supplier concentra-

tion, *SupC*5 and *SupC*3. Our indicators of firm information transparency can be divided into two measurement perspectives: information contained in the stock price and the transparency of accounting information.

For the first perspective, information contained in the stock price, we choose the *KV* index and stock price synchronization (*SYN*) as our two indicators. According to Kim and Verrecchia (2001), when a firm's information disclosure is sufficient, investors' reliance on trading volume information decreases, reducing the impact of trading volume on yields. This measure became what is known as the *KV* index, which reflects the market's dependence on trading volume information and the extent of corporate information disclosure. We expect the *KV* index to be negatively correlated with corporate transparency. Roll (1988) finds that R^2, a measure of stock price synchronization, can be used as a proxy for stock price information and that in a low-noise market, stock price change is driven by the individual information of the firm. Conversely, Lee and Liu (2011) find that in a high-noise market, stock price synchronization positively reflects the information efficiency of the market. Dasgupta et al. (2010) also observe that increased noise increases the uncertainty of stock price movement in the future and that stock price synchronization is positively correlated with information efficiency. Given the relative emergence of China as a market with high noise, we conclude that corporate transparency is positively correlated with stock price synchronization, based on recent research in the literature.

For the second perspective, the transparency of accounting information, we use accrued profit (*Accrual*) and earnings smoothness (*ES*) as our indicators. *Accrual* follows the calculation method of Bhattacharya et al. (2003) and Dhaliwal et al. (2012), with a higher value indicating a higher degree of earnings management and therefore a lower level of information transparency. *ES* is a measure of accounting opacity proposed by Bhattacharya et al. (2003). It captures the relationship between reported earnings and real earnings of listed firms. The smoother the earnings, the more likely is the firm to conceal fluctuations in its performance, resulting in less transparency. Therefore, a higher *ES* value indicates higher accounting information transparency. The specific calculation methods of these indicators are provided in the Appendix.

Table 3 illustrates the results of this section. Columns (1)–(8) correspond to the four indicators, *KV*, *SYN*, *Accrual* and *ES*, respectively. With the exception of *SYN*, the coefficients are positive and significant; the coefficient of *SYN* is negative and significant. The table shows that the results in Columns (1) and (2) are significant at the 1% level, those in Columns (7) and (8) are significant at the 5% level and those in Columns (3)–(6) are significant at the 10% level. *SYN* is positively correlated with transparency, whereas the other indicators are negatively correlated with transparency. These findings suggest that supplier concentration increases the firm's financial information transparency, thus reducing information asymmetry. Our results are consistent with those of McVay (2006) and Barua et al. (2010), who find that weak firms in the supply chain increase their core earnings and performance through classified transfer earnings management activities. Given this logic, firms with a greater concentration of suppliers are more likely to adjust their reporting data to minimize supply chain risk. Although adjusting the reporting data could make the firm's supply chain more secure, it generates an informational impediment for analysts.

Most indicators of information quality are derived from accounting information and stock prices. These indicators measure the quality of firm disclosure through accounting reports and public information available to investors. However, the supply chain perspective must be considered to conduct a comprehensive analysis as a basis for predicting outcomes. This is not easy for investors, and their difficulties in measuring supplier concentration and information quality may result in professional analysts having greater access to such information than the public. The implications of supplier concentration for the four transparency proxy indicators may be considered adverse, but overall they do not necessarily have a negative effect on the information quality of a firm because much of the supply chain information is not captured by the aforementioned indicators.

4.3. Firm and industry heterogeneity

We perform a cross-sectional analysis to examine the association between analyst forecast dispersion and supplier concentration, controlling for the effects of financial transparency, institutional ownership and product market competition. To do this, we divide the sample into subsamples based on high and low firm-level

Table 3
Information Transparency. This table presents the relationship between supplier concentration and information transparency for a sample of listed firms in China from 2008 to 2019. The dependent variables are *KV* (the coefficient of the impact of trading volume on yield, following Kim and Verrecchia (2001)), *SYN* (stock price synchronization calculated using R^2 statistic from the market model fromRoll (1988)), *Accrual* (the accrued profit used in calculating *FFIN*) and *ES* (earning Smooth is the relationship between reported earnings and true earnings of a listed firm (Bhattacharya, Daouk, and Welker, 2003)) in year t. The main explanatory variables *SupC5* and *SupC3* are the supplier concentrations calculated as the sum of the squared sales-based purchasing ratios of the top five and three suppliers (Campello and Gao, 2017; Patatoukas, 2012). The control variables include *Size* (the natural logarithm of total assets), *Lev* (total liabilities to total assets), *ROA*(net income over total assets), *Age* (the natural logarithm of the age of the firm), *MepsVol* (the volatility of *Meps*), *Loss* (a dummy variable that is 1 when net profit is negative and 0 otherwise), *SOE* (a dummy variable, 1 for state-owned enterprises and 0 for others), and *OwnCon* (the total shareholding ratio of the top ten shareholders of the firm). The detailed variable definitions are presented in Table A1. All regressions include firm and year fixed effects. The robust t-statistics clustered by the firm are reported in parentheses. ***, **, and * denote the significance at the 1%, 5%, and 10% levels, respectively.

	(1) KV	(2) KV	(3) SYN	(4) SYN	(5) Accrual	(6) Accrual	(7) ES	(8) ES
SupC5	0.0680***		−0.1085*		0.0657*		2.2266**	
	(3.44)		(−1.78)		(1.70)		(2.12)	
SupC3		0.0657***		−0.1038*		0.0653*		2.2654**
		(3.34)		(−1.67)		(1.66)		(2.14)
Size	−0.0296***	−0.0297***	0.0282***	0.0282***	0.0185***	0.0184***	−0.1780	−0.1788
	(−7.33)	(−7.34)	(5.17)	(5.19)	(5.14)	(5.13)	(−1.28)	(−1.29)
Lev	−0.0116	−0.0116	−0.1007***	−0.1007***	−0.2831***	−0.2831***	1.4022***	1.4037***
	(−0.87)	(−0.86)	(−6.06)	(−6.06)	(−20.60)	(−20.60)	(2.94)	(2.95)
ROA	0.0698***	0.0700***	−0.0986***	−0.0986***	0.3277***	0.3279***	−2.4313***	−2.4297***
	(3.26)	(3.26)	(−5.96)	(−5.96)	(6.80)	(6.80)	(−3.49)	(−3.49)
Age	−0.1028***	−0.1028***	−0.1252***	−0.1251***	0.0313	0.0313	−2.2349*	−2.2359*
	(−3.93)	(−3.93)	(−3.48)	(−3.47)	(1.27)	(1.28)	(−1.73)	(−1.73)
MepsVol	−0.0049	−0.0049	−0.0211***	−0.0211***	0.0364***	0.0364***	−4.3664***	−4.3665***
	(−0.88)	(−0.88)	(−2.74)	(−2.74)	(4.64)	(4.64)	(−15.77)	(−15.77)
Loss	0.0022	0.0022	−0.0051	−0.0051	0.0029	0.0029	−0.8797***	−0.8796***
	(0.63)	(0.63)	(−0.81)	(−0.82)	(0.58)	(0.58)	(−7.70)	(−7.70)
SOE	0.0153	0.0154	−0.0195	−0.0196	−0.0037	−0.0037	−1.7047	−1.7067
	(0.92)	(0.93)	(−0.60)	(−0.61)	(−0.15)	(−0.15)	(−1.38)	(−1.38)
OwnCon	0.3298***	0.3298***	−0.1375***	−0.1377***	0.0074	0.0074	−0.1085	−0.1071
	(18.65)	(18.65)	(−5.02)	(−5.03)	(0.42)	(0.43)	(−0.16)	(−0.16)
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Observations	12,378	12,378	10,791	10,791	11,239	11,239	6,923	6,923
Number of Firms	2,258	2,258	2,227	2,227	2,023	2,023	1,482	1,482
Adjusted R^2	0.57	0.57	0.34	0.34	0.09	0.09	0.55	0.55

financial transparency, institutional ownership and industry concentration. This allows us to conduct additional analyses.

4.3.1. Financial transparency

Richardson and Welker (2001) and Boone and White (2015) find that both financial transparency and the institutional shareholding ratio can influence analyst forecast behaviors. Financial transparency directly affects the availability of accounting information to analysts, with low transparency making it more difficult to obtain information and reducing the accuracy of their analysis. To exclude this influence on our results, we divide our sample according to the firms' degree of financial transparency. Specifically, we measure financial transparency using the dummy variable *FFIN*, which is based on publicly available information and almost no supply chain information. Using Dhaliwal et al. (2012) as a reference, we calculate each firm's scaled accruals (*ACCRUAL*) and allocate a value of one to firms if their *FFIN* is above the industry average; otherwise, we allocate them a value of zero.

Table 4 presents the results of the subsample regression analysis, displaying the coefficients of the explanatory variables only. Panel A reveals that supplier concentration influences analyst forecast dispersion for com-

panies with low financial transparency, whereas the effect is not as evident for firms with high transparency. This is likely to occur because financial transparency has a greater impact on analyst forecast dispersion when the influence of suppliers is reduced. At low levels of transparency, supply chain information can improve the information environment and lead to suppliers providing more accurate forecasts to analysts. Supplier concentration has a dual effect on transparency in that it can inhibit financial information but help to mine supply chain information; thus, it is beneficial to further separate the results according to transparency. For the sub-

Table 4
Cross-Sectional Analysis. This table presents the association between supplier concentration and analyst forecast dispersion for subsamples of China-listed firms from 2008 to 2019. The sample is divided into two parts based on firm-level financial transparency (*FFIN*), institutional shareholding ratio (*InstHolder*), and industry concentration (*HHI*), respectively. Industry concentration is the product market competition measure calculated as the sum of the squared sales-based market shares. The dependent variables are *FDISP*1 and FDISP2 in year t. The main explanatory variables are *SupC*5 and *SupC*3. Other control variables include *Size* (the natural logarithm of total assets), Lev (total liabilities to total assets), *ROA* (net income over total assets), *Age* (the natural logarithm of the age of the firm), *MepsVol* (the volatility of *Meps*), Loss (a dummy variable that is 1 when net profit is negative and 0 otherwise), *SOE* (a dummy variable, 1 for state-owned enterprises and 0 for others), and *OwnCon* (the total shareholding ratio of the top ten shareholders of the firm). The detailed variable definitions are presented in Table A1. All regressions include firm and year fixed effects. The robust t-statistics clustered by the firm are reported in parentheses. ***, **, and * denote the significance at the 1%, 5%, and 10% levels, respectively.

Panel A. Transparency

	Low		High	
	(1)	(2)	(3)	(4)
T5	−0.0541***		−0.0066	
	(−2.69)		(−0.35)	
T3		−0.0540***		−0.0067
		(−2.72)		(−0.34)
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	4,699	4,699	4,946	4,946
Number of Firms	1,423	1,423	1,479	1,479
Adjusted R^2	0.41	0.41	0.36	0.36

Panel B. Institutional Ownership

	Low		High	
	(1)	(2)	(3)	(4)
T5	−0.0023		−0.0513***	
	(−0.15)		(−2.87)	
T3		−0.0024		−0.0510***
		(−0.15)		(−2.86)
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	6,278	6,278	4,950	4,950
Number of Firms	1,345	1,345	1,021	1,021
Adjusted R^2	0.38	0.38	0.45	0.45

Panel C. Industry Concentration

	Low		High	
	(1)	(2)	(3)	(4)
T5	−0.0.389***		−0.0160	
	(−2.81)		(−0.98)	
T3		−0.0378***		−0.0174
		(−2.73)		(−1.09)
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	6,297	6,297	4,591	4,591
Number of Firms	1,295	1,295	900	900
Adjusted R^2	0.39	0.39	0.40	0.40

samples with low transparency, the coefficients of *SupC*5 and *SupC*3 are –0.0541 and –0.0540, respectively, and they are significant at the 1% level. Comparing the coefficients to the baseline, we find that the absolute values of the coefficients in the subsamples exceed those of the original regression based on the full sample.

4.3.2. Institutional ownership

As external investors, institutions exert strong monitoring effects on firms when institutional ownership is high. Increased institutional ownership fosters the disclosure of accurate information by firms (Boone and White, 2015). The disclosure of accurate information enhances mutual trust among firms in the supply chain and facilitates stable, long-term cooperation. In addition, high institutional ownership improves the operational performance of firms (Lin and Fu, 2017), which in turn increases the probability of establishing long-term, stable partnerships. As the business ties among firms in the supply chain strengthen, firms exhibit an increasing degree of reliance on their suppliers. Consequently, we contend that our main results will be more pronounced when institutional ownership is higher.

To evaluate a firm's institutional ownership, we divide our sample using a continuous variable, *InstHolder*, which is the percentage of shares held by institutional investors. In Table 4, Panel B presents the association between supplier concentration and analyst forecast behavior under different levels of institutional shareholding ratios. Columns (3) and (4) show that for firms with high institutional ownership, supplier concentration has a significant effect on analyst forecast behavior, as evidenced by the significant coefficients at the 1% level. In contrast, the effect is not evident for firms with a low institutional shareholding ratio. For the subsample with high institutional shareholding, the coefficients of *SupC*5 and *SupC*3 are –0.0513 and –0.0510, respectively, and the absolute values of the coefficients exceed those from the baseline results, confirming our prediction. High institutional shareholding is likely to improve certain information environments due to the supervisory role played by institutional investors, which results in greater standardization of firm behavior and more apparent supply chain functions.

4.3.3. Industry concentration

A firm's ability to influence its suppliers may depend on its bargaining power, which we measure using the degree of industry concentration. A lower degree of industry concentration indicates that the industry is more competitive, weakening the firm's bargaining power. This reduces the firm's advantage in transactions and increases its likelihood of being influenced by suppliers. Following Hou and Robinson (2006), we use *HHI* to measure industry concentration. *HHI* ranges from zero to one, with higher values indicating a higher degree of industry concentration and lower levels of competition.

Panel C of Table 4 shows the results for *HHI*. We observe that as industry concentration increases, the impact of supplier concentration on analyst forecast behavior becomes less significant. For firms with low industry concentration, the coefficients of *SupC*5 and *SupC*3 are –0.0389 and –0.0378, respectively, and both are significant at the 1% level. These values are higher than those of the baseline regression, which aligns with our expectations and supports our conclusion. When industry concentration is low, firms have limited bargaining power, and suppliers control over the firms increases. As a result, the likelihood that firms will compromise with suppliers to maintain business relations increases (Dyer, 1996). In this way, supply chains can constrain firms, and we find that the effect is significant.

4.4. Plausible channels

The number of analyst followers is an important indicator influencing analyst forecast behavior (Irani and Karamanou, 2003). Studies show that firms with more analyst followers are associated with less divergence in analyst forecasts (Irani and Karamanou, 2003). From the supply chain perspective, firms with high supplier concentration have a more straightforward supply chain structure than those with low supplier concentration, making it easier for analysts to track their entire chain (Hui et al., 2012; Cen et al., 2016). This increases analyst attention, as such firms are unlikely to manipulate information (Lang et al. 2004). Thus, we expect firms with high supplier concentration to attract many analyst followers, which is associated with improvements in analyst forecast behavior.

In summary, analyst following is expected to be an essential intermediary indicator in our analysis. Furthermore, firms are incentivized to align their earnings management with analyst forecasts (Abarbanell and Lehavy, 2003; Hunton et al., 2006), which decreases analyst forecast dispersion. Both of these effects have an impact on analyst forecasts. This section performs a two-step mediation analysis to identify the potential mechanism through which supplier concentration influences analyst forecasts. Specifically, we use the following standard method:

$$M_{it} = \alpha SupC5_{it} + \lambda X_{it} + \mu_i + \theta_t + \varepsilon_{it}$$

and

$$FDISP_{it} = \alpha M_{it} + \lambda X_{it} + \mu_i + \theta_t + \varepsilon_{it}$$

where $FDISP_{it}$ denotes analyst forecast dispersion for firm i in year t and M_{it} denotes the mediating variables. The first step is to study the relationship between the supplier concentration of the firm and analysts following earnings management. In the second step, we regress analyst forecast dispersion on supplier concentration, the mediator and other control variables.

We use the number of analysts covering the firm in a year, which can be obtained directly from the CSMAR database, and take the natural logarithm as a proxy for analyst following. We employ the modified Jones model proposed by Bartov et al. (2000) to measure earnings management, and calculate indicators such as *DisAcc* (accrued earnings management). A higher index indicates higher levels of earnings management, which can reduce analyst forecast dispersion. The specific calculation method is provided in the Appendix.

Table 5 presents the results of the mediation analyses for two variables: supplier concentration (*SupC*5) and analyst forecast dispersion (*FDISP*1). Columns (1) and (2) replicate our regression results for the mediating and independent variables. The analysis in Column (1) reveals that there is a positive and statistically significant relationship between analyst following (*Follow*) and *SupC*5. This finding suggests that firms with a higher concentration of suppliers tend to draw more analysts to follow them. This could result from the fact that, often, the costs of analysts tracking the supply chain is lower for firms with a higher concentration of suppliers, and the clear structure makes these firms easy to analyze. As a result, analysts are more likely to keep a closer eye on these firms than on their counterparts.

Column (2) shows that a higher *SupC*5 is positively correlated with a higher *DisAcc*, and this result is significant at the 5% level. This suggests that firms may engage in earnings management to meet the expectations of major suppliers and to maintain their trading relationships. The results for the remaining variables are similar.

We report the regression results of the independent variables and the mediating variables in Columns (3) and (4) to examine the existence of two potential channels. Our findings reveal that the coefficient of *Follow* and *DisAcc* remain negative and statistically significant at the 1% level, aligning with our prediction. These results suggest that *Follow* and *DisAcc* potentially serve as two channels through which supplier concentration influences analyst forecast behavior.

5. Robustness checks

5.1. Endogeneity issues

5.1.1. Instrumental variable regression

Our baseline results may be affected by potential endogeneity issues. We may not have considered some firm characteristics that could create a false correlation between supplier concentration and analyst forecast dispersion. In addition, analysts' research can influence firms' behavior, which could result in reverse causality issues. To address these potential issues, we continue to estimate the impact of supplier concentration on analyst forecast dispersion.

We estimate a two-stage least-squares model with IVs, in which *SupC*5 and *SupC*3 are regarded as endogenous variables. Following Dhaliwal et al. (2016), we choose the lagged industry average of supplier concentration as an IV, *ASupC*5 and *ASupC* 3. *ASupC*5 is the equally weighted average of *SupC*5 for all firms in the same industry, excluding the focal firm, over a fiscal year. *ASupC*3 is computed similarly. In addition, stud-

Table 5
Possible Mechanism. This table presents the mediating role of analyst following and accrued earnings management in the association between supplier concentration and analyst forecast dispersion for a sample of China-listed firms from 2008 to 2019. The dependent variables in Columns (1) and (2) are *Follow* and *DisAcc*. *Follow* is the natural logarithm of the number of analysts or teams following the firm in the same year. *DisAcc* is accrued earnings management calculated by the Modified Jones Model (Bartov, Gul, and Tsui, 2000). The main explanatory variable *SupC*5 is the top five supplier concentration constructed with the HHI method. The dependent variables in Columns (3) and (4) are all *FDISP*1 in year t, which is the proxy of analyst forecast dispersion. The explanatory variables are *Follow* and *DisAcc*. Other control variables include *Size* (the natural logarithm of total assets), *Lev* (total liabilities to total assets), *ROA* (net income over total assets), *Age* (the natural logarithm of the age of the firm), *MepsVol* (the volatility of *Meps*), *Loss* (a dummy variable that is 1 when net profit is negative and 0 otherwise), *SOE* (a dummy variable, 1 for state-owned enterprises and 0 for others), and *OwnCon* (the total shareholding ratio of the top ten shareholders of the firm). All regressions include firm and year fixed effects. The robust t-statistics clustered by the firm are reported in parentheses. ***, **, and * denote the significance at the 1%, 5%, and 10% levels, respectively.

	(1) Follow	(2) DisAcc	(3) FDISP	(4) FDISP
SupC5	−0.0069***	0.0221***		
	(2.70)	(2.07)		
Follow			−0.0026***	
			(−16.64)	
DisAcc				−0.0117***
				(−5.74)
Size	0.5758***	0.0043***	0.0045***	0.0032***
	(17.38)	(2.66)	(12.79)	(9.35)
Lev	−0.4230***	0.0005	−0.0049***	−0.0033***
	(−3.75)	(0.09)	(−3.77)	(−2.58)
ROA	2.4764***	−0.0518***	−0.0354***	−0.0446***
	(11.34)	(−3.75)	(−11.70)	(−14.79)
Age	−0.3444*	−0.0027	0.0040**	0.0044***
	(−1.83)	(−0.29)	(2.54)	(2.79)
MepsVol	0.0648	0.0161***	0.0122***	0.0121***
	(1.23)	(5.48)	(18.65)	(18.52)
Loss	−0.0117	0.0129***	−0.0005	−0.0005
	(−0.33)	(5.37)	(−0.99)	(−0.93)
SOE	−0.0145	−0.0106	0.0017	0.0013
	(−0.08)	(−1.18)	(0.85)	(0.62)
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	12,444	12,444	22,611	22,611
Number of Firms	2,262	2,262	3,097	3,097
Adjusted R^2	0.64	0.14	0.39	0.38

ies indicate that lagged independent variables can be used as IVs (Doytch and Uctum, 2011). Therefore, we select lagged supplier concentration as one of our IVs. Due to sample size limitations, we select the variable lagged by one period as an IV to reduce the loss of observations. Typically, supplier concentration remains relatively stable over time, so a firm's current supplier concentration is correlated with the previous level. The exclusion restriction is satisfied by these two IVs, with any direct relationship between them and the other variables in the current year avoided. Thus, these two variables can be used as IVs.

Table 6 presents the results of the IV regressions. Columns (1) and (2) present the first-stage results. We use the sum of the purchasing ratio of the top five suppliers (*SupC*5) or the top three suppliers (*SupC*3) as the dependent variable, with two IVs (*L.SupC*5 and *L.ASupC*5 or *L.SupC*3 and *L.ASupC*3) and other control variables as the main explanatory variables. The results show that both *L.SupC*5 and *L.ASupC*5 are significant and positively correlated with *SupC*5, which aligns with our expectation that a firm's supply chain structure has some continuity and is relevant to its industry. The results for *SupC*3 are similar. Furthermore, the Cragg–Donald Wald F statistics in these two regressions are 260.71 and 251.36, respectively, indicating that these two IVs do not suffer from weak IV issues. The Hansen J test confirms that our chosen IVs satisfy the exclusion restriction.

Table 6
Instrumental Variable Regression. The table presents the elimination of endogeneity with the instrumental variable method for a sample of China-listed firms from 2008 to 2019. The instrumental variables are *ASpC*5 (the equally-weighted average of *SupC*5 of firms in the industry and a fiscal year excluding the focal firm from Dhaliwal et al. (2016)) and *SupC*5 (the supplier concentration of the top five suppliers) in year t − 1. The instrumental variables for *SupC*3 are similar. The dependent variables are *FDISP*1 and *FDISP*2 in year t. The control variables include *Size* (the natural logarithm of total assets), *Lev* (total liabilities to total assets), *ROA* (net income over total assets), *Age* (the natural logarithm of the age of the firm), *MepsVol* (the volatility of Meps), *Loss* (a dummy variable that is 1 when net profit is negative and 0 otherwise), *SOE* (a dummy variable, 1 for state-owned enterprises and 0 for others), and *OwnCon* (the total shareholding ratio of the top ten shareholders of the firm), which is same with the baseline. The detailed variable definitions are presented in Table A1. All regressions include firm and year fixed effects. The robust t-statistics clustered by the firm are reported in parentheses. ***, **, and * denote the significance at the 1%, 5%, and 10% levels, respectively.

	First Stage			Second Stage		
	(1) SupC5	(2) SupC3	(3) FDISP1	(4) FDISP2	(5) FDISP1	(6) FDISP2
L.SupC5	0.2468***					
	(13.20)					
L.ASupC5	0.1259**					
	(2.04)					
L.SupC3		0.2423***				
		(12.93)				
L.ASupC3		0.1175*				
		(1.88)				
SupC5			−0.0677**	−0.0727**		
			(−2.23)	(−2.09)		
SupC3					−0.0713**	−0.0762**
					(−2.26)	(−2.12)
Size	−0.0056***	−0.0052***	0.0056***	0.0075***	0.0056***	0.0075***
	(−4.08)	(−3.80)	(7.68)	(8.96)	(7.74)	(9.03)
Lev	0.0043	0.0040	−0.0045*	−0.0078***	−0.0045*	−0.0078***
	(0.86)	(0.83)	(−1.81)	(−2.71)	(−1.81)	(−2.71)
ROA	0.0015	−0.0002	−0.0365***	−0.0440***	−0.0366***	−0.0441***
	(0.17)	(−0.02)	(−6.92)	(−7.30)	(−6.95)	(−7.33)
Age	−0.0040	−0.0045	−0.0180***	−0.0213***	−0.0180***	−0.0214***
	(−0.46)	(−0.53)	(−3.77)	(−3.94)	(−3.78)	(−3.95)
MepsVol	0.0039*	0.0038*	0.0171***	0.0213***	0.0171***	0.0213***
	(1.95)	(1.94)	(12.37)	(13.29)	(12.38)	(13.31)
Loss	−0.0006	−0.0007	−0.0011	−0.0001	−0.0011	−0.0001
	(−0.38)	(−0.48)	(−1.19)	(−0.06)	(−1.20)	(−0.08)
SOE	0.0264***	0.0264***	0.0011	0.0003	0.0012	0.0005
	(3.05)	(3.08)	(0.17)	(0.05)	(0.18)	(0.06)
OwnCon	−0.0064	−0.0065	−0.0313***	−0.0380***	−0.0314***	−0.0381***
	(−0.94)	(−0.97)	(−8.33)	(−8.87)	(−8.35)	(−8.89)
Firm FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	10,640	10,640	9,761	9,761	9,761	9,761
Number of Firms	2,181	2,181				
Cragg-Donald Wald F statistic			260.71	260.71	251.36	251.36
Hansen J statistic (p-value)			0.50	0.62	0.55	0.68

The second-stage regression results, shown in Columns (3)–(6), indicate that analyst forecast dispersion (*FDISP*1 or *FDISP*2) is the main explanatory variable. We find that the coefficients of *SupC*5 and *SupC*3 are both negatively correlated and significant at the 5% level, consistent with our baseline. The p values for the Hansen's J statistic are greater than 0.50, so we cannot reject the joint null hypothesis that our IVs are unrelated to the error term. This suggests that our primary findings remain robust after appropriately addressing endogeneity concerns through IV regression.

Table 7

Propensity Score Matching. This table presents the effect of supplier concentration on analysts' forecast behavior for a sample of China-listed firms from 2008 to 2019. Panel A reports insignificant differences in covariates between the treated and control groups after matching, and Panel B reports the regression results of the matched samples. The matched sample is constructed using the propensity score matching technique. The firms with the above-median supplier concentration are the treatment group, and the other firms are the control group. The one-to-one nearest neighborhood matching algorithm is applied without replacement using firm size, firm age, leverage, return on assets, EPS volatility, earnings losses, state ownership, and ownership concentration as the matching covariates. We also need the matched firms from the same industry and fiscal year. The dependent variables are *FDISP*1 and *FDISP*2 in year t. The main explanatory variables are *SupC*5 and *SupC*3. Other control variables include *Size* (the natural logarithm of total assets), *Lev* (total liabilities to total assets), *ROA* (net income over total assets), *Age* (the natural logarithm of the age of the firm), *MepsVol* (the volatility of Meps), *Loss* (a dummy variable that is 1 when net profit is negative and 0 otherwise), *SOE* (a dummy variable, 1 for state-owned enterprises and 0 for others), and *OwnCon* (the total shareholding ratio of the top ten shareholders of the firm). The detailed variable definitions are presented in Table A1. All regressions include firm and year fixed effects. The robust t-statistics clustered by the firm and year are reported in parentheses.***, **, and * denote the significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Covariate Balance

	Sample	Control	Treatment	Diff	T-stats
size	Full	22.07	21.77	0.29	18.43
	Matched	22.03	22.04	−0.01	−0.04
Lev	Full	0.45	0.40	0.06	19.27
	Matched	0.40	0.40	−0.00	−0.06
ROA	Full	0.04	0.03	0.00	3.53
	Matched	0.04	0.04	0.00	0.03
Age	Full	2.78	2.81	−0.03	−7.21
	Matched	2.79	2.79	−0.00	−0.01
Loss	Full	0.24	0.26	−0.02	−4.76
	Matched	0.25	0.25	−0.00	−0.07
SOE	Full	0.10	0.12	−0.01	−3.57
	Matched	0.10	0.10	−0.00	−0.04

Panel B: Matched Sample

	(1) FDISP1	(2) FDISP2	(3) FDISP1	(4) FDISP2
SupC5	−0.0093***	−0.0143***		
	(−2.60)	(−3.53)		
SupC3			−0.0094**	−0.0146***
			(−2.54)	(−3.47)
Size	0.0057***	0.0077***	0.0060***	0.0081***
	(7.77)	(8.99)	(7.24)	(8.28)
Lev	−0.0045*	−0.0080***	−0.0045	−0.0084**
	(−1.75)	(−2.64)	(−1.54)	(−2.38)
ROA	−0.0385***	−0.0463***	−0.0422***	−0.0485***
	(−6.75)	(−7.05)	(−6.25)	(−6.18)
Age	−0.0091**	−0.0135**	−0.0107**	−0.0147**
	(−1.98)	(−2.47)	(−2.07)	(−2.37)
MepsVol	0.0149***	0.0191***	0.0166***	0.0210***
	(9.58)	(10.48)	(9.52)	(9.98)
Loss	−0.0011	−0.0000	−0.0013	−0.0004
	(−1.01)	(−0.04)	(−1.06)	(−0.30)
SOE	−0.0024	−0.0035	−0.0055	−0.0074
	(−0.38)	(−0.46)	(−0.92)	(−1.03)
OwnCon	−0.0310***	−0.0385***	−0.0289***	−0.0358***
	(−7.99)	(−8.75)	(−6.57)	(−7.07)
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	7,331	7,331	5,467	5,467
Number of Firms	1,746	1,746	1,417	1,417
Adjusted R^2	0.39	0.40	0.40	0.40

5.1.2. Propensity score matching

We address the concern that our baseline results may be driven by systematic differences between firms with high or low levels of supplier concentration through PSM. Specifically, we define the firms with an above-median level of supplier concentration as the treatment group, and the remaining firms as the control group. Then, we estimate a logit model with firm *Size*, *Age*, *Lev*, *ROA*, *MepsVol*, *Loss*, *SOE* and *OwnCon* as matching covariates to obtain the propensity scores. These control variables are consistent with those in our baseline regression. We consider the matched firms from the same industry and fiscal year, following the classification method published by the CSRC in 2012. Applying the one-to-one nearest neighbor matching technique without replacement, the matched sample consists of 7,331 and 5,467 firm-year observations.

The covariate balance test in Panel A of Table 7 reveals insignificant differences in covariates between the treatment and control groups after PSM. Fig. 1 confirms that PSM successfully minimizes the systematic difference in the firm characteristics of the matched sample. To conserve space, we show the test results only for *SupC*5 here. The results are quantitatively similar for *SupC*3.

Panel B of Table 7 presents the results of the regression performed on the matched sample, with *FDISP*1 or *FDISP*2 as the primary explanatory variable. We find that the coefficients of *SupC*5 and *SupC*3 are negative in all columns, with Columns (1), (2) and (4) being significant at the 1% level and Column (3) at the 5% level. The magnitude of the coefficients is similar to that of our baseline estimation when the PSM technique is implemented. Thus, our main results remain unchanged after matching, suggesting that the relationship between analyst forecast behavior and supplier concentration is independent of the systemic characteristics of firms. Therefore, our results are robust when PSM is employed.

5.2. Alternative variable definitions

To assess the strength of our study findings, we substitute the proxy for analyst opinion divergence in our baseline model with the alternatives *FDISP*3 and *FERROR*. As noted previously, *FDISP*3 is an index of analyst forecast dispersion and *FERROR* is a measure of analyst forecast error. Thus, we use these variables in a regression analysis as a robustness check.

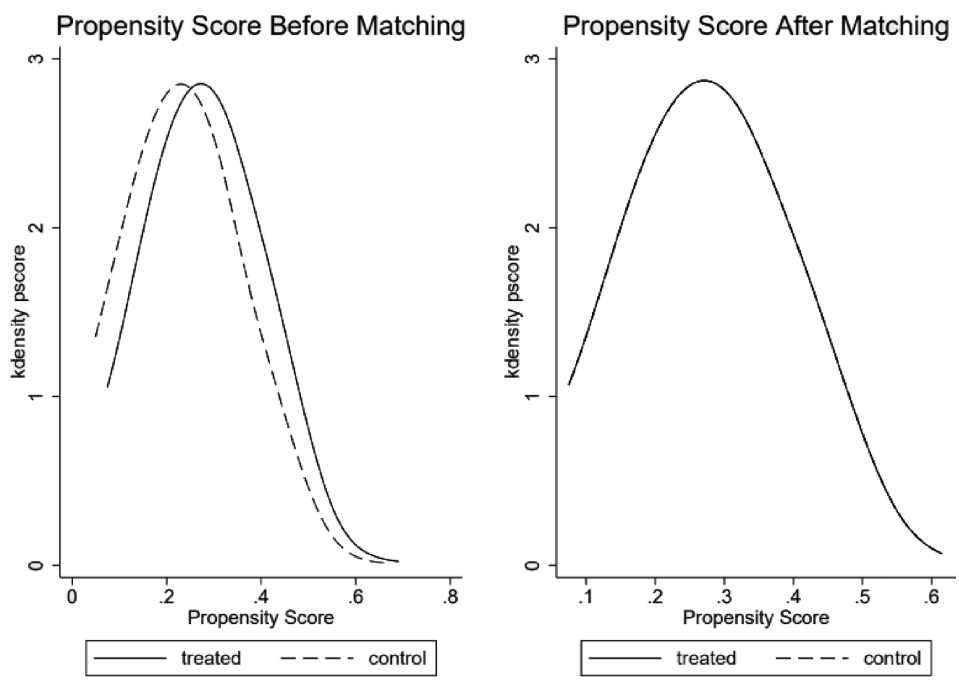

Fig. 1. Propensity Score Before and After Matching.

Table 8 presents the results of the *SupC*5 and *SupC*3 models. For *SupC*5, the regression coefficients of *FDISP*3 and *FERROR* are all negative and significant at the 10% level. Similarly, for *SupC*3, the regression coefficients of the explanatory variables are all negative and significant at the 10% level. These results demonstrate that supplier concentration significantly improves analyst forecast dispersion. The improvement in supplier concentration appears to affect analyst forecast behavior. We speculate that this occurs because of the information contained in the supply chain, which can be beneficial to analyst forecasts. With a centralized supply chain, this information becomes readily accessible and, therefore, it can improve forecast accuracy. In addition, supplier concentration often implies risk, tempering analysts' optimism. These results are consistent with those of our baseline regression, demonstrating the robustness of our findings.

We further test the robustness of our results by replacing the explained variable *HHI* with *T*5, the sum of the purchasing ratio of the top five suppliers, as explained previously. We conduct a regression analysis with our proxies for analyst opinion divergence (*FDISP*1, *FDISP*2, *FDISP*3 and *FERROR*), enabling us to effectively assess the robustness of our results.

Table 9 presents the regression results and reveals that all of the coefficients are negative and significant. *FDISP*1 and *FDISP*2 (Columns (1) and (2), respectively) are significant at the 1% level, whereas *FDISP*3 (Col-

Table 8
Alternative Analyst Forecast Dispersion and Error. This table presents the association of supplier concentration with an alternative measure of analysts' forecast behavior for a sample of China-listed firms from 2008 to 2019. The dependent variables are *FDISP*3 (the dispersion in analyst forecasts calculated by the actual value (Papakroni, 2013)) and *FERROR* (the accuracy in analyst forecasts calculated by the share price of the beginning of the year, following Brown and Kim (1991), and Lys and Soo (1995)). The main explanatory variables are *SupC*5 and *SupC*3, which are the supplier concentrations of top five and three suppliers, following Campello and Gao (2017) and Patatoukas (2012). The control variables include *Size* (the natural logarithm of total assets), *Lev* (total liabilities to total assets), *ROA* (net income over total assets), *Age* (the natural logarithm of the age of the firm),*MepsVol* (the volatility of Meps), *Loss* (a dummy variable that is 1 when net profit is negative and 0 otherwise), *SOE* (a dummy variable, 1 for state-owned enterprises and 0 for others), and *OwnCon* (the total shareholding ratio of the top ten shareholders of the firm). The detailed variable definitions are presented in Table A1. All regressions include firm and year fixed effects. The robust t-statistics clustered by the firm are reported in parentheses. ***, **, and * denote the significance at the 1%, 5%, and 10% levels, respectively.

	SupC5		SupC3	
	(1) FDISP3	(2) FERROR	(3) FDISP3	(4) FERROR
SupC5	−1.5622*	−0.0122*		
	(−1.94)	(−1.85)		
SupC3			−1.5287*	−0.0122*
			(−1.91)	(−1.87)
Size	0.2500**	0.0038***	0.2512**	0.0038***
	(2.14)	(2.59)	(2.15)	(2.60)
Lev	−0.6413	−0.0020	−0.6425	−0.0020
	(−1.50)	(−0.42)	(−1.50)	(−0.42)
ROA	−7.7399***	−0.3441***	−7.7432***	−0.3441***
	(−7.01)	(−26.05)	(−7.01)	(−26.05)
Age	−1.1994*	−0.0125*	−1.1990*	−0.0125*
	(−1.70)	(−1.72)	(−1.70)	(−1.72)
MepsVol		0.0616***	0.4580*	0.0616***
	0.4586*			
	(1.90)	(18.64)	(1.90)	(18.63)
Loss	−2.5154***	0.0239***	−2.5156***	0.0239***
	(−8.41)	(10.26)	(−8.41)	(10.26)
SOE	0.3372	0.0002	0.3369	0.0002
	(0.30)	(0.02)	(0.30)	(0.02)
OwnCon	−4.1139***	−0.0434***	−4.1141***	−0.0434***
	(6.17)	(−5.97)	(6.17)	(−5.97)
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	11,462	12,437	11,462	12,437
Number of Firms	2,134	2,262	2,134	2,262
Adjusted R^2	0.20	0.64	0.20	0.64

umn (3)) is significant at the 5% level and *FERROR* (Column (4)) is significant at the 10% level. These results are in line with the findings for *SupC*5 and *SupC*3 in the baseline regression, lending further support to the robustness of the conclusions drawn in this study.

5.3. Additional control variables

We investigate the robustness of our research results by adding control variables to our basic model. The results of Table 10 show that although we select *FDISP*1 and *SupC*5 for reporting, the remaining variable combinations are consistent with these representative variables.

Column (1) of Table 10 provides our baseline result for comparison with the results after adding the control variables. We add two control variables to our baseline regression equation, *FFIN* and *InstHolder*, with the results reported in Column (2). Boone and White (2015) show that financial transparency directly affects analyst forecast accuracy and that institutional ownership influences information transparency as a result of agency problems and analyst forecast behavior. Therefore, we add these two indicators as control variables and use them for subsample analyses.

In Column (2) of Table 10, we add a non-financial metric to the regression results, analysts' forecast horizon (*Horizon*), which measures the time between the forecast date and the earnings announcement date. De Bondt and Thaler (1990) and O'Brien (1990) find that as the forecast horizon increases, analyst forecast error

Table 9
Alternative Supplier Concentration Measures. This table presents the association of supplier concentration on an alternative measure of analysts' forecast behavior for a sample of China-listed firms from 2008 to 2019. The dependent variables are *FDISP*1 (the dispersion in analyst forecasts calculated by monthly average stock prices), *FDISP*2 (the dispersion in analyst forecasts calculated by year-end stock prices), *FDISP*3 (the dispersion in analyst forecasts calculated by the actual value (Papakroni, 2013)) and *FERROR* (the accuracy in analyst forecasts calculated by the share price of the beginning of the year, following Brown and Kim (1991) and Lys and Soo (1995)). The main explanatory variable *T*5 is the total purchasing share of the top five suppliers. The control variables include *Size* (the natural logarithm of total assets), Lev (total liabilities to total assets), *ROA* (net income over total assets), *Age* (the natural logarith of the age of the firm), *MepsVol* (the volatility of Meps), *Loss* (a dummy variable that is 1 when net profit is negative and 0 otherwise), *SOE* (a dummy variable, 1 for state-owned enterprises and 0 for others), and *OwnCon* (the total shareholding ratio of the top ten shareholders of the firm). The detailed variable definitions are presented in Table A1. All regressions include firm and year fixed effects. The robust t-statistics clustered by the firm are reported in parentheses. ***, **, and * denote the significance at the 1%, 5%, and 10% levels, respectively.

	(1) FDISP1	(2) FDISP2	(3) FDISP3	(4) FERROR
T5	−0.0048***	−0.0065***	−0.3657**	−0.0044*
	(−2.83)	(−3.40)	(−2.17)	(−1.75)
Size	0.0054***	0.0074***	0.0890	0.0043***
	(8.74)	(10.31)	(1.39)	(4.66)
Lev	−0.0048**	−0.0082***	−0.5312**	−0.0106***
	(−2.19)	(−3.19)	(−2.40)	(−3.41)
ROA	−0.0425***	−0.0507***	−4.8732***	−0.1538***
	(−8.64)	(−9.04)	(−8.76)	(−22.23)
Age	−0.0150***	−0.0188***	−0.7014**	−0.0147***
	(−3.96)	(−4.18)	(−2.03)	(−2.72)
MepsVol	0.0159***	0.0202***	0.2868**	0.0307***
	(12.49)	(13.57)	(2.21)	(15.37)
Loss	−0.0011	−0.0001	−1.5877***	0.0214***
	(−1.25)	(−0.15)	(−12.26)	(15.58)
SOE	−0.0016	−0.0026	0.3315	0.0063
	(−0.33)	(−0.45)	(0.58)	(1.12)
OwnCon	−0.0290***	−0.0355***	−2.6216***	−0.0363***
	(−8.78)	(−9.25)	(−7.67)	(−7.39)
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	11,456	11,456	11,462	12,437
Number of Firms	2,134	2,134	2,134	2,262
Adjusted R^2	0.39	0.41	0.27	0.55

Table 10
Additional Control Variables. This table presents the association of supplier concentration on analysts' forecast behavior with different models for a sample of China-listed firms from 2008 to 2019. The dependent variables are *FDISP*1 (the dispersion in analyst forecasts calculated by monthly average stock prices) in year t. The main explanatory variable *SupC*5 is the supplier concentration measure calculated as the sum of the squared sales-based purchasing ratios of the top five suppliers. The main control variables include *Size* (the natural logarithm of total assets), *Lev* (total liabilities to total assets), *ROA* (net income over total assets), *Age* (the natural logarithm of the age of the firm), *MepsVol* (the volatility of *Meps*), *Loss* (a dummy variable that is 1 when net profit is negative and 0 otherwise), *SOE*(a dummy variable, 1 for state-owned enterprises and 0 for others), and *OwnCon* (the total shareholding ratio of the top ten shareholders of the firm). The control variables in Column (2) add *FFIN* (the firm-level financial transparency) and *InstHolder* (institutional shareholding ratio). The control variables in Column (3) add *Horizon* (the range of analysts' forecast). The control variables in Column (4) add *BM* (book-to-market value), *CF* (the ratio of cash flow), and *FA* (the ratio of fixed assets). The detailed variable definitions are presented in Table A1. All regressions include firm and year fixed effects. The robust t-statistics clustered by the firm are reported in parentheses. ***, **, and * denote the significance at the 1%, 5%, and 10% levels, respectively.

	(1) FDISP1	(2) FDISP1	(3) FDISP1	(4) FDISP1
SupC5	−0.0106***	−0.0114***	−0.0109***	−0.0093**
	(−3.16)	(−3.35)	(−2.80)	(−2.34)
FFIN		−0.0007*	−0.0010***	−0.0012***
		(−1.95)	(−3.02)	(−3.49)
InstHolder		−0.0002***	−0.0003***	−0.0002***
		(−8.07)	(−8.71)	(−6.09)
Horizon			−0.0016**	−0.0026***
			(−2.52)	(−4.08)
BM				0.0221***
				(10.85)
CF				−0.0082***
				(−2.93)
FA				0.0110***
				(2.97)
Size	0.0054***	0.0066***	0.0067***	0.0045***
	(8.93)	(9.60)	(9.01)	(5.13)
Lev	−0.0048**	−0.0085***	−0.0111***	−0.0103***
	(−2.19)	(−3.55)	(−4.10)	(−3.76)
ROA	−0.0426***	−0.0402***	−0.0590***	−0.0419***
	(−8.66)	(−7.98)	(−9.22)	(−6.69)
Age	−0.0148***	−0.0142***	−0.0107**	−0.0096**
	(−3.92)	(−3.07)	(−2.16)	(−2.02)
MepsVol	0.0160***	0.0178***	0.0205***	0.0216***
	(12.54)	(12.79)	(13.00)	(13.85)
Loss	−0.0011	−0.0007	−0.0012	−0.0005
	(−1.27)	(−0.81)	(−1.21)	(−0.47)
SOE	−0.0016	−0.0016	−0.0002	−0.0005
	(−0.33)	(−0.34)	(−0.03)	(−0.11)
OwnCon	−0.0291***	−0.0068	−0.0040	−0.0132***
	(−8.80)	(−1.55)	(−0.85)	(−2.74)
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	11,456	10,333	8,722	8,493
Number of Firms	2,134	1,920	1,763	1,751
Adjusted R^2	0.39	0.40	0.42	0.44

also increases, which is probably because of the amount of information available for forecasting. In addition, we add three financial indicators to the control variables: book-to-market ratio (*BM*), cash holding ratio (*CF*) and fixed assets ratio (*FA*). The results of these regressions are reported in Columns (3) and (4), respectively. The definitions of these control variables are provided in the Appendix.

The regression coefficients of *SupC*5 in Table 10 are all negative and significant. The coefficients in Columns (1), (2) and (3) are significant at the 1% level and that in Column (4) is significant at the 5% level. Furthermore, the range of the regression coefficients is reasonable, and the direction of the newly added control variables is

consistent with the literature (DeFond and Hung, 2003; Wang and Alam, 2007). This suggests that our findings are robust to alternative model specifications.

6. Further discussion

6.1. Analyst attention

The analysis above reveals that supplier concentration is receiving increasing attention from analysts. To further investigate this phenomenon, we construct four indicators: analyst attention based on research reports (*RepAtt*), the proportion of expert analysts (*BePro*), the proportion of star analysts (*BeStar*) and the number of star analysts (*StarNum*). *RepAtt* measures the number of research reports analyzing the firm *i* in year *t*. *BePro* and *BeStar* indicate which indicator of supplier concentration has the greatest effect on increasing analyst attention. To identify the expert and star analysts, we use the length of working years, ranking all analysts and defining those with above-average working years as experts. Because of missing values in the star analyst data, we use a tobit model for the regression analysis.

Table 11
Further Exploration of Analyst Attention. The table presents the impact of supplier concentration on the component of analysts attracted for a sample of China-listed firms from 2008 to 2019. Tobit regression is used for the regression. Panel A shows the influence of analyst professionalism and reports attention. The dependent variables are *RepAtt* (research newspaper attention) and *BePro* (the proportion of expert analysts among analysts) in year t. Panel B shows the influence of star analysts. The dependent variables are *BeStar* (the proportion of star analysts among analysts) and *StarNum* (the number of star analysts among analysts) in year t. The main explanatory variables are *SupC*5 and *SupC*3, which are the supplier concentrations calculated as the sum of the squared sales- based purchasing ratios of the top five and three suppliers, following Campello and Gao (2017) and Patatoukas (2012). The control variables include *Size* (the natural logarithm of total assets), *Lev*(total liabilities to total assets), *ROA* (net income over total assets), *Age* (the natural logarithm of the age of the firm), *MepsVol*(the volatility of *Meps*), *Loss* (a dummy variable that is 1 when net profit is negative and 0 otherwise), *SOE* (a dummy variable, 1 for state-owned enterprises and 0 for others), and *OwnCon* (the total shareholding ratio of the top ten shareholders of the firm). The detailed variable definitions are presented in Table A1. All regressions include firm and year fixed effects. The robust t-statistics clustered by the firm are reported in parentheses. ***, **, and * denote the significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Reports Attention and Professional Analysts Attention

	(1) RepAtt	(2) RepAtt	(3) BePro	(4) BePro
SupC5	0.4995***		−0.1808*	
	(2.66)		(−1.81)	
SupC3		0.5091***		−0.1777*
		(2.72)		(−1.76)
Controls	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	12,444	12,444	9,393	9,393
Number of Firms	2,262	2,262	1,922	1,922
Adjusted R^2	0.65	0.65	0.11	0.11

Panel B: Star Analysts Attention Based on Tobit Measure

	(1)	(2)	(3)	(4)
	BeStar	BeStar	StarNum	StarNum
SupC5	−0.1367***		−2.4638***	
	(−2.87)		(−4.14)	
SupC3		−0.1323***		−2.3930***
		(−2.77)		(−4.01)
Controls	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	10,136	10,136	12,623	12,623
chi2	394.18	393.57	996.89	995.73

Table 11 reports the results of the tobit regression for *RepAtt* and *BePro*. *RepAtt* is significant and positively associated with supplier concentration at the 1% level. Conversely, the coefficients of *SupC*5 and *SupC*3 in Columns (3) and (4), respectively, are negative and significant at the 10% level. These results indicate that supplier concentration increases analyst attention from the perspective of research reports and decreases the proportion of expert analysts.

In contrast to this increased analyst attention, when we focus on professional analysts, we find that they pay less attention to firms with higher supplier concentration. Panel B of Table 11 shows that the coefficient of *BeStar* is negative and significant at the 1% level, similar to the results of *BePro*. To explore whether this reduction is due to a larger base or a decrease in the number of star analysts, we introduce another explanatory variable, namely, the logarithm of the star analyst scale (*StarNum*). Columns (3) and (4) show that the coefficients of *SupC*5 and *SupC*3, respectively, are negative and significant at the 1% level. This suggests that supplier concentration attracts additional analysts but results in a reduction in attention from star analysts. Firms with higher supplier concentration may have simpler businesses and may therefore be more attractive to average analysts. However, star analysts are likely to be cautious of the increased risk in the supply chain and thus avoid such firms.

6.2. Analyst concerns regarding supply chains

Our aim is to clarify that supplier concentration can improve analysts' focus on the supply chain. Although the result in the Guan et al. (2011) suggests that this is the case, they do not provide certain evidence. We use

Table 12

Analysts' Concerns about Supply. The table presents the impact of supplier concentration on the focus of analysts' attention for a sample of China-listed firms from 2008 to 2019. Tobit regression is used for the regression. The dependent variables are *Upstream* (a dummy variable of whether problems contain the keyword "upstream") and *RawMaterial* (a dummy variable of whether problems contain the keyword "raw material") in year t. The main explanatory variables are *SupC*5 and *SupC*3, which are the supplier concentrations calculated as the sum of the squared sales-based purchasing ratios of the top five and three suppliers, following Campello and Gao (2017) and Patatoukas (2012). The control variables include *Size* (the natural logarithm of total assets), *Lev* (total liabilities to total assets), *ROA* (net income over total assets), *Age* (the natural logarithm of the age of the firm), *MepsVol* (the volatility of *Meps*), *Loss* (a dummy variable that is 1 when net profit is negative and 0 otherwise), *SOE* (a dummy variable, 1 for state-owned enterprises and 0 for others), and *OwnCon* (the total shareholding ratio of the top ten shareholders of the firm). The detailed variable definitions are presented in Table A1. All regressions include firm and year fixed effects. The robust t-statistics clustered by the firm are reported in parentheses. ***, **, and * denote the significance at the 1%, 5%, and 10% levels, respectively.

	(1) Upstream	(2) Upstream	(3) Raw Material	(4) Raw Material
SupC5	0.1130***		0.0941*	
	(3.27)		(1.89)	
SupC3		0.1144***		0.0873*
		(3.20)		(1.69)
Size	0.0019	0.0019	0.0059**	0.0058**
	(1.03)	(1.01)	(2.22)	(2.20)
Lev	0.0120	0.0119	−0.0558***	−0.0561***
	(1.08)	(1.07)	(−3.54)	(−3.56)
ROA	0.1258***	0.1256***	0.1543***	0.1540***
	(3.37)	(3.36)	(3.04)	(3.03)
Age	−0.0008	−0.0008	0.0134*	0.0134*
	(−0.17)	(−0.17)	(1.92)	(1.92)
MepsVol	0.0148**	0.0148**	0.0235***	0.0235***
	(2.25)	(2.25)	(2.59)	(2.59)
Loss	0.0042	0.0042	−0.0005	−0.0005
	(0.48)	(0.49)	(−0.04)	(−0.04)
SOE	−0.0062	−0.0062	0.0063	0.0063
	(−1.42)	(−1.42)	(1.09)	(1.10)
OwnCon	0.0326***	0.0326***	−0.0143	−0.0143
	(2.66)	(2.66)	(−0.85)	(−0.85)
Observations	7,597	7,597	7,597	7,597
chi2	46.54	46.14	60.49	59.80

the analyst research record data in our database to further investigate this issue. We extract keywords from the questions asked by analysts when researching firms and use these to construct dummy variables for our study. We choose two targeted keywords, ''Upstream'' and ''Raw Material,'' and assign a value of one to analyst questions containing these keywords; otherwise, the questions take a value of zero. Due to limited data, some observations are lost in this process.

Table 12 shows the results. Columns (1) and (2) present the results for the dummy variable of the keyword ''Upstream.'' The coefficients of *SupC*5 and *SupC*3 are both positive and significant at the 1% level, indicating that an increase in supplier concentration improves analyst attention to the upstream of firms' supply chains. Similarly, Columns (3) and (4) report the results for the dummy variable of the keyword ''Raw Material.'' In this case, the coefficients of the supplier concentration proxy variables are generally positive and significant at the 10% level. This suggests that improving supplier concentration can increase the attention that analyst pay to firms' sources of raw materials. When combined with our earlier results, it is clear that analysts are paying increasing attention to the supply chain itself, particularly at the supplier end, due to the increasing concentration of the supply chain. This confirms that supplier concentration increases the number of analysts following firms and encourages analysts to pay more attention to the supply chain.

7. Conclusion

Studies reveal that analysts can increase their forecast accuracy by keeping track of the disclosures of their major suppliers and customers (Guan et al., 2015; Luo and Nagarajan, 2015), and thereby communicate the correct signals to the capital markets. This study supports and extends this conclusion by exploring the specific influence of the supply chain structure on this effect. It complements research on the effects of supply chains on firms (Raman and Shahrur, 2008; Chu et al., 2019) and identifies new non-financial information that can affect analysts' forecast behavior.

This study examines the influence of supplier concentration on analyst forecasts using listed firms in the Chinese market from 2008 to 2019 as a sample. We find that higher supplier concentration leads to less divergence in analyst forecasts. Our results remain significant after controlling for omitted variable bias and reverse causality issues through IV regression and PSM. Furthermore, we conduct various robustness tests, including substituting proxy variables of supplier concentration and analyst forecast behavior and adding control variables to the modeling method. Our results remain robust and significant following these checks. We find that supplier concentration significantly influences analyst forecasts, particularly for firms with low transparency, high institutional ownership ratios and competitive industries. We further explore the channels through which supplier concentration can promote analyst forecasts and find that it attracts increasing attention from analysts, resulting in a reduction in analyst forecast dispersion. In addition, we analyze the composition of analysts following firms with high supplier concentration and find that they are typically not star analysts with strong expertise and experience, but average analysts. This is likely to occur because firms with higher supplier concentration have simpler businesses and present less difficulty for analysts to track their supply chains. Thus, firms with high supplier concentration find it easier to attract relatively inexperienced analysts.

The findings of this study illustrate that the supply chain relationship can have a significant impact on firms. From a policy perspective, the relevant regulatory agency should strengthen the requirements for supply chain information disclosure by listed firms to improve the information efficiency of the Chinese capital market.

Declaration of Competing Interest

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

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Appendix.

See Table A1.

Table A1
Variable Definitions.

Variable	Definitions
Dependent Variables	
FDISP1	The standard deviation of analyst forecast divided by the 12-month average of share price, following the method of Hope (2003a) and Johnson (2004)
FDISP2	The standard deviation of analyst forecast divided by share price of the year, following the method of Zhang (2006b)
FDISP3	The standard deviation of analyst forecast divided by the actual value, following the method of Papakroni (2013)
FERROR	The absolute value of the difference between the mean of analysts' forecast and the true value divided by the share price of the beginning of the year, following Brown and Kim (1991) and Lys and Soo (1995)
Explanatory Variables	
SupC5	The supplier concentration is calculated by the HHI method, and the specific calculation method is:$SupC5_{it} = \sum_{j=1}^{5}\left(\frac{Sales_{ijt}}{Sales_{it}}\right)^2$
SupC3	The supplier concentration is calculated by the HHI method, and the specific calculation method is:$SupC3_{it} = \sum_{j=1}^{3}\left(\frac{Sales_{ijt}}{Sales_{it}}\right)^2$
T5	Total purchasing share of the top five suppliers
Size	Natural logarithm of a firm's total assets
Lev	The ratio of a firm's total liabilities to total assets
ROA	Return on assets, which is the ratio of net profit to total assets
Age	Natural logarithm of the number of years since initial public offerings
MepsVol	A firm's earnings per share volatility, which is expressed as the standard deviation of the previous five periods
Loss	Dummy that equals 1 for the firm's net profit is negative and 0 otherwise
SOE	Dummy that equals 1 for the state-owned firm and 0 otherwise
OwnCon	The total shareholding ratio of the top ten shareholders of the firm
Horizon	The range of analysts' forecast, which is the natural logarithm of the median analysts' forecast time to the day the annual results are released
BM	Market-to-book ratio of assets
CF	The ratio of monetary funds held by a firm to total assets
FA	The ratio of fixed assets held by a firm to total assets
FFIN	Dummy equals 1 for the firm, which has a higher than the industry-year mean of Accrual and 0 otherwise. It's a measure of firm-level financial transparency measured by industry- and year-adjusted total scaled accruals (Bhattacharya, Daouk, and Welker, 2003; Dhaliwal et al., 2012). Scaled accruals (ACCRUAL) are computed as: $ACCRUAL = (\Delta CA - \Delta CL - \Delta CASH + \Delta STD - DEP + \Delta TP)/lag(TA)$, where ΔCA is the change of total current assets, ΔCL is the change of total current liabilities, $\Delta CASH$ is the change of cash held, ΔSTD is the change of the current portion of long-term debt included in total current liabilities, DEP is depreciation and amortization expense, ΔTP is the change of income taxes payable and $lag(TA)$ is total assets at the end of the previous year.
InstHolder	The ratio of Institutional shareholding
Other Variables	
HHI	Industry concentration is calculated using the Herfindahl index, following Hou and Robinson (2006). It is calculated by $HHI_{it} = \sum_{i=1}^{I}(s_{ij})^2$, where s_{ij} is the market share of firm i in industry j.
Follow	Natural logarithm of the number of analysts or teams following the firm in the same year
SYN	Stock price synchronization calculated using R^2 statistic from the market model, following Roll (1988)
KV	The coefficient of the impact of trading volume on yield, following Kim and Verrecchia (2001). KV is calculated as: $Ln\left\lvert\frac{\Delta P_t}{\Delta P_{t-1}}\right\rvert = \alpha + \beta(Vol_t - Vol_0) + \mu_i$, where P is the closing price on day t, Vol_t is the number of shares traded on day t, Vol_0 is the annual average number of shares traded, $\beta * 1000000$ is KV
Accrual	The accrued profit used in calculating FFIN, see the definition method of FFIN
ES	Earning Smooth is the relationship between reported earnings and true earnings of a listed firm, calculated as: $\frac{std\left(Cash_{t-3,t}/BA_{t-3,t}\right)}{std\left(NI_{t-3,t}/BA_{t-3,t}\right)}$, where $std\left(Cash_{t-3,t}/BA_{t-3,t}\right)$ is the standard deviation of the ratio of the firm's net cash flow from operating activities between year $t-3$ and year t to the ratio of total assets at the beginning of the same year, the same thing in the denominator and NI is net profit (Bhattacharya, Daouk, and Welker, 2003).

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Does executives' overseas experience improve firms' labor investment efficiency?

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ABSTRACT

Based on upper echelons theory and using a sample of private Chinese A-share listed firms from 2008 to 2020, this paper studies the impact of executives' overseas experience on firms' labor investment efficiency. The results show that executives with overseas experience significantly enhance firms' labor investment efficiency. After distinguishing between different types of overseas experience, the results show that executives with only study experience or with both study and work experience abroad have a significant positive effect on firms' labor investment efficiency, while executives with only overseas work experience have no significant effect. A cross-sectional analysis based on labor adjustment costs shows that the positive impact of executives' overseas experience is more pronounced in labor-intensive firms, firms with a greater proportion of R&D investment and firms with a higher percentage of highly educated employees. The mechanism tests show that executives with overseas experience can optimize labor investment efficiency by lowering agency costs, attracting analyst attention and alleviating financing constraints under conditions of underemployment. This study enriches the literature on the characteristics of executive teams and the efficiency of labor investment, providing reference and inspiration for firms to attract more high-quality returnees and optimize their labor resource allocation.

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1. Introduction

In the report of the 19th National Congress in October 2017, the Central Committee of the Chinese Communist Party clearly stated that it is urgent to promote China's high-quality economic development by improving total factor productivity so that the Chinese economy can advance to the stage of high-quality development. In particular, the effective allocation of labor is the key to improving total factor productivity. However, research mainly focuses on the efficiency of firms' physical capital allocation (e.g., Dai et al., 2018), and only in recent years has firms' labor resource allocation begun to attract academic attention (Jung et al., 2014; Ghaly et al., 2020; Li and Wu, 2023). "China Enterprise Social Insurance White Paper 2018"[1] shows that among the surveyed enterprises, 53 % have a labor cost share above 30 %, and 16.27 % have a labor cost share of up to 50 %. In the context of increasing labor costs, it is of great practical significance to improve the efficiency of firms' labor resource allocation for high-quality development.

In recent years, Chinese local governments have drawn up various high-level talent introduction plans to attract more overseas returnees. During the 2016–2019 period, 2,518,000 Chinese students studied abroad; the number of returnees was 2,013,000, for a 79.9 % return rate. "The 2020 Returnee Employability Survey Report"[2] shows that the number of returnees in 2020 was 800,000, an increase of 70 % from the previous year. Returning talents have a unique international outlook and good foreign language communication skills. Their overseas experience helps them cultivate more open and innovative thinking, form more advanced management concepts (Yang et al., 2018) and obtain more advantages in cross-cultural integration and competitive advantages (Zhou et al., 2020).

Executives' past experience has a strong impact on firms' investment decisions. Based on upper echelons theory, we theoretically analyze and empirically test the impact of executives' overseas experience on firms' labor investment efficiency. We further explore the differences in the impact of overseas experience executives on labor investment efficiency under different labor cost adjustments and the mechanism by which returnee executives affect labor investment efficiency. We find that executives' overseas experience significantly enhances firms' labor investment efficiency. The positive effect of executives' overseas experience on labor investment efficiency is more significant under higher labor adjustment costs. The mechanism tests show that executives' overseas experience improves labor investment efficiency by reducing agency costs, attracting analyst attention and alleviating financing constraints.

\\Our research makes the following three contributions. First, we expand the literature on the impact of executives' overseas experience on firms' investment decisions. The literature mainly studies the impact of executives' overseas experience on information disclosure quality, the executive compensation gap, innovation and corporate performance. Our paper expands the impact of executives' overseas experience on corporate governance from the perspective of labor resource allocation, showing that executives' overseas experience has a positive effect on firms' labor investment efficiency. Second, the literature shows that financial reporting quality, corporate governance, analysts and institutional investors affect firms' labor investment efficiency. We provide novel evidence that executives' overseas experience is also an important factor in improving firms' labor investment efficiency. Third, we identify three channels through which executives' overseas experience improves labor investment efficiency: reducing agency costs, attracting analyst attention and alleviating financing constraints. These results provide theoretical and empirical evidence for firms' recruitment of returning talents to strengthen their corporate governance and enhance the efficiency of their labor resource allocation.

2. Literature review

2.1. Executives' overseas experience

Upper echelons theory suggests that the objectively observable personal characteristics of top management teams can influence their cognitive styles and ideologies, which in turn can affect managers' managerial

[1] This report is released by 51 Social Security, a well-known social security professional organization in China.
[2] This report is released by UniCareer, an online vocational education company.

decisions and investment behaviors (Hambrick and Manson, 1984). Based on this theory, managerial traits have become a popular research topic in recent decades. Overseas experience, as an important trait of executive team members, has received extensive attention in recent years, mainly focusing on the impact of executives' overseas experience on information disclosure, corporate investment and firm performance.

In terms of information disclosure, Giannetti et al. (2015), He and Zhang (2018) and Du et al. (2018) find that returnee executives can reduce firms' earnings management and improve their accounting information transparency. Regarding corporate investment, Dai and Kong (2017) and Dai et al. (2018) show that returnee executives reduce the tendency to over-invest and improve firms' labor investment efficiency. Studies also show that executives with overseas experience increase the level of risk-taking (Song et al., 2017), increase firms' investments in innovation and improve their innovation performance (Liu et al., 2017; Yang et al., 2018). Third, in terms of corporate performance, Zhou et al. (2020) show that returnee executives can significantly improve the financial performance of international mergers and acquisitions through their cross-cultural integration advantage. Dai and Liu (2009) and Li et al. (2012) find that returnee entrepreneurs have advantages such as richer professional knowledge and unique social networks, and thus have better entrepreneurial performance than local entrepreneurs. Liu and Kong (2018) show that executives' overseas experience widens the pay gap among executives while weakening their pay incentives, leading to lower firm performance.

2.2. Labor investment efficiency

Firms' labor investment efficiency has attracted the attention of financial accounting scholars in recent years. Studies on the factors influencing labor investment efficiency mainly focus on accounting information quality, corporate governance, management characteristics, corporate strategy and external factors.

In terms of information quality, Jung et al. (2014) show that high quality financial reports can improve firms' labor investment efficiency. Ben-Nasr and Alshwer (2016) further reveal that stock price informativeness is positively correlated with firms' labor investment efficiency. Regarding corporate governance, in the context of internal governance, Ha and Feng (2018) find that accounting conservatism reduces information asymmetry between managers and investors, alleviates agency problems and thus reduces labor investment inefficiency. Khedmati et al. (2020) study the effect of social ties between chief executive officers (CEOs) and independent directors on labor investment efficiency and find that such ties deteriorate corporate governance and reduce labor investment efficiency. Sualihu et al. (2020) study the effect of equity compensation incentives on labor investment efficiency and find that stock options deteriorate labor investment efficiency while restricted equity incentives mitigate labor investment inefficiency. In terms of external governance, studies show that securities analysts (Chen et al., 2018; Lee and Mo, 2020), institutional investors (Ghaly et al., 2020), stock liquidity (Mong et al., 2022) and short-selling mechanisms (Chu and Fang, 2020; Ding et al., 2020) mitigate agency problems and improve firms' labor investment efficiency. In terms of management characteristics, Kong and Hu (2019) show that the age, tenure and education level of executives improve labor investment efficiency. Lai et al. (2021) find that overconfident executives are more aggressive in recruiting labor, which reduces labor investment efficiency. Regarding corporate strategy, Zhang et al. (2020) reveal that firms with expansion strategies have lower labor investment efficiency than those with conservative strategies. Habib and Hasan (2019) show that firms with aggressive strategies reduce labor investment efficiency, while those with defensive strategies increase labor investment efficiency. They also demonstrate that uncertainty, rather than agency problems, is the main reason why aggressive strategies reduce the efficiency of firms' labor investment. In terms of external factors, Bu and Sun (2020) argue that environmental uncertainty exacerbates agency problems and reduces the effectiveness of management decision-making, which reduces labor investment efficiency. Kong et al. (2020) and Guo et al. (2021) use the introduction of the Labor Contract Law in China as an exogenous event and find that this introduction led to a rise in labor costs and an increase in the number of redundant employees, thereby reducing labor investment efficiency. In addition, Li and Wu (2023) find that industrial policy, focusing on economic development, reduces the labor policy burden caused by government intervention, thereby improving labor investment efficiency.

In summary, to the best of our knowledge, no study to date has examined the impact of executives' overseas experience on firms' labor investment efficiency. As the effective allocation of human resources is an important factor in promoting firms' high-quality development, it is of practical significance to study the relationship

between executives' overseas experience and firms' labor investment efficiency for firms' recruitment of executives with overseas experience and the improvement of firms' labor investment decisions.

3. Hypothesis development

Overseas experience can help learners and workers quickly improve their ability to adapt to unfamiliar environments and respond quickly to unknown risks. When different cultures collide, they are able to understand and become familiar with multiculturalism and the code of conduct of foreign countries, which will unconsciously influence their values and behavioral perceptions. Executives with overseas experience can benefit from the following competitive advantages. First, overseas experience allows executives to develop deeper knowledge reserves and professional technical capabilities (Du et al., 2018). Second, through their overseas experience, executives are exposed to advanced management concepts, develop an international mindset and acquire greater innovation and entrepreneurial capabilities (Dong, 2013). Third, returnee executives have more international resources and interpersonal relationships, which can help their firms build a broader business network (Dai and Kong, 2017; Zhou et al., 2020). Overall, executives with overseas experience have clear advantages in enhancing the efficiency of firms' resource allocation and corporate governance. The literature on labor investment efficiency identifies information asymmetry and principal–agent problems as the main causes of labor investment inefficiency (Jung et al., 2014). The agency problem caused by information asymmetry between shareholders and managers makes managers lazy, and thus they do not adjust the level of labor investment when it deviates from the optimal level. For example, managers do not lay off employees in case of over-investment in labor or do not recruit new labor in case of labor shortage, or they may over-invest in labor to build an empire. Therefore, it is important to improve firms' labor investment efficiency by reducing information asymmetry and mitigating agency problems. We contend that executives with overseas experience can reduce information asymmetry, mitigate agency problems and financing constraints and thus enhance firms' labor investment efficiency.

First, executives with overseas experience can reduce agency costs through their advanced management concepts and knowledge, thus optimizing firms' labor investment decisions. As mentioned, the principal–agent problem is the main cause of labor investment inefficiency (Jung et al., 2014). Indeed, overseas experience develops executives' knowledge, skills and management capabilities, which can improve corporate governance, reduce conflicts of interest between management and shareholders and alleviate potential principal–agent problems (Dai and Kong, 2017; Zhou et al., 2020). Returnee executives can also reduce corporate earnings management and disclose higher quality accounting information (Giannetti et al., 2015; Du et al., 2018; He and Zhang, 2018), thus reducing executives' self-serving tendency. Furthermore, directors and independent directors with overseas experience can better perform their monitoring function, improve the internal corporate governance mechanism, implement better compensation covenants and give full play to the role of compensation incentives (Giannetti et al., 2015; Wang et al., 2015). Firms can reduce agency conflicts through effective internal monitoring and compensation incentives. When agency conflicts are mitigated, the inefficiency of labor investment will also be reduced (Ghaly et al., 2020). Therefore, executives with overseas experience can reduce agency costs and improve labor investment efficiency.

Second, firms whose executives have overseas experience can attract more analysts for external monitoring, thus reducing information asymmetry and improving labor investment efficiency. The literature shows that directors with overseas experience can improve corporate governance (Du et al., 2018) and better fulfill the oversight function of the board of directors, and are more likely to attract the attention of securities analysts (Wang et al., 2018). As important intermediaries in the capital market, securities analysts, through their monitoring of listed firms, can examine firm information in depth and understand the macroenvironment, as well as convey valuable investment information to investors, which can enhance the transparency of corporate information, reduce information asymmetry and therefore improve labor investment efficiency (Fang, 2007; Lai et al., 2021). Securities analysts can also play a supervisory role within firms, effectively mitigating agency conflicts and enhancing labor investment efficiency (Chen et al., 2018; Lee and Mo, 2020). Therefore, executives with overseas experience can improve labor investment efficiency by attracting analyst attention, reducing information asymmetry and strengthening external monitoring.

Third, firms whose executives have overseas experience can reduce financing constraints, thereby enhancing labor investment efficiency. It is important for firms with sufficient funds to make effective labor investment decisions. Financing constraints impede the improvement of labor investment efficiency (Benmelech et al., 2021), and the lack of capital makes it difficult for firms to adjust their number of employees, leading to underemployment. Executives' overseas experience can alleviate agency problems and reduce information asymmetry by attracting analyst attention, and the financing constraints faced by firms can also be alleviated. In addition, executives who study or work abroad can accumulate more high-quality international resources and meet outstanding management talents and professional elites. With their advantages in language communication and interpersonal relationships, they can attract high-quality foreign investors or investment institutions to their firm and promote foreign financing and mergers and acquisitions (Zhou et al., 2020), thus enhancing their firm's external financing. With fewer financing constraints, firms will be able to make better labor investment decisions.

In summary, firms whose executives have overseas experience can enhance their labor investment efficiency through three channels: (1) reducing agency costs, (2) reducing information asymmetry and strengthening external supervision and (3) alleviating financing constraints. Therefore, we propose the following hypothesis:

Hypothesis: Executives' overseas experience can significantly improve firms' labor investment efficiency.

4. Research design

4.1. Sample selection and data sources

Our sample consists of data from private Chinese A-share listed firms from 2008 to 2020, due to that the data on overseas returnee executives released by the China Stock Market and Accounting Research (CSMAR) database began in 2008. Following the literature, the following observations are excluded: (1) firms in the finance and insurance industries; (2) special treatment (ST, *ST, and PT) firms; (3) pure B-share firms; (4) firms with fewer than 30 employees; (5) firms with a negative asset–liability ratio; and (6) firms with missing values. Our final sample includes 12,824 observations. All data are obtained from CSMAR database. To mitigate the effect of outliers, all continuous variables are winsorized at the 1st and 99th percentiles.

4.2. Measure of labor investment efficiency

Following Jung et al. (2014), labor investment efficiency is measured by the percentage change in abnormal net hiring, calculated as actual net hiring minus expected net hiring predicted by the regression of Model (1) by industry and by year. The absolute value of the residual from Model (1), *Abresid*, is then used as a proxy for firms' labor investment efficiency. Model (1) is as follows:

$$\begin{aligned} NET\_HIRE_{i,t} &= \beta_0 + \beta_1 SALES\_GROWTH_{i,t} + \beta_2 SALES\_GROWTH_{i,t-1} + \beta_3 ROA_{i,t} \\ &+ \beta_4 \Delta ROA_{i,t} + \beta_5 \Delta ROA_{i,t-1} + \beta_6 RETURN_{i,t} + \beta_7 SIZE_{Ri,t-1} \\ &+ \beta_8 QUICK_{i,t} + \beta_9 \Delta QUICK_{i,t} + \beta_{10} \Delta QUICK_{i,t-1} + \beta_{11} LEV_{i,t-1} \\ &+ \beta_{12} LOSSBIN1_{i,t-1} + \beta_{13} LOSSBIN2_{i,t-1} + \beta_{14} LOSSBIN3_{i,t-1} \\ &+ \beta_{15} LOSSBIN4_{i,t-1} + \beta_{16} LOSSBIN5_{i,t-1} + \varepsilon_{i,t} \end{aligned} \tag{1}$$

where *NET_HIRE* is the percentage change in the number of employees; *SALES_GROWTH* is the percentage change in sales revenue; *ROA* is net income scaled by total assets; *RETURN* is the annual stock return for year *t*; *SIZE_R* is the log of the market value of equity; *QUICK* is the ratio of cash and short-term investments plus receivables to current liabilities; *LEV* is the ratio of long term debt to total assets; and *LOSSBIN* indicates each 0.005 interval of *ROA* from the previous year, from 0 to –0.025. If *ROA* in the previous year is between –0.005 and 0, then *LOSSBIN1* equals 1 and otherwise 0; if *ROA* in the previous year is between –0.010 and –0.005, then *LOSSBIN2* equals 1 and otherwise 0, and so on. The primary measure of abnormal net hiring, *Abresid*, is the absolute difference between actual net hiring and the expected level. *Abresid* is a reverse indi-

cator, with a higher value indicating a greater deviation between actual net hiring and expected net hiring, representing lower labor investment efficiency.

4.3. Measure of executives' overseas experience

Executives' overseas experience (*Oversea*) is defined as having at least one member of the management team or board of directors with overseas study or work experience in a given year. When one of the above conditions is met, *Oversea* equals 1 and otherwise 0. To further differentiate the impact of different forms of overseas experience, we construct three dummy variables of overseas experience, namely *Oversea Only Work*: Executives with overseas work experience only, *Oversea Only Edu*: Executives with overseas study experience only and *Oversea Work and Edu*: Executives with both overseas work and study experience, as shown in Table 1.

4.4. Regression model

To examine the effect of executives' overseas experience on firms' labor investment efficiency, Model (2) is developed following the literature (Jung et al., 2014; Ben-Nasr and Alshwer, 2016; Bu and Sun, 2020).

$$\begin{aligned} Abresid_{i,t} &= \alpha_0 + \alpha_1 Oversea_{i,t} + \alpha_2 SIZE_{i,t} + \alpha_3 QUICK_{i,t} + \alpha_4 LEV_{i,t} \\ &+ \alpha_5 ROA_{i,t} + \alpha_6 MB_{i,t} + \alpha_7 STD\_CFO_{i,t} + \alpha_8 STD\_SALE_{i,t} \\ &+ \alpha_9 STD\_NETHIRE_{i,t} + \alpha_{10} TANGIBLE_{i,t} + \alpha_{11} LABOR_{i,t} \\ &+ \Sigma Year + \Sigma Industry + \varepsilon_{i,t} \end{aligned} \tag{2}$$

We expect the coefficient α_1 in Model (2) to be significant and negative, indicating that labor investment efficiency improves when executives have overseas experience. Table 1 defines all of the variables.

5. Empirical results

5.1. Descriptive statistics

Table 2 reports the descriptive statistics of the main variables. The mean value of *Abresid* is 0.209 with a standard deviation of 0.349, which is generally consistent with the results of previous studies (Zhang et al., 2020). The mean value of *Oversea* is 0.591, indicating that 59.1 % of the firms in the sample have at least one executive with overseas experience. Among these firms, 29.5 % have at least one executive with only overseas work experience, 34.3 % have at least one executive with only overseas study experience and 17.8 % have at least one executive with both overseas work and study experience.

5.2. Univariate analysis

Following Dai and Kong (2017), we divide the sample into executives with overseas experience and executives without overseas experience and report the results of the univariate tests in Table 3. The results show that firms whose executives have overseas experience have higher labor investment efficiency than other firms, and the differences between the two subsamples are significant at the 1 % level, which preliminarily verifies our hypothesis.

5.3. Multivariate regression results

Table 4 reports the regression results of Model (2). Column (1) reports the regression results of the relationship between executives' overseas experience and firms' labor investment efficiency. The coefficient of *Oversea* is –0.013, which is significant at the 5 % level, indicating that firms whose executives have overseas study or work experience can significantly reduce their labor investment inefficiency (i.e., improve their labor investment efficiency); our hypothesis is thus verified. Columns (2)–(4) report the effects of executives' overseas work experience only, overseas study experience only, and both overseas study and work experience on labor invest-

Table 1
Variable definitions.

Variable	Description
Model (1) variables	
NET_HIRE	The percentage change in the number of employees.
SALES_GROWTH	The percentage change in sales revenue.
ROA	Return on total assets.
△ROA	Change in return on assets
RETURN	The annual stock return in a given year.
SIZE_R	The natural logarithm of the market value of equity.
QUICK	The ratio of cash and short-term investments plus receivables to current liabilities.
△QUICK	Percentage change in the quick ratio
LEV	The ratio of long term debt to total assets.
LOSSBIN	There are five separate loss bins to indicate each 0.005 interval of *ROA* from the previous year, from 0 to –0.025. *LOSSBIN1* equal 1 if *ROA* in the previous year is between −0.005 and 0, and so on for the other *LOSSBIN(2,3,4,5)*.
Model (2) variables	
Abresid	The absolute value of the difference between the observed value of labor investment (i.e., the difference between the current and previous number of employees) and the predicted value of labor investment based on economic fundamentals using Model (1).
Over-investment	Positive abnormal net hiring.
Under-investment	Negative abnormal net hiring.
Over-hiring	Over-investment when the expected level of net hiring is positive.
Under-firing	Over-investment when the expected level of net hiring is negative.
Under-hiring	Under-investment when the expected level of net hiring is positive.
Over-firing	Under-investment when the expected level of net hiring is negative.
Oversea	A dummy variable equal to 1 if a firm has at least one member of the management team or board of directors with experience working or studying abroad in a given year, and 0 otherwise.
Oversea Only Work	A dummy variable equal to 1 if a firm has at least one member of the management team or board of directors with overseas work experience only in a given year, and 0 otherwise.
Oversea Only Edu	A dummy variable equal to 1 if a firm has at least one member of the management team or board of directors with overseas study experience only in a given year, and 0 otherwise.
Oversea Work and Edu	A dummy variable equal to 1 if a firm has at least one member of the management team or board of directors with both overseas work and study experience in a given year, and 0 otherwise.
SIZE	The natural logarithm of total assets.
MB	The market-to-book ratio.
STD_CFO	The standard deviation of cash flow from operations calculated over a period of 5 years.
STD_SALE	The standard deviation of sales calculated over a period of 5 years.
STD_NETHIRE	The standard deviation of the number of employees calculated over a period of 5 years.
TANGIBLE	The ratio of net property, plant and equipment to total assets.
LABOR	The ratio of the number of employees to total assets.
Model (3) variables	
AGE	The number of years a firm has been listed.
TOBINQ	The sum of the book value of debt and the market value of equity divided by a firm's total assets.
CASH	Net income plus depreciation minus cash paid to acquire fixed assets, intangible assets and other long-term assets, scaled by total assets.
TOP1	The fraction of shares held by the largest shareholder.
B_SIZE	The natural logarithm of the total number of directors.
B_IND	The ratio of the number of independent directors to the total number of directors.
DUALITY	A dummy variable equal to 1 if a firm's chairman and CEO are the same person and 0 otherwise.
Other variables	
Oversea_ratio	The ratio of the number of returnee executives to the total number of executives.
RANK	The natural logarithm of marketization rankings for each province following Wang et al. (2021).
Oversea_Chairman or CEO	A dummy variable equal to 1 if the chair of the board or CEO has overseas experience.
Oversea_CEO	A dummy variable equal to 1 if the CEO has overseas experience.
Oversea_Chairman	A dummy variable equal to 1 if the chair of the board has overseas experience.
CHRISTIAN	A dummy variable equal to 1 if the province where a firm is located has a university founded by Christian missionaries before the end of 1920.
Labor_intensity	The ratio of the number of employees to total assets.

(*continued on next page*)

Table 1 (*continued*)

Variable	Description
R&D_investment	The ratio of R&D investment to total assets.
Highly_educated_employees	The ratio of the number of employees with a master's degree or above to sales revenue.
Turnover	The ratio of sales revenue to total assets.
Analyst	The natural logarithm of the number of analysts following a firm plus 1.
KZ	The financing constraint index measure constructed following Kaplan and Zingales (1997).

Table 2
Descriptive statistics.

Variable	N	Mean	S.D.	Min	Median	Max
Abresid	12,824	0.209	0.349	0.000	0.113	3.361
Oversea	12,824	0.591	0.492	0	1	1
Oversea Only Work	12,824	0.295	0.456	0	0	1
Oversea Only Edu	12,824	0.343	0.475	0	0	1
Oversea Work and Edu	12,824	0.178	0.383	0	0	1
SIZE	12,824	21.978	1.113	19.673	21.879	25.341
QUICK	12,824	1.827	2.106	0.193	1.168	13.762
LEV	12,824	0.064	0.082	0.000	0.030	0.366
ROA	12,824	0.034	0.070	−0.333	0.035	0.198
MB	12,824	2.697	1.910	0.886	2.087	11.619
STD_CFO	12,824	18.623	1.207	15.975	18.530	21.917
STD_SALE	12,824	19.684	1.396	16.458	19.644	23.400
STD_NETHIRE	12,824	0.495	1.440	0.013	0.171	12.096
TANGIBLE	12,824	0.201	0.141	0.002	0.178	0.591
LABOR	12,824	3.997	0.921	1.313	4.096	5.887

S.D.: standard deviation; Min: minimum; Max: maximum.

Table 3
Results of univariate tests.

	N	*Abresid*/*p*-value
Firms without executives with overseas experience (*Oversea* = 0)	5,251	0.219
Firms with executives with overseas experience (*Oversea* = 1)	7,573	0.202
Mean test	–	0.010
Wilcoxon signed-rank test	–	0.000

ment efficiency, respectively. The results show that the labor investment inefficiency of firms whose executives have overseas study experience only and both overseas study and work experience is significant and negative, while the effect of overseas work experience only is not significant, indicating that the impact of executives' overseas experience on firms' labor investment efficiency is mainly manifested in the effect of overseas study experience. This finding may be explained by the difference between overseas study experience and overseas work experience. Students who study abroad are more likely to be influenced by and internalize foreign cultural education and behavioral norms, and therefore their personal behavioral perceptions and values are likely to be influenced. In contrast, people who work abroad may be less affected by foreign cultures and are therefore less likely to influence the efficiency of firms' labor investment. Regarding the control variables, a high long-term debt ratio (*LEV*), a high market-to-book ratio (*MB*) and a low fixed asset ratio (*TANGIBLE*) reduce labor investment efficiency, which is consistent with the results of previous studies (Jung et al., 2014).

Table 4
Multivariate regression results.

	(1)	(2)	(3)	(4)
	Abresid	*Abresid*	*Abresid*	*Abresid*
Oversea	–0.013**			
	(–2.074)			
Oversea_Only_Work		–0.005		
		(–0.834)		
Oversea_Only_Edu			–0.018***	
			(–2.964)	
Oversea_Work_and_Edu				–0.016**
				(–2.259)
SIZE	–0.010	–0.010	–0.010	–0.010
	(–1.316)	(–1.387)	(–1.348)	(–1.330)
QUICK	–0.005***	–0.005***	–0.005***	–0.005***
	(–3.783)	(–3.832)	(–3.789)	(–3.709)
LEV	0.113**	0.113**	0.113**	0.113**
	(2.215)	(2.220)	(2.213)	(2.208)
ROA	–0.044	–0.045	–0.045	–0.046
	(–0.893)	(–0.896)	(–0.897)	(–0.933)
MB	0.013***	0.013***	0.013***	0.013***
	(5.276)	(5.214)	(5.230)	(5.258)
STD_CFO	–0.017***	–0.017***	–0.017***	–0.017***
	(–2.983)	(–2.954)	(–2.943)	(–2.939)
STD_SALE	0.023***	0.022***	0.023***	0.022***
	(4.687)	(4.636)	(4.682)	(4.622)
STD_NETHIRE	0.060***	0.060***	0.060***	0.060***
	(10.702)	(10.715)	(10.720)	(10.716)
TANGIBLE	–0.121***	–0.120***	–0.123***	–0.122***
	(–4.427)	(–4.387)	(–4.473)	(–4.448)
LABOR	–0.026***	–0.026***	–0.025***	–0.026***
	(–4.846)	(–4.898)	(–4.797)	(–4.810)
Constant	0.399***	0.409***	0.399***	0.401***
	(4.118)	(4.233)	(4.117)	(4.135)
Year	yes	yes	yes	yes
Industry	yes	yes	yes	yes
N	12,824	12,824	12,824	12,824
Adj-R^2	0.107	0.107	0.107	0.107

Note: This table reports the results of the ordinary least squares (OLS) regression. Robust t-statistics are in parentheses. The variables are defined in Table 1. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

5.4. Types of labor investment inefficiency

To further study the specific form of overseas experience that affects labor investment efficiency, following Kong and Hu (2019), labor investment inefficiency is divided into four subsamples based on the results of Model (1). Specifically, labor over-investment is divided into over-hiring and under-firing, with over-hiring referring to over-investment and positive expected net hiring and under-firing referring to over-investment and negative expected net hiring. Similarly, labor under-investment is divided into under-hiring and over-firing, with under-hiring referring to under-investment and positive expected net hiring and over-firing referring to under-investment and negative expected net hiring.

The results are presented in Table 5. The coefficients of *Oversea* are –0.038 and –0.007 under over-hiring and under-hiring and are significant at the 5 % and 10 % levels, respectively, indicating that the positive effect of executives' overseas experience on firms' labor investment efficiency lies mainly in the reduction of hiring redundancy and underemployment.

Table 5
Executives' overseas experience and specific types of labor investment inefficiency.

	Over-investment		Under-investment	
	(1) Over-hiring *Abresid*	(2) Under-firing *Abresid*	(3) Under-hiring *Abresid*	(4) Over-firing *Abresid*
Oversea	–0.038**	–0.014	–0.007*	0.006
	(–2.064)	(–0.672)	(–1.663)	(0.815)
SIZE	0.045**	0.030	–0.061***	–0.011*
	(2.046)	(1.349)	(–10.580)	(–1.647)
QUICK	–0.014***	–0.006*	–0.002**	–0.000
	(–2.636)	(–1.650)	(–1.972)	(–0.177)
LEV	0.107	0.118	–0.018	0.001
	(0.720)	(0.698)	(–0.484)	(0.030)
ROA	0.213	–0.210	–0.122***	–0.112***
	(1.110)	(–1.380)	(–2.608)	(–2.848)
MB	0.014**	0.031**	0.008***	0.016***
	(2.210)	(2.413)	(4.468)	(4.829)
STD_CFO	–0.024	–0.038**	0.003	0.007
	(–1.512)	(–2.402)	(0.695)	(1.280)
STD_SALE	–0.003	0.006	0.039***	0.003
	(–0.229)	(0.471)	(10.077)	(0.760)
STD_NETHIRE	0.124***	0.125***	0.010***	0.014***
	(9.214)	(3.626)	(4.405)	(3.409)
TANGIBLE	–0.170*	–0.030	–0.060***	–0.024
	(–1.942)	(–0.354)	(–3.501)	(–0.948)
LABOR	0.014	–0.015	–0.061***	–0.034***
	(0.866)	(–0.826)	(–15.291)	(–7.553)
Constant	–0.202	0.075	0.964***	0.289***
	(–0.683)	(0.203)	(13.322)	(2.799)
Year	yes	yes	yes	yes
Industry	yes	yes	yes	yes
N	3,489	1,292	6,912	1,131
Adj-R^2	0.177	0.181	0.174	0.176

Note: This table reports the results of the OLS regression. Robust t-statistics are in parentheses. The variables are defined in Table 1. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

6. Robustness tests

6.1. Ruling out the impact of the global financial crisis

The global financial crisis in 2008 had a major impact on the balance between supply and demand in the Chinese labor market. Many firms had to resort to layoffs and other means to maintain operations. Considering the potential impact of this factor on the regression results, we exclude all observations from 2008 and re-examine the effect of executives' overseas experience on firms' labor investment efficiency. As shown in Table 6, Column (1), the coefficient of *Oversea* is still negative and significant at the 5 % level after ruling out the impact of the global financial crisis.

6.2. Alternative proxy for executives' overseas experience

We rerun the regression using the ratio of returnee executives to the total number of executives to measure the level of executives' overseas experience. As shown in Table 6, Column (2), the results indicate that the coefficient of *Oversea_ratio* is still negative and significant at the 5 % level.

Table 6
Robustness results.

	(1) Ruling out the impact of the global financial crisis	(2) Alternative proxy for executives' overseas experience	(3) Excluding coastal cities	(4) Considering the market environment
	Abresid	*Abresid*	*Abresid*	*Abresid*
Oversea	–0.013**		–0.015**	–0.012**
	(–2.053)		(–2.165)	(–1.966)
Oversea_ratio		–0.063**		
		(–2.349)		
SIZE	–0.010	–0.010	–0.004	–0.010
	(–1.357)	(–1.314)	(–0.426)	(–1.395)
QUICK	–0.005***	–0.005***	–0.005***	–0.005***
	(–3.805)	(–3.756)	(–3.908)	(–3.808)
LEV	0.118**	0.116**	0.095*	0.110**
	(2.272)	(2.267)	(1.688)	(2.161)
ROA	–0.051	–0.046	–0.033	–0.038
	(–1.003)	(–0.922)	(–0.626)	(–0.766)
MB	0.013***	0.013***	0.014***	0.013***
	(5.210)	(5.342)	(4.930)	(5.219)
STD_CFO	–0.018***	–0.017***	–0.017***	–0.017***
	(–3.025)	(–2.991)	(–2.685)	(–2.976)
STD_SALE	0.024***	0.023***	0.018***	0.023***
	(4.751)	(4.692)	(3.272)	(4.766)
STD_NETHIRE		0.059***	0.060***	0.069***
		0.060***		
(10.495)	(10.717)	(9.784)	(10.687)	
TANGIBLE	–0.134***	–0.122***	–0.126***	–0.124***
	(–4.855)	(–4.450)	(–4.369)	(–4.480)
LABOR	–0.026***	–0.026***	–0.030***	–0.025***
	(–4.762)	(–4.831)	(–5.128)	(–4.793)
RANK				0.008**
				(2.011)
Constant	0.383***	0.396***	0.391***	0.382***
	(3.830)	(4.097)	(3.599)	(3.903)
Year	yes	yes	yes	yes
Industry	yes	yes	yes	yes
N	12,416	12,824	10,498	12,824
Adj-R^2	0.108	0.107	0.114	0.107

Note:This table reports the results of the OLS regression. Robust t-statistics are in parentheses. The variables are defined in Table 1. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

6.3. Excluding the sample of coastal cities

Coastal cities may be more attractive to individuals with overseas experience because such cities have greater marketization, greater labor mobility and greater labor competition, all of which may increase firms' labor investment efficiency. We exclude the sample of coastal cities to rule out their possible effects on our results. Specifically, coastal cities include Dalian, Qinhuangdao, Tianjin, Yantai, Qingdao, Lianyungang, Nantong, Shanghai, Ningbo, Wenzhou, Fuzhou, Guangzhou, Zhanjiang and Beihai, the first group of cities approved by the State Council to open to the outside world in 1984. After excluding the observations of listed firms located in these coastal cities, we rerun the regression. The results are presented in Column (3) of Table 6 and are consistent with our main results.

6.4. Considering the market environment

Following Tang et al. (2020), we control for the degree of marketization to mitigate the effect of regional market environments on talent attraction. The regression results are shown in Column (4) of Table 6 and are consistent with our main results.

6.5. Overseas experience of the chair of the board or CEO

As firms' decisions are ultimately made by the chair of the board or CEO, to directly measure the impact of the chair of the board's or CEO's overseas experience on labor investment decisions, we divide executives into the chair of the board or CEO. *Oversea_Chairman or CEO* equals 1 if the chair of the board or CEO has overseas experience, and the regression results are shown in Table 7, Column (1). *Oversea_CEO* equals 1 if the CEO has overseas experience, and the regression results are shown in Table 7, Column (2). Finally, *Oversea_Chairman* equals 1 if the chair of the board has overseas experience, and the regression results are shown in Table 7, Column (3). Our main results still hold.

6.6. Endogeneity concerns

Our results may be affected by potential endogeneity problems. First, the model may lead to sample selection bias due to the omission of some important variables or measurement errors. Second, there may be bidirectional causality between executives' overseas experience and firms' labor investment efficiency, i.e., executives' overseas experience improves firms' labor investment efficiency, while at the same time, firms with higher labor investment efficiency may attract executives with overseas experience. We use various methods to mitigate endogeneity concerns.

6.6.1. Independent variable lagged by one period

Given the possible impact of firms' labor investment efficiency on returnee executives, following Dai and Kong (2017), we lag our indicator of executives' overseas experience (*Oversea*) by one period. Indeed, as the impact of overseas experience is continuous while labor investment efficiency changes under the influences of various factors, lagging the independent variable by one period can effectively mitigate the impact of high labor investment efficiency on returnee executives. As shown in Column (1) of Table 8, the regression results indicate that *Oversea* lagged by one period is negatively correlated with firms' labor investment inefficiency at the 5 % level.

6.6.2. Propensity score matching method

To reduce sample selection bias, we adopt the propensity score matching (PSM) method to pair all observations in the original sample using 1:1 matching with replacement and a caliper radius of 0.05, before rerunning the model with the matched sample. The control variables used in the model are potential factors that affect the employment of executives with overseas experience in prior studies (Giannetti et al., 2015; Wen and Song, 2017). *SIZE* is the natural logarithm of total assets; *AGE* is the number of years a firm has been listed; *TOBINQ* is the sum of the book value of debt and the market value of equity divided by a firm's total assets; *LEV* is the ratio of long term debt to total assets; *SALES_GROWTH* is the percentage change in sales revenue; *ROA* is net income scaled by total assets; *CASH* is net income plus depreciation minus cash paid to acquire fixed assets, intangible assets and other long-term assets, scaled by total assets; *TOP1* is the fraction of shares held by the largest shareholder; *B_SIZE* is the natural logarithm of the total number of directors; *B_IND* is the ratio of the number of independent directors to the total number of directors; and *DUALITY* is a dummy variable equal to 1 if a firm's chairman and CEO are the same person and 0 otherwise. Model (3) is as follows:

Table 7
Results for the chair of the board's or CEO's overseas experience.

	(1)	(2)	(3)
	Abresid	*Abresid*	*Abresid*
Oversea_Chairman or CEO	–0.025**		
	(–2.067)		
Oversea_CEO		–0.040***	
		(–2.686)	
Oversea_Chairman			–0.023*
			(–1.706)
SIZE	–0.017	0.004	–0.023
	(–1.206)	(0.182)	(–1.333)
QUICK	–0.003	–0.005	–0.004
	(–0.866)	(–1.403)	(–0.899)
LEV	0.163	0.097	0.079
	(1.633)	(0.618)	(0.576)
ROA	–0.301**	–0.139	–0.338**
	(–2.365)	(–1.143)	(–2.176)
MB	0.016***	0.011*	0.018***
	(3.234)	(1.912)	(2.794)
STD_CFO	–0.015	–0.014	–0.009
	(–1.320)	(–0.962)	(–0.737)
STD_SALE	0.028***	0.008	0.029**
	(2.985)	(0.607)	(2.537)
STD_NETHIRE	0.074***	0.089***	0.066***
	(5.553)	(5.515)	(4.892)
TANGIBLE	–0.098*	–0.140*	–0.079
	(–1.683)	(–1.647)	(–1.137)
LABOR	–0.031***	–0.017	–0.026**
	(–3.068)	(–1.141)	(–2.163)
Constant	0.423**	0.339	0.373
	(2.066)	(1.236)	(1.511)
Year	yes	yes	yes
Industry	yes	yes	yes
N	3,266	2,236	2,311
Adj-R^2	0.123	0.150	0.141

Note:This table reports the results of the OLS regression. Robust t-statistics are in parentheses. The variables are defined in Table 1. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

$$\begin{aligned} Oversea_{i,t} = {} & \gamma_0 + \gamma_1 SIZE_{i,t} + \gamma_2 AGE_{i,t} + \gamma_3 TOBINQ_{i,t} + \gamma_4 LEV_{i,t} + \gamma_5 SALES\_GROWTH_{i,t} + \gamma_6 ROA_{i,t} \\ & + \gamma_7 CASH_{i,t} + \gamma_8 TOP1_{i,t} + \gamma_9 B\_SIZE_{i,t} + \gamma_{10} B\_IND_{i,t} + \gamma_{11} DUALITY_{i,t} + \Sigma\, Year \\ & + \Sigma\, Industry + \varepsilon_{i,t} \end{aligned} \quad (3)$$

Using Model (3), each firm with at least one executive with overseas experience is matched with a firm without such an executive with the closest propensity score through probit regression. Ultimately, 10,684 observations are successfully matched. Column (2) of Table 8 shows the regression results for the matched sample after PSM. The results show that executives' overseas experience is still significantly negatively associated with firms' labor investment inefficiency.

6.6.3. Heckman's two-stage test

To further alleviate endogeneity concerns, following Wen and Song (2017), we use Heckman's two-stage test. First, we run a probit regression on executives' overseas experience (*Oversea*) using Model (3) and calculate the inverse Mills ratio (*IMR*). Then, *IMR* is added as a control variable to Model (2) for further regression. The results of the second-stage regression are shown in Column (3) of Table 8. The coefficient of *IMR* is 0.065, which is significant at the 5 % level, and the coefficient of *Oversea* is still negatively correlated with

Table 8
Endogeneity concerns.

	(1) *Oversea* lagged by one period	(2) PSM	(3) Heckman's two-stage test	(4) First stage	(5) Second stage
	Abresid	*Abresid*	*Abresid*	*Oversea*	*Abresid*
L.Oversea	–0.015**				
	(–2.193)				
Oversea		–0.016**	–0.012*		–0.103*
		(–2.098)	(–1.903)		(–1.741)
SIZE	–0.010	–0.003	–0.002	0.191***	0.009
	(–1.285)	(–0.382)	(–0.193)	(7.616)	(0.636)
QUICK	–0.005***	–0.005***	–0.005***	0.016**	–0.004**
	(–3.041)	(–3.173)	(–3.338)	(2.559)	(–2.153)
LEV	0.070	0.106*	0.100*	0.065	0.118**
	(1.336)	(1.896)	(1.948)	(0.385)	(2.312)
ROA	–0.061	–0.100*	–0.042	0.056	–0.036
	(–1.142)	(–1.714)	(–0.829)	(0.311)	(–0.722)
MB	0.011***	0.015***	0.016***	0.062***	0.019***
	(4.863)	(5.335)	(5.837)	(7.480)	(4.344)
STD_CFO	–0.018***	–0.020***	–0.017***	–0.087***	–0.026***
	(–2.860)	(–3.121)	(–3.025)	(–4.808)	(–3.257)
STD_SALE	0.027***	0.021***	0.022***	0.075***	0.031***
	(5.109)	(3.757)	(4.487)	(4.566)	(4.524)
STD_NETHIRE	0.045***	0.064***	0.060***	–0.032***	0.057***
	(8.405)	(9.717)	(10.645)	(–3.872)	(9.674)
TANGIBLE	–0.122***	–0.136***	–0.119***	–0.183*	–0.140***
	(–4.361)	(–4.460)	(–4.337)	(–1.842)	(–4.668)
LABOR	–0.026***	–0.023***	–0.025***	0.051***	–0.020***
	(–4.541)	(–3.901)	(–4.558)	(3.043)	(–3.213)
IMR			0.065**		
			(1.987)		
CHRISTIAN				0.128***	
				(4.660)	
Constant	0.341***	0.344***	0.162	–4.785***	–0.067
	(3.263)	(3.266)	(1.043)	(–13.182)	(–0.223)
Year	yes	yes	yes	yes	yes
Industry	yes	yes	yes	yes	yes
N	10,193	10,684	12,688	12,810	12,810
Adj-R^2	0.084	0.110	0.108	0.035	0.107

Note:Columns (1)–(3) and Column (5) report the results of the OLS regression. Robust t-statistics are in parentheses. The variables are defined in Table 1. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively. Column (4) reports the results of the probit regression. Robust z-statistics are in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

firms' labor investment inefficiency and significant at the 10 % level. This suggests that our main results still hold after controlling for sample selection bias.

6.6.4. Instrumental variable approach

Following Ang et al. (2014) and Dai and Kong (2017), we use the dummy variable *CHRISTIAN* as an instrumental variable. If the province where a firm is located has a university founded by Christian missionaries before the end of 1920, *CHRISTIAN* equals 1. The data come from the Survey of Christianity in China from 1901 to 1920. This instrumental variable is chosen for two reasons. First, the source of these data is early enough that it does not have a direct effect on firms' labor investment efficiency. Second, residents in the area where a Christian university is located are likely to be more influenced by Western culture, more inclined to go overseas and more likely to return home after their studies than residents in other areas.

Column (4) of Table 8 presents the results of the first-stage regression. The coefficient of *CHRISTIAN* on *Oversea* is 0.128, which is significant at the 1 % level and in line with expectations. Column (5) of Table 8 shows the results of the second-stage regression. The coefficient of *Oversea* is negative and significant at the

Table 9
Cross-sectional analysis of labor intensity.

	(1) High labor intensity	(2) Low labor intensity
	Abresid	*Abresid*
Oversea	–0.022**	–0.004
	(–2.346)	(–0.430)
SIZE	–0.014	–0.004
	(–1.269)	(–0.388)
QUICK	–0.006**	–0.005***
	(–2.412)	(–3.073)
LEV	0.135	0.096*
	(1.442)	(1.671)
ROA	0.012	–0.093
	(0.161)	(–1.307)
MB	0.008**	0.019***
	(2.524)	(4.712)
STD_CFO	–0.012	–0.025***
	(–1.448)	(–3.040)
STD_SALE	0.017**	0.027***
	(2.418)	(4.177)
STD_NETHIRE	0.076***	0.047***
	(8.199)	(7.011)
TANGIBLE	–0.134***	–0.109***
	(–3.302)	(–2.980)
LABOR	0.002	–0.062***
	(0.115)	(–6.519)
Constant	0.364**	0.453***
	(2.212)	(3.601)
Year	yes	yes
Industry	yes	yes
N	6,475	6,349
Adj-R^2	0.121	0.102

Note:This table reports the results of the OLS regression. Robust t-statistics are in parentheses. The variables are defined in Table 1. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

10 % level, indicating that after controlling for potential endogeneity issues, executives' overseas experience still significantly enhances firms' investment efficiency. Meanwhile, the F-value in the weak instrumental variable test is 22.060, which is significant at the 1 % level, indicating that our instrumental variable is not weak.

7. Further analysis

7.1. Cross-sectional analysis based on labor adjustment costs

In addition to labor investment costs and compensation costs paid to employees, there are hidden costs (i.e., labor adjustment costs) related to employee hiring, training and dismissal (Hamermesh, 1995). The existence of labor adjustment costs indicates that any changes among employees can affect firms' profits and future value (Zhang et al., 2019), putting pressure on management to make labor decisions. In a business environment where labor adjustment costs are high, executives with overseas experience may be more effective in their governance role and in improving labor investment efficiency. We test the differences in the impact of overseas experience on labor investment efficiency under different labor adjustment costs from three aspects: labor intensity, the share of R&D investment and the proportion of highly educated personnel.

Table 10
Cross-sectional analysis of R&D investment.

	(1) High R&D investment	(2) Low R&D investment
	Abresid	*Abresid*
Oversea	–0.018**	–0.000
	(–2.001)	(–0.036)
SIZE	–0.018*	0.008
	(–1.886)	(0.626)
QUICK	–0.005***	–0.005**
	(–3.019)	(–2.106)
LEV	0.123	0.067
	(1.229)	(0.940)
ROA	–0.016	–0.093
	(–0.218)	(–1.136)
MB	0.011***	0.021***
	(3.569)	(4.111)
STD_CFO	–0.008	–0.024***
	(–0.933)	(–2.727)
STD_SALE	0.021***	0.023***
	(2.796)	(2.792)
STD_NETHIRE	0.069***	0.074***
	(6.302)	(6.751)
TANGIBLE	–0.073	–0.159***
	(–1.607)	(–4.030)
LABOR	–0.011	–0.015
	(–1.191)	(–1.581)
Constant	0.400***	0.112
	(3.092)	(0.596)
Year	yes	yes
Industry	yes	yes
N	5,208	5,084
Adj-R^2	0.102	0.117

Note:This table reports the results of the OLS regression. Robust t-statistics are in parentheses. The variables are defined in Table 1. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

7.1.1. Labor intensity

In labor-intensive firms, labor costs represent a greater proportion of total costs than in other firms (Lu et al., 2015). Accordingly, higher labor adjustment costs will be incurred during the labor resource allocation process. As such, we expect executives with overseas experience to have a greater impact on labor-intensive firms. Following Zhang et al. (2019), labor intensity is measured as the ratio of the number of employees to total assets. The sample is divided into high and low labor intensity groups according to the median labor intensity calculated by industry and by year. As shown in Table 9, the effect of executives' overseas experience on firms' labor investment efficiency is more significant in labor-intensive firms, which is consistent with our expectations.

7.1.2. R&D investment

Firms' technological innovation activities are usually inseparable from the recruitment and training of high-quality and highly skilled personnel. These activities will increase a firm's wage costs and labor adjustment costs. Therefore, the higher the level of investment in innovation, the higher the labor adjustment costs. Following Ghaly et al. (2020), we use the ratio of R&D investment to total assets to measure the degree of R&D investment and divide the sample into high and low R&D investment groups according to the median calculated by industry and by year. Table 10 reports the regression results. Column (1) shows that in the high R&D investment group, the effect of executives' overseas experience on labor investment efficiency is significant, sug-

Table 11
Cross-sectional analysis of highly educated employees.

	(1) High proportion of highly educated employees	(2) Low proportion of highly educated employees
	Abresid	*Abresid*
Oversea	–0.017*	–0.011
	(–1.724)	(–1.184)
SIZE	–0.004	–0.005
	(–0.349)	(–0.472)
QUICK	–0.003	–0.010***
	(–1.517)	(–5.173)
LEV	0.185**	0.074
	(2.264)	(0.961)
ROA	–0.153*	0.048
	(–1.842)	(0.686)
MB	0.014***	0.015***
	(3.889)	(3.680)
STD_CFO	–0.018**	–0.021**
	(–2.047)	(–2.438)
STD_SALE	0.017**	0.026***
	(2.087)	(3.871)
STD_NETHIRE	0.066***	0.053***
	(7.411)	(6.595)
TANGIBLE	–0.158***	–0.122***
	(–3.588)	(–2.874)
LABOR	–0.027***	–0.017**
	(–2.924)	(–2.249)
Constant	0.405***	0.377**
	(2.844)	(2.460)
Year	yes	yes
Industry	yes	yes
N	5,777	5,366
Adj-R^2	0.119	0.098

Note:This table reports the results of the OLS regression. Robust t-statistics are in parentheses. The variables are defined in Table 1. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

gesting that firms with high R&D investment ratios face higher labor costs and that hiring executives with overseas experience improves labor investment efficiency.

7.1.3. Employees' education level

Firms with more educated employees face higher labor adjustment costs. If executives with overseas experience play an active governance role, their role in improving labor investment efficiency should be more important in firms with more educated employees. Using the ratio of the number of employees with a master's degree or above to business revenue, we compute the median by industry and by year and divide the sample into two groups: firms with high and low proportions of highly educated employees. As shown in Table 11, Column (1), the coefficient of *Oversea* in the group with a high proportion of highly educated employees is –0.017, which is significant at the 10 % level, while the coefficient of *Oversea* is not significant in the group with a low proportion of highly educated employees in Column (2).

7.2. Mechanism testing

In the theoretical analysis section, we argue that executives with overseas experience have an impact on firms' labor investment efficiency by reducing agency costs, attracting analyst attention and alleviating financing constraints. To test these mechanisms, we establish the following mediation models:

$$Abresid_{i,t} = \alpha_0 + \alpha_1 Oversea_{i,t} + \alpha Controls_{i,t} + \varepsilon_{i,t} \quad (4)$$

Table 12
Results for the mediating effect of agency costs.

	(1) *Abresid*	(2) *Turnover*	(3) *Abresid*
Oversea	–0.013**	0.015***	–0.012*
	(–2.074)	(3.168)	(–1.936)
Turnover			–0.056***
			(–4.596)
SIZE	–0.010	–0.268***	–0.025***
	(–1.316)	(–35.280)	(–3.013)
QUICK	–0.005***	–0.005***	–0.006***
	(–3.783)	(–4.011)	(–3.976)
LEV	0.113**	–0.391***	0.091*
	(2.215)	(–11.821)	(1.779)
ROA	–0.044	0.595***	–0.011
	(–0.893)	(13.076)	(–0.225)
MB	0.013***	–0.019***	0.012***
	(5.276)	(–10.088)	(4.842)
STD_CFO	–0.017***	0.037***	–0.015***
	(–2.983)	(9.579)	(–2.611)
STD_SALE	0.023***	0.264***	0.037***
	(4.687)	(49.876)	(6.589)
STD_NETHIRE	0.060***	–0.014***	0.059***
	(10.702)	(–6.201)	(10.630)
TANGIBLE	–0.121***	0.066***	–0.118***
	(–4.427)	(3.285)	(–4.293)
LABOR	–0.026***	0.099***	–0.020***
	(–4.846)	(23.551)	(–3.707)
Constant	0.399***	0.170**	0.409***
	(4.118)	(1.975)	(4.208)
Year	yes	yes	yes
Industry	yes	yes	yes
N	12,824	12,824	12,824
Adj-R^2	0.107	0.554	0.109
Sobel test (z-value)			–2.687
Bootstrap test (95 % confidence interval)		–0.0015677	–0.0003207

Note:This table reports the results of the OLS regression. Robust t-statistics are in parentheses. The variables are defined in Table 1. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

$$X_{i,t} = \delta_0 + \delta_1 Oversea_{i,t} + \delta Controls_{i,t} + \varepsilon_{i,t} \tag{5}$$

$$Abresid_{i,t} = \varphi_0 + \varphi_1 Oversea_{i,t} + \varphi_2 X_{i,t} + \varphi Controls_{i,t} + \varepsilon_{i,t} \tag{6}$$

where X denotes one of the mediating variables, i.e., agency problems (*Turnover*), analyst attention (*Analyst*) and financing constraints (*KZ*). The above mechanisms are verified according to the mediation test of Wen et al. (2004) and Wen and Ye (2014).

7.2.1. Mediating effect of agency costs

Executives with overseas experience can improve their cognitive abilities and cultivate a forward-thinking mindset through the accumulation of cultural knowledge or overseas management experience, such that their personal interests and those of shareholders tend to be consistent, which can reduce principal–agent problems and improve labor investment efficiency. Following Li (2007), we use the asset turnover ratio to measure agency costs. The higher the asset turnover ratio, the lower the agency costs.

The results are shown in Table 12. Column (1) reports the benchmark regression results, showing that executives' overseas experience has a significant positive effect on firms' labor investment efficiency. Column (2) shows that executives with overseas experience can increase the asset turnover ratio, which is significant at the 1 % level, thereby reducing agency costs. Column (3) shows that after adding the mediating variable *Turn-*

Table 13
Results for the mediating effect of analyst attention.

	(1) *Abresid*	(2) *Analyst*	(3) *Abresid*
Oversea	–0.013**	0.133***	–0.011*
	(–2.074)	(8.094)	(–1.756)
Analyst			–0.015***
			(–4.274)
SIZE	–0.010	0.577***	–0.001
	(–1.316)	(32.561)	(–0.159)
QUICK	–0.005***	0.028***	–0.005***
	(–3.783)	(6.406)	(–3.482)
LEV	0.113**	–0.184	0.111**
	(2.215)	(–1.587)	(2.163)
ROA	–0.044	4.316***	0.018
	(–0.893)	(31.733)	(0.352)
MB	0.013***	0.146***	0.015***
	(5.276)	(25.285)	(5.831)
STD_CFO	–0.017***	–0.140***	–0.019***
	(–2.983)	(–10.941)	(–3.325)
STD_SALE	0.023***	0.163***	0.025***
	(4.687)	(14.017)	(5.114)
STD_NETHIRE	0.060***	–0.047***	0.059***
	(10.702)	(–8.118)	(10.628)
TANGIBLE	–0.121***	–0.248***	–0.125***
	(–4.427)	(–3.611)	(–4.564)
LABOR	–0.026***	0.158***	–0.023***
	(–4.846)	(13.422)	(–4.421)
Constant	0.399***	–12.366***	0.219**
	(4.118)	(–51.343)	(2.006)
Year	yes	yes	yes
Industry	yes	yes	yes
N	12,824	12,824	12,824
Adj-R^2	0.107	0.421	0.108
Sobel test (z-value)			–3.891
Bootstrap test (95 % confidence interval)		–0.0030620	–0.0010117

Note:This table reports the results of the OLS regression. Robust t-statistics are in parentheses. The variables are defined in Table 1. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

over, the effect of executives with overseas experience on firms' labor investment efficiency is still significant at the 10 % level, and *Turnover* has a significant effect on labor investment efficiency. In additional analyses, the z-value of the Sobel test is –2.687, and the 95 % confidence interval of the bootstrap test is [–0.0015677, –0.0003207], which is significant, indicating that executives' overseas experience can improve firms' labor investment efficiency by reducing agency costs.

7.2.2. Mediating effect of analyst attention

Executives with extensive overseas experience and management experience can effectively improve corporate governance, attract more securities analysts to follow their firms and increase the power of external supervision, thereby improving labor investment efficiency. For the second mechanism, following the literature (Chen et al., 2018), we define analyst attention (*Analyst*) as the log of the number of analysts following a firm plus 1.

Table 13 shows the results for the mediating effect of analyst attention. The results in Column (1) are consistent with those in Column (1) of Table 4. In Column (2), the effect of executives' overseas experience on analyst attention is significant at the 1 % level, indicating that hiring executives with overseas experience attracts more analysts to follow the firm. In Column (3), the coefficient of *Oversea* decreases to –0.011 after adding *Analyst* to the model, which is still significant at the 10 % level. The coefficient of *Analyst* is –0.015,

Table 14
Results for the mediating effect of financing constraints.

	(1) *Abresid*	(2) *KZ*	(3) *Abresid*
Oversea	–0.00703*	–0.115***	–0.00659
	(–1.663)	(–2.800)	(–1.560)
KZ			0.004**
			(2.522)
SIZE	–0.061***	–0.174***	–0.060***
	(–10.580)	(–3.500)	(–10.567)
QUICK	–0.002**	–0.441***	–0.001
	(–1.972)	(–26.575)	(–0.544)
LEV	–0.018	4.872***	–0.037
	(–0.484)	(16.084)	(–0.973)
ROA	–0.122***	–17.784***	–0.053
	(–2.608)	(–27.559)	(–0.962)
MB	0.008***	0.275***	0.007***
	(4.468)	(16.637)	(3.919)
STD_CFO	0.003	–0.183***	0.003
	(0.695)	(–5.192)	(0.867)
STD_SALE	0.039***	0.119***	0.038***
	(10.077)	(3.737)	(10.023)
STD_NETHIRE	0.010***	0.068***	0.010***
	(4.405)	(4.695)	(4.296)
TANGIBLE	–0.060***	–0.547***	–0.058***
	(–3.501)	(–3.421)	(–3.395)
LABOR	–0.061***	–0.286***	–0.060***
	(–15.291)	(–8.823)	(–14.965)
Constant	0.964***	7.413***	0.936***
	(13.322)	(11.446)	(13.035)
Year	yes	yes	yes
Industry	yes	yes	yes
N	6,912	6,912	6,912
Adj-R^2	0.174	0.506	0.175
Sobel test (z-value)			–2.094
Bootstrap test (95 % confidence interval)		–0.0011605	–0.0000948

Note: This table reports the results of the OLS regression. Robust t-statistics are in parentheses. The variables are defined in Table 1. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

which is significant at the 1 % level, indicating that analyst attention plays a partial mediating role in the relationship between executives' overseas experience and firms' labor investment efficiency. Meanwhile, the z-value of the Sobel test is –3.891 and the 95 % confidence interval of the bootstrap test is [–0.0030620, –0.0010117], which also confirms the mediating effect of analyst attention.

7.2.3. Mediating effect of financing constraints

To the extent that the overseas experience of executives can reduce agency costs and information asymmetry, it is easier for firms to attract investors, further alleviating their financing constraints. In addition, returnee executives have broader interpersonal relationships and economic resources abroad, which give them additional advantages in attracting foreign financing and mergers and acquisitions, thereby facilitating overseas financing. For the third mechanism, we adopt the KZ index to measure the degree of external financing constraints of firms following Kaplan and Zingales (1997).

In a stepwise regression on the full sample (not reported), we find that returnee executives do not significantly affect firms' labor investment efficiency by alleviating financing constraints. Considering that the effect of financing constraints is more likely to occur in the case of under-hiring, we further test the mechanism using the under-hiring subsample. As shown in Table 14, the results in Column (1) are consistent with the above finding that returnee executives can promote firms' labor investment efficiency. In Column (2), the coefficient

between *Oversea* and *KZ* is negative and significant at the 1 % level, indicating that executives with overseas experience can significantly reduce financing constraints. The results in Column (3) show that the effect of *KZ* on *Abresid* is significant at the 5 % level, while the coefficient between *Oversea* and *Abresid* is not significant, which demonstrates the full mediating role of alleviating financing constraints when hiring is insufficient. Meanwhile, under conditions of underemployment, the mediating effect of financing constraints passes the significance test of the Sobel and bootstrap methods, with the z-value of the Sobel test being –2.094 and the 95 % confidence interval of the bootstrap test being [–0.0011605, –0.0000948]. The above results suggest that alleviating financing constraints is a path for returnee executives to improve labor investment efficiency under conditions of underemployment.

8. Conclusions

As a key resource and production factor, labor allocation efficiency can affect the high-quality development of firms. We theoretically analyze and empirically test the impact of executives' overseas experience on firms' labor investment efficiency and draw the following conclusions. (1) Executives with overseas experience can significantly improve firms' labor investment efficiency. After distinguishing between different types of overseas experience, we find that overseas study experience only and both overseas study and work experience have a significant and positive effect on firms' labor investment efficiency, whereas overseas work experience only has no significant effect. (2) Our cross-sectional tests based on labor adjustment costs show that the positive effect of executives' overseas experience is more pronounced in labor-intensive firms, in firms with a greater proportion of R&D investment and in firms with a greater proportion of highly educated employees. (3) Reducing agency costs, attracting more analysts and alleviating financing constraints under conditions of underemployment are the three mechanisms through which executives' overseas experience improves labor investment efficiency.

This paper has the following two implications. First, executives' overseas experience can optimize the efficiency of firms' labor resource allocation, so firms should actively hire high-level returning talents, fully exploit the advantages of returning talents and enhance their reasonable allocation of labor resources. Second, local governments should continue to promote the policy of attracting talents returned from abroad, create a good working environment for returning talents and provide them with institutional protection, so as to increase the level of high-quality labor resources and promote the high-quality development of firms.

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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IPO suspension, financing uncertainty and corporate tax avoidance

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ABSTRACT

The acquisition of external financing is an important factor affecting the development of enterprises and even the economic growth of a country. However, changes in the external environment often expose enterprises to uncertainties in obtaining external financing. Taking China's initial public offering (IPO) suspension policy as a setting, this paper examines the impact of the associated external financing uncertainty on firms. The empirical results show that firms that are unable to secure planned financing due to the IPO suspension policy engage in greater tax avoidance activities than successful IPOs during the IPO suspension period; this phenomenon is mainly concentrated in firms that are not state-owned, have no venture capital or private equity backing, have lower debt servicing capacity and have lower tax avoidance risk. Moreover, the tax avoidance activities of enterprises positively influence their fixed asset investment and innovation investment during the IPO suspension period. Evidence based on IPO price performance indicates that investors respond positively to firms' tax avoidance practices during IPO suspensions.

1. Introduction

In recent years, policy uncertainty in China and around the world has reached unprecedented levels, influenced by factors such as the coronavirus disease 2019 (COVID-19) pandemic and Sino–US trade friction (Sharif et al., 2020). Policy uncertainty has also become an important external factor affecting the production and operations of microenterprises and macroeconomic development (Baker et al., 2016). Based on compre-

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hensive indicators, studies have found that policy uncertainty has a significant impact on corporate investment, financing and other behaviors (e.g., Pástor and Veronesi, 2013; Gulen and Ion, 2016; Gu et al., 2018). However, examining the economic consequences of policy uncertainty based on comprehensive indicators may lead to problems, such as a lack of pertinence in research inspiration and complex analysis mechanisms. Consequently, many scholars have focused on specific policy uncertainty events to discern the potential economic consequences associated with various types of policy uncertainty (e.g., Chen et al., 2016a, 2016b; Gonçalves et al., 2022; Jacob et al., 2022).

Distinct from prior studies, this paper focuses on a noteworthy yet comparatively overlooked dimension of uncertainty in business enterprises: financing uncertainty. The acquisition of external financing serves as a vital determinant of enterprise development and even has implications for the economic growth of a country (King and Levine, 1993; Allen et al., 2005). However, due to information asymmetry, government regulation, and ever-changing external environments, firms frequently face difficulties in obtaining timely and adequate financing from the capital market as initially planned. For example, to ensure the healthy development of the stock market, the China Securities Regulatory Commission (CSRC) has implemented a temporary initial public offering (IPO) suspension policy. This policy prevents approved firms from accessing equity financing through an IPO as expected and leaves them uncertain about the duration of the suspension. Therefore, the IPO suspension policy may expose these firms to high uncertainty in terms of access to external financing. Based on this institutional background, this paper explores the real economic consequences of external financing uncertainty for firms from the perspective of corporate tax avoidance.

We conduct this study from the perspective of corporate tax avoidance because taxes are an important cost for enterprises. Numerous studies have found that when firms face crises, they often manage cash flow and expenses to reduce costs through tax avoidance (Richardson et al., 2015; Wang et al., 2018; Xu and Li, 2020). Therefore, conducting research from this perspective can reveal how firms effectively deal with external financing uncertainty. This paper takes China's IPO suspensions in 2008, 2012, and 2015 as a quasi-natural experiment and selects A-share nonfinancial listed firms that were approved for IPO in the year prior to the above three suspension events as the research object. The findings of this study are as follows. First, firms facing substantial uncertainty in obtaining equity financing due to the IPO suspension policy exhibit a considerably higher level of tax avoidance than unaffected firms during the IPO suspension period. The findings are robust to alternative measures of the core variables, addressing possible endogeneity problems, and replacing empirical models. Second, corporate tax avoidance during the IPO suspension period is mainly concentrated in non-state-owned enterprises (non-SOEs), enterprises without venture capital (VC) or private equity (PE) funding, and enterprises with low debt servicing capacity, i.e., enterprises whose financing activities are greatly affected by the IPO suspension policy. In addition, firms with lower tax avoidance costs and risks engage in more tax avoidance activities during the IPO suspension period. Finally, this paper examines the economic consequences of tax avoidance activities during the IPO suspension period. The results indicate that tax avoidance activities promote firms' fixed asset investment and innovation investment during the IPO suspension period and lead to a better stock market reaction after a successful IPO. This demonstrates that such tax avoidance activities mitigate the negative impact of IPO suspensions on firms. These findings comprehensively present the impact and economic consequences of the external financing uncertainty caused by IPO suspensions on corporate tax avoidance activities.

The marginal contributions of this paper include the following three points. (1) Taking China's IPO suspension events as a research scenario, this paper examines the impact of specific policy uncertainty on corporate tax avoidance and related economic consequences, an approach that is not only different from studies that have used comprehensive indicators of uncertainty (Baker et al., 2016; Gulen and Ion, 2016) but also different from studies based on specific policy uncertainty (Chen et al., 2016a, 2016b; Chen and Chen, 2018), thus effectively complementing relevant studies on the impact of policy uncertainty on corporate behavior. (2) This paper expands the related literature on the relationship between the financing environment and corporate tax avoidance by focusing on financing uncertainty. Studies have mainly examined the impact of financing constraints on corporate tax avoidance (Law and Mills, 2015; Edwards et al., 2016; Goh et al., 2016; Wang, 2016). However, because the characteristics of an enterprise (such as small and microenterprises and non-SOEs) and the capital market in the region where the enterprise is located (such as countries and regions with low levels of financial development) tend to remain stable, the certainty of financing constraints is rela-

tively high. In contrast, the external financing environment faced by enterprises often experiences substantial change and uncertainty. Therefore, unlike prior studies, the present study examines the economic consequences of uncertainty in the financing environment, which is of both theoretical and practical importance and represents an underexplored topic in the literature. (3) This paper contributes to research on the economic consequences of IPO suspension policies from the perspective of corporate tax avoidance. The literature has found that IPO suspensions may increase the issuance cost of enterprises (Song and Xin, 2017) and have a negative impact on enterprise innovation (Cong and Howell, 2021). This paper provides new evidence from the perspective of corporate tax avoidance.

Notably, while an IPO suspension causes uncertainty for firms in terms of financing access and can help to identify causal factors, it has certain unique qualities. For example, an IPO is a means of equity financing for firms, which differs from debt financing; in addition, an IPO suspension occurs infrequently. Therefore, the conclusions of this paper may not be generalizable to other causes of external financing uncertainty and their effects on corporate tax avoidance. However, with the continuous expansion of the scale of IPO financing in China in recent years, IPOs have become increasingly important for enterprises. Consequently, there is a growing need to investigate the economic consequences of IPO suspensions.

2. Literature review and institutional background

2.1. Literature review

2.1.1. Research on the economic consequences of policy uncertainty

Policy uncertainty is a comprehensive concept that reflects the inability of economic agents to accurately anticipate policy changes (Gulen and Ion, 2016). Empirical evidence indicates that policy uncertainty has an impact on the production and operations of enterprises. Studies have investigated the economic consequences of policy uncertainty mainly from two perspectives: comprehensive indicators of policy uncertainty and specific policy uncertainty events.

Researchers have studied the economic consequences of policy uncertainty using the Economic Policy Uncertainty (EPU) Index, a comprehensive indicator. First, numerous studies have found that policy uncertainty affects firms' investment decisions. Drawing on growth options theory, some studies have proposed that firms may invest more during periods of high policy uncertainty to gain comparative advantages (Hartman, 1972). Conversely, based on real options theory, other studies have found that firms invest less due to uncertainty about future expectations (Gulen and Ion, 2016; Zhang and Liu, 2018). Relevant research has further found that investment during periods of high policy uncertainty tends to exhibit higher investment efficiency (Rao et al., 2018; Yu et al., 2020). Second, studies have found that policy uncertainty can affect firms' cash holding strategies and financing decisions. Wang et al. (2014) showed that to improve their ability to conduct sustainable operations, enterprises can increase their cash holdings during periods of high policy uncertainty. Peng et al. (2018) found that firms may augment their holdings of value-preserving financial assets to cope with uncertainty in the external environment. Policy uncertainty can escalate market risk and enterprises' financing costs, thereby inhibiting their financing (Pástor and Veronesi, 2013) and reducing their leverage ratios (Cai et al., 2018). Last, several studies have identified the influence of policy uncertainty on firm innovation (Chen et al., 2016a, 2016b; Meng and Shi, 2017; Gu et al., 2018). Apart from these three aspects, research has addressed the impact of policy uncertainty on corporate risk taking, information disclosure quality, and agency costs (Hoskisson et al., 2017; EI Ghoul et al., 2021).

Studies have also investigated the economic consequences of policy uncertainty by examining specific policy uncertainty events, such as political uncertainty events and policy change events. Scholars have found that national elections and changes in local officials can increase the level of policy uncertainty, subsequently affecting the investment and tax avoidance decisions of enterprises (Julio and Yook, 2012; Chen et al., 2016a, 2016b). Some studies have focused on specific policy change events and found that policy uncertainty caused by IPO suspensions can have a negative impact on corporate innovation (Cong and Howell, 2021), and that tax-related policy uncertainty events (for example, tax law changes, tax rate adjustments, and changes in tax collection intensity) can have an impact on corporate tax avoidance, information disclosure, and cash holdings (Beck and Lisowsky, 2014; Hanlon et al., 2017; Guenther et al., 2019).

2.1.2. Research on the relationship between the financing environment and corporate tax avoidance

Building on the Modigliani–Miller (M&M) theorem, various theories have been developed to explain the financing behavior of enterprises, including pecking order theory and trade-off theory. Such theories are all based on the premise that the capital market can provide enterprises with timely and sufficient financing. However, real-world economic conditions often deviate from this assumption, due to information asymmetry and other factors causing enterprises to face financing decision-making problems, such as financing constraints, financing costs, and financing method selection (Fazzari et al., 1988; Kaplan and Zingales, 1997). When encountering financing difficulties, the value of cash holdings for enterprises can increase accordingly (Almeida et al., 2004), leading them to rely more on internal financing (Myers and Majluf, 2018). The government's taxing power makes it something akin to the largest minority shareholder of all enterprises (Desai et al., 2007), and enterprises are obligated to pay a certain percentage of their profits to the government in cash. Therefore, when faced with financing difficulties, enterprises may be motivated to engage in tax avoidance activities and use the cash thus saved as a source of capital (Law and Mills, 2015).

The literature has primarily focused on the "cash flow effect" of tax avoidance activities and studied the impact of the financing environment on corporate tax avoidance activities. In general, when a firm is in financial distress, its level of tax avoidance tends to increase (Edwards et al., 2016). Some studies have also explored more specific events, finding that in response to the deteriorating external financing environment caused by the 2008 global financial crisis, firms engaged in more tax avoidance activities to reduce cash outflows (Richardson et al., 2015; Wang, 2016). Moreover, this phenomenon was more serious in regions with lower levels of financial development (Beck and Lisowsky, 2014; Liu and Ye, 2014). In terms of the underlying mechanism, Goh et al. (2016) found that the tax avoidance activities of enterprises facing financing dilemmas can reduce their cost of equity.

2.2. Institutional background

Bank credit has always been an important way for Chinese enterprises to obtain external financing. However, this financing method has limitations, such as ownership preference and restrictive clauses (Yu and Pan, 2008). Therefore, with the establishment and improvement of the capital market, an increasing number of enterprises have opted for equity financing in the open market to obtain external financial support. According to statistics from the Wind database, the scale of China's equity financing market grew from 123.107 billion yuan in 2001 to 1,736.179 billion yuan in 2021, with an average annual growth rate of 65.52%. Among the various forms of equity financing, IPOs have emerged as the most prevalent, accounting for an average of 30.96%. In 2021, China witnessed 523 new A-share listed firms, raising a total of 542.653 billion yuan through IPOs. Moreover, with the continuous expansion of the reform of the registration system, the number of firms raising funds through IPOs is likely to increase further. In addition, as a specific form of equity financing, IPOs not only provide direct financial support to enterprises but also exert a significant effect on their innovation and corporate governance (Krishnan et al., 2011; Cong and Howell, 2021). In conclusion, IPOs play a vital role in the development of firms.

The CSRC stipulates that an IPO must go through at least six steps: reorganization and restructuring, due diligence and guidance, document preparation and declaration, issuance examination, roadshow price inquiry and pricing, and issuance and listing. The research content of this paper is closely related to the issuance examination process; therefore, this paper focuses on the relevant content involved in this process. Once a firm submits the required documents related to its IPO application to the CSRC, the CSRC arranges for China's Securities Issuance Examination Committee (CSIEC) to review the materials. The CSIEC consists of experts specializing in law, regulation, and accounting. Based on the submitted prospectus and other materials, the CSIEC uses an expert scoring method to determine whether to grant approval for public listing (Zhang et al., 2021). Because the issuance examination process is a dynamic process, it typically takes an average of 3–6 months to complete. To ensure the quality of listed firms, the CSIEC rejects approximately 20%–30% of applications after rigorous review (Yang, 2013). A firm must be listed on the stock exchange within 6 months of obtaining its IPO qualification. Otherwise, the firm must resubmit its examination materials to the CSIEC. Therefore, firms tend to publicly issue shares within 6 months of obtaining approval for listing.

However, the time lag between listing approval and listing may not be accurately predictable due to IPO suspension policies. An IPO suspension policy is a means for the CSRC to regulate the market. Since 1990, there have been nine IPO suspension events in China's A-share market. The specific IPO suspension and restart times are shown in Table 1. The duration of IPO suspension events in China has ranged from 3 to 14 months. These IPO suspension events have two important characteristics: first, the suspension is not triggered by specific firm-level characteristics but is instead influenced by the market conditions at the time; second, the market cannot predict the precise start and end time of an IPO suspension event. These two features ensure the relative exogeneity of IPO suspension events, which is useful for the development of empirical analysis.

3. Theoretical analysis and hypothesis development

This paper argues that when firms face financing uncertainty due to an IPO suspension, they respond by increasing their tax avoidance activities. The underlying logic is as follows.

First, according to pecking order theory, firms facing changes in the external financing environment tend to increase their reliance on internal financing to reduce their financing costs (Opler et al., 1999; Almeida and Campello, 2010). When firms are affected by financing uncertainty, they are motivated to engage in more tax avoidance activities and improve their internal financing capabilities to cope with changes in the financing environment. Specifically, an important motivation for firms to conduct an IPO is to obtain more equity financing (Liao and Zhu, 2003). Firms that are engaged in the IPO process are forced to enter a waiting period when an IPO suspension policy comes into effect. This directly affects their ability to secure the expected equity financing, leading to financing uncertainty. At this point, it becomes a realistic option for firms to mitigate financing uncertainty by strengthening their internal financing through enhanced tax avoidance activities.

Firms may also consider alternative options such as debt financing or cost cutting rather than engaging in more tax avoidance activities. However, for the following reasons, this paper argues that these options do not affect corporate tax avoidance as a viable option. First, an IPO suspension can indeed impact the financing needs of enterprises, but the ability of enterprises to obtain financing cannot improve in a short period. Indeed, during the IPO suspension period, firms' fundamental characteristics such as profitability and the value of pledgeable assets are unlikely to change significantly; therefore, creditors' supply of credit to a firm may not change extensively. However, an IPO suspension can hinder firms from accessing equity financing in a timely manner, which can affect their cash flow and disrupt debt repayment. In some cases, creditors may reduce their credit supply to such firms. Second, while cost cutting may alleviate a firm's cash flow pressure, it also can affect its real business activities. In fact, firms that apply for an IPO typically have more investment opportunities, and extensive growth through expanded production is crucial for such firms. Therefore, cost reduction measures can significantly affect the business activities of these enterprises. Moreover, cost reduction may affect the valuation of firms after the restart of the IPO, resulting in a reduction in the amount of financing available to them.

Table 1
Suspension and restart times of IPO suspension events in China.

Order of occurrence	IPO suspension date	IPO restart date	Duration (days)
1	July 21, 1994	December 7, 1994	139
2	January 19, 1995	June 9, 1995	141
3	July 5, 1995	January 3, 1996	182
4	July 31, 2001	November 2, 2001	94
5	August 26, 2004	January 23, 2005	150
6	May 25, 2005	June 2, 2006	373
7	September 19, 2008	July 10, 2009	294
8	October 19, 2012	January 7, 2014	445
9	July 4, 2015	November 6, 2015	125

Data Source: Manually collected information disclosed by the CSRC.

Second, based on precautionary motive theory (Almeida et al., 2004; Bates et al., 2009), when a firm's financing activities are uncertain, its motivation to reserve cash increases significantly. When cash flow for normal operating activities remains unchanged, saving cash through tax avoidance becomes an option.

In addition to the theoretical analysis, this paper provides relevant examples to enrich the discussion, although corporate tax avoidance activities are generally concealed. Even if an enterprise engages in tax avoidance and is discovered by the tax department, it is often resolved through private channels and is unlikely to be exposed to the public eye. Consequently, it is challenging to find specific examples of corporate tax activities during the IPO suspension period. However, the effects of IPO suspensions on corporate cash flow and financing are not uncommon. For example, for an article titled *IPO Suspended: Where Do Firms Lack of Financing Channels Go?*, the author conducted anonymous interviews with executives of firms affected by IPO suspensions. These executives explained that IPO suspensions made it impossible for firms to determine the best time to raise funds, forcing them to find alternative ways to bridge financing gaps (Yicai, 2013). Another article, titled *In the Days Without IPOs*, mentioned that after an IPO suspension event, the scale of corporate bond financing increases significantly (Economic Observation, 2015). This means that firms do find other ways to bridge the financing gap.

Based on the above analysis, the following hypothesis is proposed: If other conditions remain unchanged, firms affected by an IPO suspension policy engage in more tax avoidance activities than firms not affected.

There are also corresponding costs and risks for enterprises engaging in tax avoidance activities, such as loss of reputation upon public discovery of tax evasion, regulatory risks, and cash outlays for additional taxes and penalties, among others. These factors may weaken the theoretical basis of the proposed hypothesis. However, first, studies have found that firms generally use various methods to eliminate potential tax risks before their IPO review (Wei et al., 2018a, 2018b). Therefore, IPO-approved firms face less tax risk during the IPO suspension period. Second, according to the historical experience of China's capital market, the probability of an IPO-approved firm failing to succeed in an IPO is exceptionally low (Cong and Howell, 2021). Therefore, the regulatory risk faced by enterprises after their IPO review is relatively limited. Third, in the process of alleviating uncertainty through tax avoidance, enterprises are bound to control possible costs and risks and are unlikely to engage in extreme tax avoidance activities. Taking these factors into account, the hypothesis proposed in this paper retains a solid theoretical foundation, which is discussed further in subsequent sections, as are the empirical test results.

4. Research design

4.1. Sample selection and data

This paper takes IPO suspension events as the entry point to examine the impact of financing uncertainty on corporate tax avoidance. Specifically, this paper uses three IPO suspension events in China (in 2008, 2012, and 2015) as a quasi-natural experiment. The selection of these three IPO suspension events is mainly based on the following two considerations. (1) Data on unlisted firms must be obtained manually, and there is a serious lack of data on research variables available before 2004. (2) The two IPO suspensions that occurred between 2004 and 2006 are very close, making it difficult to distinguish the treated group from the control group.

For the sample, firms that were approved for IPO in the year prior to each IPO suspension event (i.e., September 19, 2007–September 19, 2008; October 19, 2011–October 19, 2012; and July 4, 2014–July 4, 2015) are selected as the research object. Those that failed to go public as scheduled before the IPO suspension policy was promulgated are classified as the treated group, and the other firms are classified as the control group. A 1-year interval preceding each IPO suspension event is selected for the following reasons: (1) to maximize the comparability of the treated and control groups and (2) because the regulations require firms to be listed within 6 months of IPO approval; thus, the 1-year interval yields enough firms for both groups.

The sample year is selected based on the duration of the IPO suspension policy. For the sample firms that became eligible for IPO in the year prior to the IPO suspension event in 2008, the sample year spans from 2008 to 2009 because the 2008 IPO suspension lasted from September 2008 to July 2009. Therefore, these treated firms were affected by the IPO suspensions in 2008 and 2009. Similarly, for the sample firms that were approved for IPO in the year prior to the IPO suspension event in 2012, the sample period is 2012–2014,

as this IPO suspension lasted from October 2012 to January 2014. For firms that were approved for IPO in the year prior to the IPO suspension event in 2015, the sample year is limited to 2015 because the suspension lasted from July 2015 to November 2015.

To provide a clearer and more intuitive understanding of the sample composition, information about the sample is summarized in Table 2. Because the impact period varies depending on the IPO suspension event, the sample firms and sample period also vary depending on the IPO suspension event.

Analyzing the differences in tax avoidance between the treated and control groups in a sample period allows to assess the impact of the IPO suspension policy on corporate tax avoidance. In this paper, the following observations are excluded: (1) financial firms, (2) treated firms with an interval between IPO approval and public listing of less than 200 days (to exclude the impact of firms jumping the IPO queue) (Cong and Howell, 2021), and (3) firms with missing variable information. Ultimately, 1,050 firm-year observations covering 565 firms are obtained. The sample screening process is detailed in Table 3. The relevant information about IPO approval and prelisting financial data are collected manually from the CSRC website and the prospectus of each firm; other firm-level data are obtained from the Wind database and the China Stock Market & Accounting Research (CSMAR) database, and information about VC acquisition is obtained from the CVsource investment database and the Wind database.

4.2. Empirical model and variable definitions

To examine the impact of IPO suspensions on corporate tax avoidance, this paper constructs the following empirical model based on that developed by Cong and Howell (2021):

$$\begin{aligned} ETRi,t = {} & \alpha 0 + \alpha 1 Treati + \alpha 2 Levi,t + \alpha 3 Roai,t + \alpha 4 Sizei,t + \alpha 5 LnAgei,t + \alpha 6 Ratei,t \\ & + \alpha 7 Inventi,t + \alpha 8 PPEi,t + \alpha 9 Intangi,t + \alpha 10 EPUt + \alpha 11 TEt + \mu + \theta + \varepsilon i,t \end{aligned} \tag{1}$$

where *ETR* is the effective tax rate, the dependent variable representing corporate tax avoidance. Using the effective income tax rate to measure corporate tax avoidance is a common practice in the literature (Hanlon and Heitzman, 2010). Specifically, *ETR* is equal to a firm's current income tax expense divided by its pre-tax profit. In general, the higher the applicable tax rate of a firm, the lower its tax avoidance.[1] Referring to previous studies (Wu, 2009; Wang et al., 2018), *ETR* is winsorized to the interval of [0,1]. *Treat* is an independent variable that measures whether firms are affected by an IPO suspension. If a firm received IPO approval but failed to go public as scheduled due to an IPO suspension event, *Treat* takes a value of 1, and 0 otherwise. The regression coefficient of *Treat* is expected to be significant and negative.

Referring to previous studies (Wu, 2009; Francis et al., 2017; Tang et al., 2017; Tang, 2020), the following microlevel control variables are added to the model: leverage (*Lev*), measured as year-end total debt divided by total assets; return on assets (*Roa*), measured as year-end pretax profit divided by total assets; firm size (*Size*), measured as the natural logarithm of year-end total assets; firm age (*LnAge*), measured as the natural logarithm of the enterprise's age; applicable tax rate (*Rate*), measured as the statutory income tax rate applicable to the enterprise; inventory intensity (*Invent*), measured as year-end net inventory value divided by total assets;

[1] This paper uses the effective income tax rate to measure corporate tax avoidance, meaning that it only examines the avoidance of corporate income tax and not the avoidance of other taxes (e.g., turnover tax, such as value-added tax). This approach is chosen for the following reasons. (1) The tax base of turnover tax is relatively easy to determine, whereas turnover tax avoidance is difficult to identify, as the tax authorities can review tax information through upstream and downstream enterprises. The tax base of corporate income tax is determined after the comprehensive calculation of various types of business income and costs, based on accounting standards and tax laws. There is room for firms to adjust during this process. As a result, income tax avoidance is more common than other forms of tax avoidance. In addition, turnover tax is the main tax in China. To ensure fiscal revenue, China has made great efforts to thwart turnover tax avoidance, the most representative approach being the introduction of the Golden Tax Project, which has exacerbated the difficulty of turnover tax avoidance for enterprises. (2) Several empirical indicators have been developed in the literature to measure corporate income tax avoidance, and there is a relatively consistent consensus among scholars on these indicators (Hanlon and Heitzman, 2010; Tang, 2020). In contrast, few studies have measured turnover tax avoidance. In addition, the tax burden of turnover tax is not directly reflected in firms' accounting statements and must be estimated through other relevant financial data, making the measurement of turnover tax avoidance less accurate than that of income tax avoidance. (3) If an IPO suspension leads to not only income tax avoidance but also turnover tax avoidance, then this paper underestimates, rather than overestimates, the impact of IPO suspensions on corporate tax avoidance.

tangible asset intensity (*PPE*), measured as year-end net tangible assets divided by total assets; and intangible asset intensity (*Intang*), measured as year-end net intangible assets divided by total assets. To avoid the influence of macro factors on the research conclusions, the following macrolevel control variables, which are common in the literature, are added to the model: the EPU index (*EPU*), measured as the annual arithmetic average of China's EPU index (Baker et al., 2016), and regional tax collection effort (*TE*), measured as the ratio of actual tax revenue to expected tax revenue in each region. Specifically, referring to Xu et al. (2011), the following model is used to calculate the intensity of tax collection in each region:

$$Ti,t/GDPi,t = \alpha 0 + \alpha 1IND1i,t/GDPi,t + \alpha 2IND2i,t/GDPi,t + \alpha 3OPENESSi,t/GDPi,t + \varepsilon \quad (2)$$

where $T_{i,t}$ / $GDP_{i,t}$ represents the tax revenue of each region divided by gross domestic product (*GDP*); *IND1* and *IND2* represent the year-end output of the primary and secondary industries in each region, respectively; and *OPENESS* represents the degree of openness of a region, measured as the total value of exports and imports of each region for the year. Model (2) is used to obtain the coefficients of each variable; then, the expected $T_{i,t}$ / $GDP_{i,t}$, namely $T_{i,t}$ / GDP_{i,t_EST}, is calculated. *TE* is measured as follows:

$$TEi,t = (Ti,t/GDPi,t)/(Ti,t/GDPi,t\_EST)$$

The higher the value of *TE*, the higher the intensity of tax collection in the region.

Finally, this study controls for year fixed effects, μ, and industry fixed effects, θ. To minimize the influence of heteroscedasticity and serial correlation in the regression process, the standard errors of the regression coefficients are cluster-adjusted at the firm level.

5. Empirical results and analysis

5.1. Descriptive statistics

Table 4 lists the descriptive statistics of the main variables. To minimize the influence of outliers, all continuous variables are winsorized at the 1% level. The results show that the mean *ETR* is 0.152, which is lower than the mean *Rate* of 0.160, preliminarily indicating that the sample firms generally engage in tax avoidance activities. The mean *Treat* is 0.257, indicating that approximately 25.7% of the sample firms are affected by IPO suspensions. The mean *Roa* is 10%, indicating relatively high profitability. China has performance requirements for firms applying for an IPO, which results in higher profitability among IPO applicants.

To illustrate the impact of IPO suspensions on corporate tax avoidance, the coefficients on *ETR* for the sample firms in the treated and control groups in the year prior to obtaining IPO approval and within the sample interval are presented in Fig. 1. As shown, in the year prior to obtaining IPO approval, the *ETR* values of the treated and control firms show roughly the same trend; however, after obtaining IPO approval, the treated firms could not be listed within the scheduled time due to the IPO suspension policy, indicated by a significant decrease in their *ETR* values. Conversely, the control firms were not affected by the IPO suspension policy, as evidenced by their relatively stable *ETR* values. Fig. 1 compares the two groups' *ETR*. The difference

Table 2
Sample composition.

IPO suspension event	Sample firms	Sample years	Number of firms in treated group	Number of firms in control group	Number of observations
2008 IPO suspension	Firms that were approved for IPO from September 19, 2007 to September 19, 2008	2008–2009	29	85	222
2012 IPO suspension	Firms that were approved for IPO from October 19, 2011, to October 19, 2012	2012–2014	58	140	575
2015 IPO suspension	Firms that were approved for IPO from July 4, 2014, to July 4, 2015	2015	39	214	253

Table 3
Sample screening process.

Data screening process	Sample size
Number of firms were approved for IPO in the year prior to one of the IPO suspension events (initial sample)	1,195
Exclusions:	
Financial firms	−18
Treated firms with an interval between IPO approval and public listing of less than 200 days	−74
Firms with a total profit ≤ 0	−12
Firms with missing variable information	−41
Final sample	1,050

in *ETR* between the two groups in the year prior to obtaining IPO approval is 0.0076, and the *t* value is 1.018, which is not statistically significant. The difference in *ETR* between the two groups within the sample interval is 0.0169, with a corresponding *t* value of 4.173, signifying statistical significance at the 1% level. The results in Fig. 1 preliminarily confirm the proposed research hypothesis.

5.2. Benchmark regression results

Table 5 presents the multivariate regression results of Model (1). The first column only controls for year and industry fixed effects, and the regression coefficient of *Treat* is −0.017 and is significant at the 1% level. In the second column, all control variables are included, and the regression coefficient of *Treat* is −0.011, still negative and significance at the 1% level. This result supports the proposed research hypothesis, i.e., firms engage in more tax avoidance activities during IPO suspensions when facing financing uncertainty. Considering the economic implication of this finding, the regression coefficient of *Treat* in the second column is −0.011, and the mean *ETR* of the sample firms is 0.152, indicating that the IPO suspension policy reduces *ETR* by approximately 7.24%.

5.3. Robustness tests

To ensure the reliability of the conclusions in this paper, the following robustness tests are performed.

5.3.1. Alternative measures of the dependent variable

Studies have used different measures of corporate tax avoidance. Considering the impact of China's preferential tax policies on the comparability of tax avoidance, some studies have used the difference between *Rate* and *ETR* (*DTR*) to measure enterprises' level of tax avoidance (Liu and Ye, 2013; Xu and Li, 2020). A higher *DTR* value indicates a higher degree of tax avoidance. Other studies have used book–tax differences (*BTD*) and book–tax differences after deducting the impact of accrued profits (*DDBTD*) to measure the level of

Table 4
Descriptive statistics of the main variables.

Variable	Observations	Mean	25th percentile	Median	75th percentile	Standard deviation
ETR	1,050	0.152	0.126	0.147	0.174	0.058
Treat	1,050	0.257	0.000	0.000	1.000	0.437
Lev	1,050	0.310	0.169	0.285	0.431	0.176
Roa	1,050	0.100	0.062	0.090	0.126	0.057
Size	1,050	20.956	20.344	20.785	21.397	0.921
LnAge	1,050	2.454	2.197	2.485	2.708	0.452
Rate	1,050	0.160	0.150	0.150	0.150	0.046
Invent	1,050	0.129	0.063	0.113	0.175	0.093
PPE	1,050	0.183	0.084	0.156	0.254	0.130
Intang	1,050	0.043	0.017	0.033	0.056	0.038
EPU	1,050	164.855	123.635	179.041	181.287	46.907
TE	1,050	1.035	0.882	1.037	1.131	0.181

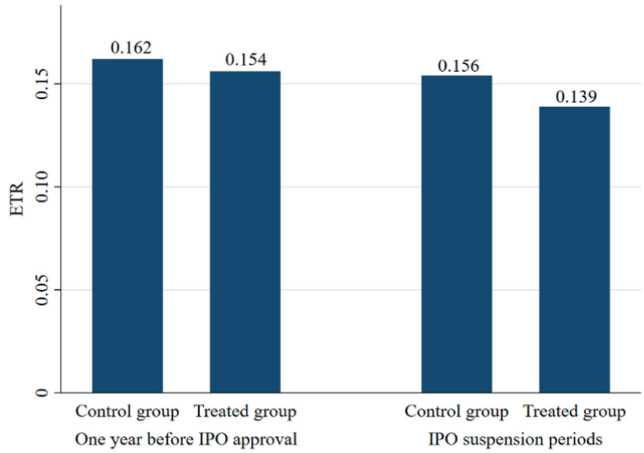

Fig. 1. Impact of IPO suspensions on corporate tax avoidance.

tax avoidance (Desai and Dharmapala, 2006; Liu and Ye, 2013), as follows: *BTD* = (pretax profit * applicable income tax rate – income tax expense) / total assets at the end of the period; and *DDBTD* = residual of *BTD* after deducting current accrued profits. The higher the *BTD* or *DDBTD* value, the greater the possibility of corporate tax avoidance. In this paper, the dependent variable is replaced by these three variables in the regression, separately; the results are reported in the first three columns of Table 6. The coefficients of *Treat* are all positive and significant at the 1% level, indicating that firms affected by an IPO suspension policy have a higher level of tax avoidance, a finding that is consistent with the above conclusions.

5.3.2. Alternative independent variables

Different from the dummy variable *Treat* used in Model (1) to measure whether a firm is affected by an IPO suspension, the number of months between the firm's IPO approval and listing (*MonthDelay*) is used to measure the impact of an IPO suspension event on the firm. In general, the higher the *MonthDelay* value, the more business operations are negatively affected by the IPO suspension. The regression results based on *MonthDelay* are reported in the fourth column of Table 6. The coefficient of *MonthDelay* is negative and significant at the 5% level, consistent with the above conclusions.

5.3.3. Placebo tests

Drawing on Cong and Howell (2021), placebo tests, i.e., counterfactual analysis and alternative sample interval, are also conducted. First, based on *MonthDelay*, the variable *MockDelay* is constructed. For firms unaffected by the IPO suspension policy, *MockDelay* is equal to *MonthDelay*. For firms affected by the IPO suspension policy, *MockDelay* is equal to *MonthDelay* minus the duration of the corresponding IPO suspension event. Thus, *MockDelay* reflects the number of months between the time a firm obtains IPO approval and its listing, excluding the impact of the IPO suspension policy. If the results are indeed driven by the IPO suspension policy, *MockDelay* should not be significant. The regression results are reported in the fifth column of Table 6. As expected, the coefficient of *MockDelay* is not statistically significant. Second, the sample interval is changed from 1 year to 2 and 3 years to re-examine the benchmark regression results, and the results are reported in the sixth and seventh columns of Table 6. The variable *Treat* is no longer significant, and the coefficient is opposite to what is predicted. This indicates that firms affected by the IPO suspension policy do not exhibit lower levels of tax avoidance outside the sample period.

5.3.4. Endogeneity issues

The study addresses potential endogeneity issues stemming from two aspects. First, a firm's IPO approval may be affected by unobservable evaluation criteria, potentially resulting in the incomplete inclusion of exoge-

Table 5
Impact of the IPO suspension policy on corporate tax avoidance.

Variable	*ETR*	*ETR*
Treat	−0.017***	−0.011***
	(−3.09)	(−2.94)
Lev		0.012
		(0.97)
Roa		−0.073**
		(−2.28)
Size		−0.001
		(−0.24)
LnAge		0.007*
		(1.74)
Rate		0.624***
		(10.99)
Invent		−0.050**
		(−2.22)
PPE		0.002
		(0.13)
Intang		0.006
		(0.11)
EPU		−0.001
		(−0.93)
TE		−0.007
		(−0.69)
Constant	0.156***	0.014
	(56.15)	(0.22)
Year effects	Yes	Yes
Industry effects	Yes	Yes
N	1,050	1,050
R^2	0.016	0.464

Notes: The *t* values are in parentheses; *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively; standard errors are cluster-adjusted at the firm level.

nous factors related to the IPO suspension events. For example, the "jumping the queue" phenomenon in China's IPO market[2] may result in some endogeneity in the identified treated group. Because the CSRC has not disclosed the conditions for IPO approval by the CSIEC, this paper examines the differences in financial characteristics between the treated and control groups in the year prior to obtaining IPO approval, following Li and Chen (2021). As shown in Table 7, there is no systematic difference in financial characteristics between the treated and control groups before the firms obtain IPO approval. Based on this, the endogenous impact caused by the approval criteria can be preliminarily ruled out.

Second, there is a potential endogeneity problem caused by missing variables. Although this paper adds many control variables that affect corporate tax avoidance to Model (1), missing variables cannot be completely ruled out. To alleviate the impact of this problem on the conclusions, an empirical difference-in-differences (DID) model is constructed by changing the regression sample and controlling for firm-level fixed effects. Specifically, based on the characteristics of the sample data, the sample period is extended by 2 years for the three IPO suspension events. Notably, this expansion enables the sample periods for both the treated and control groups to encompass the years preceding and during the IPO suspension. On this basis, a dummy

[2] The *Opinions on Playing the Role of the Capital Market to Serve the National Strategy of Poverty Alleviation*, issued by the CSRC in 2016, clearly propose that the policy of "examination right after application and approval right after passing the examination" is to be applied to the IPOs of enterprises in poor counties nationwide; in 2018, the CSRC also proposed to open a fast track for IPOs of "unicorn enterprises" (a privately held startup enterprise valued at over US$1 billion. The term was first published in 2013, coined by venture capitalist Aileen Lee, choosing the mythical animal "unicorn" to represent the statistical rarity of such successful ventures) in the four emerging industries (i.e., biotechnology, cloud computing, artificial intelligence, and high-end manufacturing) to reduce their IPO waiting time. Thus, such enterprises are able to "jump the queue" ahead of other firms.

Table 6
Alternative measures of core variables and placebo tests.

Variable	*DTR*	*BTD*	*DDBTD*	*ETR*	*ETR*	*ETR*	*ETR*
Treat	0.012***	0.007***	0.007***			−0.004	0.022
	(2.79)	(2.96)	(2.66)			(−0.70)	(1.51)
MonthDelay				−0.001**			
				(−2.23)			
MockDelay					−0.001		
					(−0.94)		
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1,050	1,050	1,050	1,050	1,050	1,048	1,037
R^2	0.228	0.216	0.218	0.466	0.463	0.232	0.108

Notes: The *t* values are in parentheses; *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively; standard errors are cluster-adjusted at the firm level.

variable, *Post*, is constructed to distinguish the periods before and after the IPO suspension. Specifically, when the sample interval corresponds to the years before an IPO suspension policy is promulgated (i.e., the 2-year sample extension forward), the value of *Post* is 0; when the interval is the year affected by the IPO suspension policy (that is, the sample interval of the benchmark regression in this article), the value of *Post* is 1. Then, the interaction term *Treat*Post* is added to the model as well as controls for firm and year fixed effects. As shown in Table 8, the coefficient of *Treat*Post* is negative and significant at the 5% level, indicating that the problem of missing variables does not affect the conclusions of this paper.

5.3.5. Impact of pre-IPO tax payments

Wei et al. (2018a, 2018b) found that firms often make additional tax payments before successfully passing their IPO review. In contrast, this study focuses on the taxation behavior of firms that obtain IPO approval but fail to go public due to the IPO suspension policy. Furthermore, the study finds that there is no significant difference in the corporate tax burden before the IPO suspension policy between affected and unaffected firms by the IPO suspension policy. The regression results of the DID model support the proposed research hypothesis. This finding indicates that the conclusions of this study are unlikely to be caused by the difference in the tax payments of the two types of firms before their IPOs.

6. Further analyses

Next, the differences in the impact of IPO suspensions on corporate tax avoidance between different types of firms are analyzed to provide further evidence to support the empirical findings.

6.1. Heterogeneity tests

Heterogeneity tests are conducted from three perspectives, i.e., the property rights of the enterprise, whether the enterprise is funded by VC or PE, and the debt servicing capacity of the enterprise, to further enrich the research content and corroborate the theoretical logic. There are two main reasons for performing a heterogeneity test from the perspective of property rights. First, given the coexistence of state-owned enterprises (SOEs) and private enterprises in China, it is of great practical importance to examine the impact of property rights. Second, there are notable differences in tax avoidance motives between these two types of enterprises. If an IPO suspension affects firms' tax avoidance motives, then the tax-related decision-making of these two types of firms should be affected differently by this IPO suspension. This analysis helps to further verify the theoretical logic of this paper.

The reason for conducting heterogeneity tests from the latter two perspectives is to fully incorporate the logic of IPO suspensions affecting corporate tax avoidance. IPO suspensions can cause financing uncertainty.

Table 7
Differences in financial characteristics between treated and control groups prior to IPO approval.

Variable	Mean difference and test			Median difference and test		
	Treat = 0	*Treat* = 1	*t* value	*Treat* = 0	*Treat* = 1	*z* value
ETR	0.162	0.154	0.963	0.149	0.148	1.355
Lev	0.450	0.444	0.341	0.445	0.438	0.313
Roa	0.153	0.166	−1.455	0.134	0.154	−1.585
Size	20.410	20.305	0.983	20.252	20.136	1.164
Rate	0.163	0.173	−0.856	0.150	0.150	1.275
Invent	0.167	0.187	−1.760*	0.152	0.171	−1.558
PPE	0.226	0.212	1.010	0.205	0.181	0.992
Intang	0.054	0.059	−0.950	0.047	0.041	0.029

Notes: *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

If external financing uncertainty is indeed a factor triggering corporate tax avoidance, then firms that have more difficulty obtaining financing through other channels face more severe uncertainty due to IPO suspensions, and thus their tax decisions are expected to be affected to a greater extent by these suspensions. Based on this logic, two other important channels for firms to obtain financing are examined: VC or PE funding and debt financing. VC and PE funding plays a crucial role in providing capital to growth-oriented firms before an IPO and also serves as a valuable resource for firms to bridge financing gaps during periods of IPO suspensions. Debt financing is one of the most important traditional financing options for enterprises.

6.1.1. Impact of property rights

Studies have found that SOEs have weaker tax avoidance motives than private enterprises (Wu, 2009). Additionally, due to the presence of soft budget constraints, SOEs are more likely to obtain debt financing when they face a shortage of funds (Lin and Li, 2004), potentially reducing their tax avoidance motives during the IPO suspension period. To verify this hypothesis, a dummy variable, *NSOE*, is constructed; the variable takes a value of 1 when the beneficial owner of the business is not the government or a subdivision thereof, and 0 otherwise. Then, this variable is interacted with *Treat*, and *NSOE* and the interaction term are included in Model (1). The results are presented in Table 9. As shown in the first column, the coefficient of *Treat*NSOE* is negative and significant at the 5% level, indicating that non-SOEs engage in more tax avoidance activities during the IPO suspension period, resulting in a greater reduction in *ETR*.

6.1.2. Impact of VC and PE backing

The support of VC and PE funding may play an important role for unlisted enterprises (Wu et al., 2012). Specifically, direct financial support from VC or PE may reduce enterprises' financing gaps. In addition, the positive reputation of VC and PE funds can help improve a firm's external financing capabilities.

Table 8
Results of the DID model.

Variable	*ETR*
*Treat*Post*	−0.024**
	(−2.29)
Controls	Yes
Firm effects	Yes
Year effects	Yes
N	2,066
R^2	0.593

Notes: The *t* values are in parentheses; *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively; standard errors are cluster-adjusted at the firm level.

Consequently, firms may have little incentive to resort to tax avoidance as a means of mitigating uncertainty during IPO suspensions if they can obtain backing from VC or PE. To verify this hypothesis, data are manually collected to construct two variables: $VCPE_{Dummy}$, which takes a value of 1 if a firm has VC or PE support before an IPO suspension, and 0 otherwise, and $VCPE_{Amount}$, which is the natural logarithm of the amount of VC or PE funds received by the firm before an IPO suspension, plus 1. These two variables and their interaction terms with *Treat* are added to Model (1). As shown in the second and third columns of Table 9, respectively, the coefficients of $Treat*VCPE_{Dummy}$ and $Treat*VCPE_{Amount}$ are both positive and significant, as expected.

6.1.3. Impact of debt servicing capacity

An IPO suspension may hinder a firm from obtaining expected equity financing. Furthermore, limited debt servicing capacity may intensify the pressure of debt repayment and restrict firms from using debt financing to alleviate financing uncertainty. In such cases, firms' motives to cope with uncertainty through tax avoidance may be strengthened. This paper expects firms with higher debt servicing capacity to experience a smaller impact of IPO suspensions on corporate tax avoidance. To verify this hypothesis, the variable *TIE* is constructed, measured as the normalized interest coverage ratio in the year prior to an IPO suspension. The higher the *TIE* value, the higher the firm's debt servicing capacity. As shown in the fourth column of Table 9, the coefficient of *Treat*TIE* is significant and positive, as expected.

Taken together, the results in Table 9 show that firms experiencing greater negative impacts on their production, operations, and financing activities due to the IPO suspension policy are likely to engage in more tax avoidance activities during the IPO suspension period.

6.2. Balance between tax avoidance benefits and costs

When faced with financing uncertainty due to an IPO suspension, firms can mitigate uncertainty by engaging in tax avoidance activities to save cash. However, corporate tax avoidance comes with costs and risks. First, a high level of corporate tax avoidance increases regulatory risk. If the regulatory authorities ascertain that a firm has engaged in tax avoidance activities, the firm must repay taxes and fines, potentially impacting the IPO process. However, on average, this risk is low. For example, there are very few firms that fail to go public after passing the IPO review. Second, once a firm is identified by the tax authorities as engaging in tax avoidance activities, the cost of reputation loss is high. For example, Hanlon and Slemrod (2009) found that when a firm's tax avoidance behavior was recognized by the capital market, its stock price feel dramatically.

Therefore, when enterprises engage in tax avoidance activities, they must weigh the benefits and costs. When an enterprise's level of tax avoidance is higher than that of other enterprises, there is a greater risk associated with a further increase in its tax avoidance, potentially resulting in higher costs. Conversely, if a firm's

Table 9
Results of heterogeneity tests.

	ETR	*ETR*	*ETR*	*ETR*
Variable	$X = NSOE$	$X = VCPE_{Dummy}$	$X = VCPE_{Amount}$	$X = TIE$
Treat	−0.004	−0.014***	−0.014***	−0.009**
	(−0.47)	(−3.49)	(−3.46)	(−2.18)
X	0.002	−0.001	0.001	−0.012
	(0.26)	(−0.17)	(−0.09)	(−1.03)
*Treat*X*	−0.018**	0.029**	0.003**	0.027*
	(−2.03)	(2.13)	(2.27)	(1.91)
Controls	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes
N	1,050	1,050	1,050	1,050
R^2	0.465	0.471	0.470	0.468

Notes: The *t* values are in parentheses; *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively; standard errors are cluster-adjusted at the firm level.

level of tax avoidance is lower than that of other firms, a further increase in its level of tax avoidance may attract less attention and entail less risk and cost. Based on this, this paper expects that in the context of an IPO suspension, increases in corporate tax avoidance are mitigated according to the distribution of tax avoidance. To test this theoretical expectation, a quantile regression is applied (Armstrong et al., 2015). The regression results are presented in Table 10. Because there are many quantile regression results, only the results for *Treat* at different quantile levels are listed. The results show that when an enterprise's *ETR* is at the 90th percentile (the highest), the coefficient of *Treat* is significant and negative and its absolute value is the highest among all of the coefficients. However, when an enterprise's *ETR* is at the 20th percentile (the lowest), the coefficient of *Treat* is no longer significant. The coefficients of *Treat* at various percentiles indicate that, on average, the impact of IPO suspensions on corporate tax avoidance decreases with increasing risks and costs of corporate tax avoidance until there is no significant impact. In summary, corporate tax avoidance decisions against the background of IPO suspensions are the result of enterprises weighing the benefits and costs of tax avoidance.

6.3. Economic consequences of corporate tax avoidance activities during IPO suspensions

6.3.1. Impact of tax avoidance activities during IPO suspensions on corporate investment

An important purpose of corporate IPOs is to meet investment needs by obtaining equity financing. An IPO suspension is likely to put a firm's planned investments on hold due to financing uncertainty. If corporate tax avoidance during the IPO suspension period effectively reduces corporate uncertainty, it is reasonable to expect that corporate investment during the same period will be less affected. To test this expectation, Model (3) is constructed as follows:

$$\begin{aligned} Investmenti,t = {} & \beta 0 + \beta 1 Treati + \beta 2 ETRi,t + \beta 3 Treati * ETRi,t + \beta 4 Sizei,t + \beta 5 Roai,t + \beta 6 Levi,t \\ & + \beta 7 LnAgei,t + \beta 8 Top1i,t + \beta 9 Cfoi,t + \beta 10 NSOEi,t + Year + Industry + \varepsilon i,t \end{aligned} \tag{3}$$

where *Investment* represents corporate investment. This paper examines a firm's fixed asset investment and research and development (R&D) investment. $Investment_{PPE}$ is fixed asset investment, measured as the original value of fixed assets in the current year minus the original value of fixed assets in the previous year, divided by the original value of fixed assets in the previous year; $Investment_{R\&D}$ is R&D investment intensity, measured as current year R&D expenditure divided by operating income. Definitions of the variables *Treat* and *ETR* are the same as above. In addition to the control variables defined above, control variables commonly been used in studies of corporate investment, such as *Top*1, representing the shareholding ratio of the largest shareholder, and *Cfo*, equal to net cash flow from operating activities divided by total assets, are added (Lin et al., 2022).

For Model (3), the regression result for the interaction term *Treat*ETR* is the focus. The coefficient of *Treat*ETR* can be interpreted as the incremental impact of tax avoidance activities on corporate investment for firms affected by the IPO suspension policy, compared with the control group (that is, firms not affected by the IPO suspension policy). Determining the coefficient of the interaction term can highlight the unique impact of corporate tax avoidance during the IPO suspension period. As shown in the first two columns of Table 11, the coefficients of *Treat*ETR* are all negative and significant at the 5% level, indicating that as the level of tax avoidance (lower *ETR*) increases among the treated firms, there is a corresponding increase in their fixed asset and R&D investments during the IPO suspension period. This finding is consistent with the expected results.

6.3.2. Post-IPO share prices

If corporate tax avoidance during an IPO suspension truly mitigates the adverse impact of the IPO suspension on a firm, investors should note this and it should be reflected in stock price performance when the IPO suspension ends and the firm's IPO occurs. To confirm this expectation, Model (4) is constructed as follows:

$$\begin{aligned} BHARi = {} & \gamma 0 + \gamma 1 Treati + \gamma 2 ETR^{sum} i + \gamma 3 Treati * ETR^{sum} i + \gamma 4 Size^{ipo-1} i + \gamma 5 Roa^{ipo-1} i \\ & + \gamma 6 Lev^{ipo-1} i + \gamma 7 LnAge^{ipo-1} i + \gamma 8 Top1^{ipo-1} i + \gamma 9 Cfo^{ipo-1} i + \gamma 10 NSOE^{ipo-1} i + Year + Industry + \varepsilon \end{aligned} \tag{4}$$

Table 10
Results of the quantile regression.

Quantile	Coefficients of *Treat*	*t* value
Q (0.1)	−0.010	−1.60
Q (0.2)	−0.010	−1.53
Q (0.3)	−0.010**	−2.50
Q (0.4)	−0.010**	−2.56
Q (0.5)	−0.008*	−1.97
Q (0.6)	−0.008*	−2.02
Q (0.7)	−0.008*	−1.95
Q (0.8)	−0.016***	−3.93
Q (0.9)	−0.022***	−4.69

Notes: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively; standard errors are robust and cluster-adjusted at the firm level.

Table 11
Economic consequences of corporate tax avoidance during IPO suspension.

Variable	$Investment_{PPE}$	$Investment_{R\&D}$	$BHAR_2$	$BHAR_3$	$BHAR_4$
Treat	0.022	0.026**	−0.155	0.864	0.227
	(0.14)	(2.30)	(−0.43)	(1.45)	(0.41)
ETR (ETR^{sum})	0.308	−0.138***	0.245	−0.111	0.135
	(0.54)	(−3.59)	(0.43)	(−0.22)	(0.22)
*Treat*ETR* ($Treat*ETR^{sum}$)	−2.168**	−0.150**	−2.038**	−3.742***	−3.045**
	(−2.49)	(−2.42)	(−2.10)	(−2.84)	(−2.52)
Controls	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes	Yes
N	1,050	1,050	523	523	523
R^2	0.260	0.425	0.519	0.546	0.517

Notes: The *t* values are in parentheses; *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively; standard errors are cluster-adjusted at the firm level.

In Model (4), following Teoh et al. (1998) and Li and Chen (2021), a firm's buy-and-hold abnormal return (*BHAR*) is used to measure stock price performance after an IPO. Specifically, *BHAR* is calculated 2, 3, and 4 months after the IPO, namely $BHAR_2$, $BHAR_3$, and $BHAR_4$, to measure post-IPO stock price performance.

Like Model (3), the primary focus is the regression results for the interaction term $Treat*ETR^{sum}$. However, unlike Model (3), because there is only one IPO for a firm, *BHAR* is a firm-level (rather than firm-year) metric. To correspond to this, the cumulative level of tax avoidance during the IPO suspension period (ETR^{sum}), which is equal to the sum of *ETR* of each sample firm during the IPO suspension period, is calculated. In addition, in terms of control variables, data for the year preceding the listing of each sample firm are used. As shown in the last three columns of Table 11, the coefficients of $Treat*ETR^{sum}$ are all significant and negative. This suggests that if firms affected by the IPO suspension policy have a higher level of tax avoidance during the suspension period (lower ETR^{sum}), their post-IPO stock performance is better once the IPO suspension policy is lifted.

7. Conclusions and implications

IPO suspensions force firms in periods of rapid growth and with very large financing demands to hit the brakes on their fundraising journey. The timing of such suspensions calls into question when these firms can resume their IPO plans and reach their destination. In this context, this paper explores how firms can adjust their tax decisions to address uncertainty due to an IPO suspension from the perspective of corporate tax avoidance. This study's findings indicate that firms affected by an IPO suspension tend to engage in more

tax avoidance activities during the IPO suspension period. This phenomenon is predominantly observed in firms that are not state-owned, have no VC or PE backing, and have low debt servicing capacity, i.e., firms whose financing activities are more affected by the IPO suspension. In addition, the findings suggest that firms weigh the benefits and costs of tax avoidance, and those with higher costs and risks are less likely to engage in extensive tax avoidance activities during the IPO suspension period. Finally, the tax avoidance activities of firms during the IPO suspension period do have a real impact on business operations; specifically, firms that engage in more tax avoidance during the IPO suspension period invest more in fixed assets and innovation, and their stock prices perform better after the IPO than firms with less tax avoidance activities.

In conclusion, this paper presents a complete picture of changes in corporate tax decisions and their economic consequences during IPO suspensions. The academic contributions of the research conclusions are as follows. First, taking China's IPO suspension events as a research scenario, this study examines the impact of a specific policy's uncertain terms on corporate tax avoidance and related economic consequences, thus contributing to the relevant literature on policy uncertainty. Second, this study expands the literature on the relationship between the financing environment and corporate tax avoidance. Third, this study expands research on the economic consequences of IPO suspension policies from the perspective of corporate tax avoidance.

The policy implications of the conclusions in this paper are as follows. An IPO suspension is one of the policy tools used by regulators to regulate the capital market. Although an IPO suspension can play a role in stabilizing the capital market, its negative impact has not received sufficient attention. The conclusions of this paper provide a reference for regulators to understand the possible economic consequences of IPO suspensions, potentially helping regulatory authorities to apply the IPO suspension policy tool more effectively.

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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Can industry information disclosure improve audit quality?

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ABSTRACT

We investigate the impact of industry information disclosure (IID) on audit quality in Chinese listed companies from 2010 to 2021, by constructing a staggered difference-in-differences model based on the implementation of the IID guidelines in the Shanghai and Shenzhen stock exchanges in 2013 as an exogenous shock. Audit quality is significantly improved after the implementation of the IID guidelines. We also use a parallel trend test, different measurements of key variables, propensity score matching, a placebo test and different samples, to ensure the validity of our findings. IID enhances audit quality by improving auditor independence, professionalism and audit engagement, particularly in firms with high-quality and numerous IIDs, high auditor rankings, strong auditor industry expertise, IIDs with a negative tone and low R&D investment. We demonstrate the effectiveness of the IID guidelines from the perspective of auditing.

1. Introduction

Information disclosure regulation is one of the most important policies in the capital market. It can effectively mitigate the resource mismatch and market failure caused by information asymmetry and increase the effective information content of the capital market. Industry information disclosed by listed companies allows investors to directly understand the production and operating status of the industry, thereby reducing the information asymmetry between listed companies and their stakeholders. It also provides more accurate infor-

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mation enabling small and medium shareholders to make investment decisions and auditors to issue audit opinions.

In January 2013, the Shenzhen Stock Exchange (SZSE) issued industry information disclosure (IID) guidelines for two pilot industries, and the Shanghai Stock Exchange (SSE) introduced guidelines for seven industries, including real estate, in October 2015. To date, the SSE and SZSE have issued 43 IID guidelines, covering 14 primary industries and 58 secondary industries,[1] aiming at addressing the problems of incomplete and incomprehensive IID. In the past, the territorial supervision mode meant that IID was not highly targeted or industry-specific. The information disclosure supervision of listed companies was unified according to the region where the company was located, and the supervisors of each listed company were required to collectively perform information supervision duties in their respective jurisdictions. However, in the context of the transformation of capital market information regulation, IID supervision has gradually shifted from territorial regulation to industry regulation, reflecting the idea of "transforming government functions and innovating regulatory methods (Shi et al., 2020, p383)," as proposed in the report of the 19th National Congress.

The implementation and enforcement of the IID guidelines raise questions about their impact on the audit quality of listed companies. Studies identify several internal and external factors affecting audit quality, such as auditor organization characteristics (DeAngelo, 1981; Bowlin et al., 2015), auditor characteristics (Chan et al., 2002; Minutti-Meza, 2013), the internal characteristics of audited enterprises (Bills et al., 2016; Bills et al., 2018) and external regulatory institutions (Boone et al., 2007; Krishnan et al., 2017). However, few studies examine the impact of the guidelines on audit quality. On the one hand, the implementation of the guidelines requires enterprises to disclose operational information, such as their operating revenues, operating costs, gross profits and research and development (R&D). This disclosure reduces uncertainty and increases transparency among peer firms, providing auditors with more useful audit information and improving audit quality. On the other hand, the value attributes and price discovery functions of corporate information (Hendershott et al., 2020) may induce companies to strategically re-disclose previously disclosed information to meet the mandatory disclosure requirements of the guidelines, instead of providing their core financial and non-financial information. The strategic re-disclosure of industry information can result in information redundancy and reduce audit quality. Therefore, the aim of this study is to investigate whether and how IID affects the audit quality of listed companies.

To address this issue, we use a staggered difference-in-differences (DID) model to test the impact of IID on audit quality based on the guidelines issued for Shanghai and Shenzhen A-share listed companies from 2010 to 2021 as a policy shock. Our results show that IID can improve audit quality by enhancing audit independence, audit professionalism and audit effort. Moreover, the impact of IID on audit quality is particularly pronounced in firms with high-quality disclosures, high-ranking auditors, prominent auditor industry expertise, a negative tone and low R&D investment.

The study makes several contributions to the literature. First, it confirms the positive effect of the IID guidelines on the audit quality of listed companies, providing empirical support for their policy effectiveness. This expands research on the economic consequences of IID and enhances our understanding of the benefits of information transparency in the capital market. Second, this study enriches the literature on the factors that influence audit quality by exploring the impact of IID. We find that IID enhances audit quality by improving auditor independence, auditor professionalism and audit effort. Finally, our study explores the differences in the impact of IID on audit quality across various disclosure quantities and quality levels, auditor sizes, types of auditor industry expertise, tone characteristics and industry characteristics. This provides strong evidence for the continuous improvement of IID and its regulation, contributing to the construction of an information-transparent capital market.

The rest of the article is organized as follows. In Section 2, we provide a literature review and discuss the research hypotheses. In Section 3, we introduce the research design. The main empirical results are presented in Section 4. In Section 5, further analysis is provided, and we present the conclusions in Section 6.

[1] Official website of the SSE: https://www.sse.com.cn/disclosure/announcement/general/. Official website of the SZSE: https://www.szse.cn/disclosure/notice/general/.

2. Institutional background, literature review and research hypotheses

2.1. Institutional background

Prior to the issuance of the IID guidelines, information disclosure supervision for A-share listed companies in Shanghai and Shenzhen was based on territorial supervision regulations, which had been in place for more than 20 years. While this approach achieved some success, it had several drawbacks. First, the uniform system of information regulation was too rigid, given the wide variation in characteristics among enterprises in the same region. Second, the regulation system was fragmented and one-sided, making it difficult to implement information regulation effectively. Finally, to meet the regulatory requirements, listed companies did not carry out sufficient "effective disclosure," resulting in issues such as patchwork disclosure, selective disclosure and even plagiarism, which hindered the governance of information disclosure and its regulation.[2]

To address these challenges, the SSE and SZSE began to reform the regulation of the information disclosure of listed companies. The SZSE piloted the guidelines for two industries, namely (1) radio, film and television and (2) pharmaceuticals and biological products, beginning on 7 January 2013. This was followed by the release of additional guidelines between 2015 and 2021, covering 24 industries, including the photovoltaics industry; the energy-saving and environmental protection services industry; and internet gaming, video and e-commerce. In 2015, the SSE also issued guidelines for 27 industries, including real estate, coal, electricity, retail, automobile manufacturing and pharmaceutical manufacturing. The guidelines issued by the SSE and SZSE covered almost all industry categories; however, for each industry category, the most common sub-sectors were selected for the pilot implementation of the guidelines. The sub-sectors selected for pilot implementation had distinct characteristics in the process of IID.

The SSE and SZSE guidelines require listed companies to disclose key operational information in their annual reports, taking into account macro factors, the market environment, operational characteristics and industry status. The SSE guidelines require listed companies to compare their operational information horizontally with that of peer firms in the same industry. The SZSE guidelines require listed companies to disclose business information that accounts for more than 30% of their revenue or net profit in the last fiscal year, as well as the key technical indicators of products that account for more than 10% of their operating revenue during the reporting period.

To illustrate the development of sub-industry information regulation, this study uses the automobile manufacturing industry as an example. SSE Announcement [2015] No. 21, issued on 6 July 2015, introduced Guidelines No. 6 for the automobile manufacturing industry. The guidelines cover the overall operation of the automobile manufacturing industry (i.e., sales volume of the sub-sector, sales growth), industry development (i.e., market access, fuel standards, emission requirements, new energy, import, export and consumption of various inputs in the sub-sector) and industry competition (i.e., major competitors in the segment, market shares and related changes). On 11 September 2015, the SSE officially issued IID Guidelines No. 1 to No. 7, including Guidelines No. 6 for the automobile manufacturing industry. Compared with the previous version, the newly issued Guidelines added some specific quantitative ranges for peer-to-peer information disclosure in the automobile manufacturing industry. They also added requirements for the summarization and separate disclosure of component supplier information. On 11 January 2021, the SSE revised the guidelines for listed companies in the automobile manufacturing industry. The revision primarily amended the relevant expressions to add disclosure specifications for new business models. Meanwhile, the SZSE issued guidelines for the automobile manufacturing industry on 6 January 2021, with a similar focus on disclosure requirements. Thus, this study considers the year of the initial introduction of the guidelines for an industry in Shanghai or Shenzhen as the starting point of the exogenous shock. For the automotive manufacturing industry, this is 2015 for the SSE and 2021 for the SZSE. Similar approaches are taken for other industries in the SSE and SZSE.

[2] For the SSE's Q&A on the regulation of information disclosure by listed companies by industry, seehttps://sse.com.cn/aboutus/mediacenter/hotandd/c/c_20150912_3988813.shtml.

Over the last 10 years, information disclosure guidelines have proven effective in the SSE and SZSE. They require the comprehensive disclosure of corporate operating, investment and financing information through regular and interim reports, as well as industry and company characteristics. The guidelines consider the costs and benefits of information disclosure, the principles of open-door regulation and its continuous revision and improvement and the specific business model of the company. The disclosure of information has been modified based on industry characteristics, reducing the information asymmetry between listed companies and shareholders and providing accurate information for decision-making. However, the implementation of the guidelines by companies remains poor and requires further improvement (Chen and Li, 2018). Despite these challenges, the guidelines increase the supply of industry-related information in the capital market, providing a quasi-natural experimental environment to study the impact of IID on audit quality. The guidelines are exogenous and do not change the operating rules or regulatory environment of the capital market. This makes them a valuable tool through which to examine the relationship between IID and audit quality.

2.2. Literature review

Scholars conduct extensive research on the factors influencing audit quality and focus on the following four areas: audit firms, auditors, audited firms and the relevant institutional environment.

Membership in professional organizations can provide benefits for small and medium-sized audit firms, such as training and collaboration and helping small audit firms to access large audit clients and increase their audit fees and audit quality (Bills et al., 2016; Lisic et al., 2019). Field studies (Bills et al., 2018) also find that the membership credentials of smaller accounting firms permit access to greater expertise and public recognition. However, the impact of accounting regulation on audit quality remains inconsistent (Boone et al., 2015; Lamoreaux, 2016). For example, when an accounting firm is subject to stringent sanctions by the U.S. Securities and Exchange Commission (SEC), the reputation of the accounting firm suffers, directly leading to a reduction in audit clients and audit fees (Chan and Wu, 2011; Boone et al., 2015). Other factors, such as consulting revenue (Lisic et al., 2019), political affiliations (Knechel and Park, 2022) and artificial intelligence use (Fedyk et al., 2022) in accounting firms, can also significantly improve audit quality.

Individual differences in auditors, such as industry expertise, can significantly improve audit quality (Reichelt and Wang, 2010). However, prior to the financial crisis, over-specialization may have weakened the positive relationship between industry specialization and audit quality in the banking sector (Cassell et al., 2019). The auditor's tenure, auditor changes and the auditor's professional qualities also affect audit quality (Bowlin et al., 2015; Bratten et al., 2019; Patterson et al., 2019).

A firm's information disclosure can affect its audit quality, with more complete and high-quality information ultimately improving audit quality (Copley, 1991; Zhang, 2018). Other factors, such as equity concentration (Gul et al., 2010), textual similarity of financial information (Brown and Knechel, 2016) and disclosure tone (Campbell et al., 2020), can also affect audit quality (Kitiwong and Sarapaivanich, 2020).

The institutional environments of enterprises can also affect audit quality. For example, inspection by the U.S. Public Company Accounting Oversight Board (PCAOB) can reduce abnormal accruals and enhance the value relevance of accounting information, thus improving audit quality (Lamoreaux, 2016; Krishnan et al., 2017).

However, studies do not examine the impact of IID, a factor at the institutional environment level, on audit quality from the perspective of changes in the external institutional environment. This study adopts a staggered DID method to examine audit quality from the perspective of IID, enriching the literature on the factors affecting audit quality. It also expands research on the economic consequences of IID, providing incremental evidence for the effectiveness of industry disclosure from an audit perspective.

2.3. Theoretical analysis and research hypotheses

Audit quality is the probability of an auditor detecting and reporting material misstatements and omissions in financial reporting (DeAngelo, 1981). According to the literature review above, IID affects audit quality via three main factors: auditor independence, auditor professionalism and audit effort.

In terms of auditor independence, the IID guidelines eliminate territorial regulation, creating geographical separation between the audited entities and auditors and reducing audit opinion shopping by the audited entities. Before the IID guidelines were implemented, territorial regulation required the same regulator to supervise the information disclosure of different industries, which made it difficult to cover all aspects of information disclosure and regulation due to limited attention and expertise, providing opportunities for managers to misbehave. Sub-industry regulation also reduces opportunities for close contact between information regulators and enterprise personnel, increasing the independence of auditing bodies and auditors. This reduces opportunities for management opportunism, improves corporate transparency (Johl et al., 2021) and ultimately enhances audit quality.

In terms of auditor professionalism, the guidelines increase the quantity and quality of industry-related information through changes in the disclosure and regulatory model. This increases the amount of IID, reduces information asymmetry and deepens the auditor's understanding of the audited company. The disclosure of enterprises' operating information also enhances the comparison of relevant information among enterprises in the same industry, which can further reduce the degree of information asymmetry (Johnstone, 2021). The comparison of companies in the same industry reduces information asymmetry, increases the probability of detecting bad news and improves audit quality. Additionally, the comparison of industry information reduces the difficulty and costs of searching information, reducing the auditor's workload and further improving audit quality.

In terms of audit effort, the guidelines require auditors to pay sufficient attention to and increase audit inputs to avoid audit risk, thereby improving audit quality. The promulgation and implementation of the guidelines are innovative, mandatory, universal and legitimate, incentivizing auditors and listed companies to pay attention to them. Auditors increase their audit pricing and audit hours, and enterprises increase their spending on audit fees. Investment in audit fees and audit hours is ultimately manifested as an improvement in audit quality (Dye, 1993). The cross-regional regulatory enforcement of IID increases compliance with information disclosure, reducing audit risk and legal liability and ultimately improving audit quality.

Overall, the guidelines increase the professionalism and independence of auditors and increase the audit input to avoid audit risk. This, in turn, enhances the transparency of corporate information and reduces information asymmetry, and it improves the effectiveness of information for decision-making, which leads to higher audit quality.

Based on the literature review, the following research hypothesis is proposed:

H1. Ceteris paribus, IID can improve audit quality.

However, selective and strategic IID can potentially hinder the auditor's work and reduce audit quality. According to noise theory, invalid information in disclosures can detract the attention of the trustee and hinder access to effective information. Management may also use invalid disclosures in financial reports to mislead the public (Blanco et al., 2021). Additionally, studies find that in implementing the IID guidelines, almost half of enterprises do not strictly follow the regulations, particularly with regard to confidential corporate information such as critical business data and unique risk information, making IID less effective (Chen and Li, 2018). Corporate competition theory suggests that firms are hesitant to disclose information with value attributes and price discovery functions (Hendershott et al., 2020). Disclosing valuable core information can provide competitors in the same industry with opportunities to catch up, and firms that proactively disclose key industry information are at a competitive disadvantage. To comply with the mandatory disclosure requirements of the guidelines, enterprises may disclose industry-related information either selectively or strategically (Chen et al., 2021). This meets the mandatory requirement of compliant disclosure while avoiding the leakage of critical information about the enterprise's operations. Both selective and strategic disclosure can increase noise in financial reporting, leading to greater information asymmetry between management and auditors. Management may use financial reporting redundancy to hide "bad news" for their own benefit, resulting in increased audit risk and difficulties for auditors (Schrand and Walther, 2000). As more invalid information is disclosed about the industry, the level of redundancy in financial reporting increases, increasing the auditor's cognitive load and lowering audit quality.

The hypothesis development framework for this study is shown in Fig. 1, and the second research hypothesis is as follows:

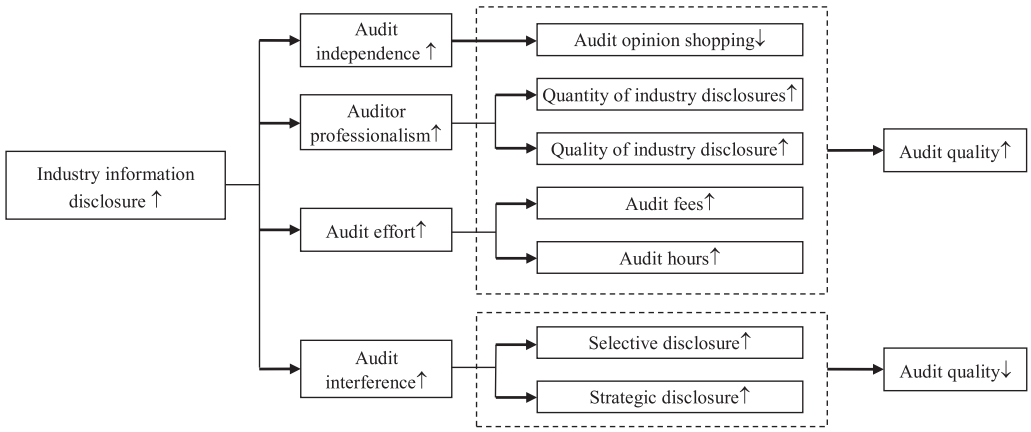

Fig. 1. The hypothesis development framework. Note: "↑" indicates an increase; "↓" indicates a decrease.

H2. Ceteris paribus, IID can reduce audit quality.

3. Data and research design

3.1. Data sources and sample selection

The IID guidelines were initially introduced and implemented by the SZSE on 7 January 2013, and the SSE and SZSE later launched industry pilots of the guidelines in 2015, which continued until January 2021. To investigate the impacts of these guidelines, this study selects all Chinese A-share listed companies in the SSE and SZSE operating from 2010 to 2021 as a research sample. After excluding listed companies in the financial sector, those with Special Treatment (ST) and Particular Transfer (PT) status and those with missing financial data, we obtain a final sample of 20,413 observations. The study uses data from the China Stock Market & Accounting Research Database (CSMAR) and Chinese Research Data Service (CNRDS) databases, and all continuous variables are winsorized at 1% and 99% to mitigate the influence of extreme values.

3.2. Models and variables

This study employs a staggered DID model to investigate the impact of the IID guidelines gradually introduced and implemented by the SZSE and SSE on audit quality. To ensure the reliability of the research findings, two distinct models, ordinary least squares (OLS) and logit models, are used concurrently to conduct the study.

$$Opinion_{i,t}/AQ_{i,t} = \alpha_0 + \alpha_1 Post_{i,t} + \alpha_2 Controls_{i,t} + \alpha_3 \sum Firm_{i,t} + \alpha_4 \sum Year_{i,t} + \varepsilon_{i,t} \quad (1)$$

The explanatory variable $Opinion_{i,t}/AQ_{i,t}$ represents a firm's audit quality and measures whether the firm receives a non-standard audit opinion ($Opinion_{i,t}$) in the current year (Chen et al., 2011; Tong et al., 2022). The value of $Opinion_{i,t}$ is 1 if the firm receives a non-standard audit opinion in the current year and 0 otherwise. The measurement of a firm's audit quality $AQ_{i,t}$is based on Luo et al. (2018), considering the audit opinion of the firm, and it is defined as shown in Table 1. The explanatory variable $Post_{i,t}$ is used to measure the

Table 1
Variable definitions.

Type	Variable	Symbol	Definition
Explained variable	Audit quality	*Opinion*	The audit opinion of company *i* in year *t* is 1 if it is not a standard audit opinion; otherwise, the value is 0.
		AQ	The audit opinion of company *i* in year *t* is coded as follows: 1 for a standard unqualified opinion, 2 for an unqualified opinion with a matter paragraph/explanation, 3 for a qualified opinion, 4 for a qualified opinion with a matter paragraph/explanation, 5 for an adverse opinion and 6 for an unavailable opinion.
Explanatory variable	IID dummy variable	*Post*	The value is 1 for the year in which the industry guidelines are first introduced and in all subsequent years; otherwise, the value is 0.
Control variables	Size	*Size*	The natural log of total assets.
	Return on assets	*Roa*	The ratio of net income to total assets.
	Leverage	*Lev*	The ratio of total liabilities to total assets.
	Current ratio	*Current*	The ratio of current assets to current liabilities.
	Sale growth	*Growth*	Sales change.
	Cash ratio	*Cash*	(Cash and cash equivalent + financial assets held for trading)/total assets.
	Inventory as a percentage	*Inv*	The ratio of inventory to total assets.
	Accounts receivable as a percentage	*Rec*	The ratio of accounts receivable to total assets.
	Loss	*Loss*	The value is 1 if the net profit of the previous year is negative; otherwise, the value is 0.
	Board size	*Board*	The number of board members.
	Size of the audit firm	*Big10*	Whether the audit firm is ranked as one of the "Top 10" audit firms in China; if yes, the value is 1 and the value is 0 otherwise.
	Percentage of independent directors	*Idr*	The number of independent directors as a percentage of the total number of board members.
	Shareholding ratio of institutional investors	*Insinvestor*	The shareholding of institutional investors as a percentage of total share capital.
	Percentage of shareholding of the largest shareholder	*Top1*	The number of shares held by the largest shareholder as a percentage of total share capital.
	CEO–chairman duality	*Dual*	The value is 1 for enterprises for which the chairman and CEO are the same person; otherwise, the value is 0.
	Audit tenure	*Autenure*	The length in years of the auditor's tenure at the focal enterprise.
	Auditor changes	*Auchange*	If the auditor changes from the previous year, the value is 1; otherwise, the value is 0.
	Nature of ownership	*Soe*	A dummy variable equal to 1 for state-owned enterprises and 0 for others.

level of information disclosure in the industry to which the firm belongs, based on the policy shock of the guidelines issued and implemented by the SSE and SZSE during the 2013–2021 period. The value of $Post_{i,t}$ is 1 in the year the guidelines are first introduced and in subsequent years and 0 in other years.[3]

This study controls for various factors based on the literature (Chen et al., 2011; Minutti-Meza, 2013; Tong et al., 2022). Financial-level indicators, such as firm size (*Size*), return on assets (*Roa*), asset–liability ratio (*Lev*), current ratio (*Current*), main revenue growth rate (*Growth*), cash ratio (*Cash*), inventory ratio (*Inv*), accounts receivable ratio (*Rec*) and loss (*Loss*), are included in the analysis. Corporate governance-level indicators, such as board size (*Board*), Chinese big10 audit firms (*Big10*), proportion of independent directors (*Idr*), shareholding of institutional investors (*Insinvestor*), shareholding of the largest shareholder (*Top1*) and dual role of the CEO and chairman (*Dual*), are also considered. Furthermore, audit-level indicators, such as audit tenure (*Autenure*) and auditor changes (*Auchange*), are controlled for. The nature of firm ownership

[3] The SSE and SZSE require the disclosure of industry-related information about the enterprise in annual and semi-annual reports (the SSE also requires monthly reports). Risk factors that have a significant adverse impact on the company's future development strategy and the achievement of its business objectives should be disclosed more regularly and in a timely manner, and the economic consequences of IID are revealed in the same year. Thus, $Post_{i,t}$ has a value of 1 for the year the guidelines for the industry to which the enterprise belongs are first issued and in all subsequent years.

Table 2
Descriptive statistics and variance inflation factor (VIF) results for key variables.

Variable	*N*	*Mean*	*SD*	*Min*	*P25*	*Median*	*P75*	*Max*	*VIF*	*1/VIF*
Opinion	20,413	0.025	0.155	0.000	0.000	0.000	0.000	1.000		
AQ	20,413	1.039	0.290	1.000	1.000	1.000	1.000	6.000		
Post	20,413	0.131	0.338	0.000	0.000	0.000	0.000	1.000	1.070	0.935
Size	20,413	22.140	1.312	19.570	21.190	21.930	22.870	25.990	1.917	0.522
Roa	20,413	0.042	0.058	–0.279	0.016	0.040	0.070	0.197	1.349	0.741
Lev	20,413	0.419	0.211	0.053	0.246	0.410	0.581	0.899	2.863	0.349
Current	20,413	2.697	2.880	0.300	1.162	1.723	2.948	16.350	2.307	0.433
Growth	20,413	0.398	1.077	–0.771	–0.031	0.131	0.414	7.423	1.084	0.923
Cash	20,413	0.221	0.158	0.016	0.105	0.174	0.296	0.741	1.761	0.568
Inv	20,413	0.149	0.138	0.000	0.061	0.115	0.187	0.705	1.310	0.764
Rec	20,413	0.113	0.099	0.000	0.032	0.090	0.166	0.472	1.124	0.889
Loss	20,413	0.077	0.267	0.000	0.000	0.000	0.000	1.000	1.070	0.934
Board	20,413	8.626	1.705	5.000	7.000	9.000	9.000	15.000	1.517	0.659
Big10	20,413	0.514	0.500	0.000	0.000	1.000	1.000	1.000	1.029	0.972
Idr	20,413	0.374	0.054	0.182	0.333	0.333	0.429	0.571	1.347	0.742
Insinvestor	20,413	44.800	24.55	0.097	25.390	46.710	64.400	91.910	1.749	0.572
Top1	20,413	35.030	15.11	8.990	23.140	33.000	45.170	75.100	1.414	0.707
Dual	20,413	0.272	0.445	0.000	0.000	0.000	1.000	1.000	1.133	0.882
Auchange	20,413	0.618	0.486	0.000	0.000	1.000	1.000	1.000	1.003	0.997
Autenure	20,413	7.126	5.307	1.000	3.000	6.000	10.000	23.000	1.067	0.938
Soe	20,413	0.360	0.480	0.000	0.000	0.000	1.000	1.000	1.408	0.710
Mean VIF									1.448	

(*Soe*) is also included. To address endogeneity issues arising from omitted variables at the firm and industry levels and to account for the impact of macroeconomic changes over time, firm–year and industry–year fixed effects are controlled for. The specific variables used in the analysis are defined in Table 1.

4. Empirical results

4.1. Descriptive statistics

Table 2 presents the descriptive statistics for the main variables. The mean values of audit quality are 0.025 and 1.039, which is consistent with the findings of other studies (Chen et al., 2011; Tong et al., 2022). Each release of the guidelines ($Post_{i,t}$) is specific to a different industry. However, only 2,678 out of 20,413 observations in all 78 sub-sectors are subject to the guidelines, accounting for only 15.10% of the total, despite 18 of the 21 industries being subject to the guidelines during the sample period. Therefore, the mean value of $Post_{i,t}$, which is 0.131, suggests that the guidelines are implemented in a stratified sampling manner, with only a small number of firms subject to the guidelines. However, the industries to which the firms belong cover most of the industries.

The descriptive statistics of the remaining variables fall within the normal range. To address multicollinearity among the variables, the variance inflation factor (VIF) is calculated for all variables, with a maximum VIF value of 2.863, a minimum value of 1.003 and a mean value of 1.448. The VIF values are well below the threshold of 10, indicating that there is no significant multicollinearity among the variables.

Table 3
Industry information disclosure (IID) and audit quality.

	Opinion (1)	*Opinion* (2)	*Opinion* (3)	*AQ* (4)	*AQ* (5)	*AQ* (6)
Post	0.7119***	0.7838***	0.0140***	0.0170**	0.0190***	0.0173**
	(3.375)	(3.502)	(3.182)	(2.486)	(2.864)	(1.974)
Size		–0.4910***	–0.0139***		–0.0159***	–0.0144**
		(-5.808)	(–4.722)		(–7.156)	(–2.458)
Roa		–11.2497***	–0.5055***		–1.0083***	–1.1135***
		(–12.739)	(–20.837)		(–25.541)	(–22.972)
Lev		4.6023***	0.1138***		0.1326***	0.1353***
		(8.971)	(8.473)		(8.130)	(5.040)
Current		0.0430	0.0014*		0.0028***	0.0024
		(0.966)	(1.792)		(2.701)	(1.570)
Growth		–0.0553	–0.0044***		–0.0002	–0.0078***
		(–0.942)	(–3.771)		(–0.125)	(–3.296)
Cash		–1.4823**	–0.0276**		–0.0374**	–0.1034***
		(–2.257)	(–2.140)		(–2.132)	(–4.010)
Inv		–3.8059***	–0.1278***		–0.1423***	–0.2908***
		(–5.407)	(–6.817)		(–7.069)	(–7.765)
Rec		–0.7780	0.0522**		–0.0341	0.1258**
		(–0.906)	(2.024)		(–1.452)	(2.444)
Loss		0.9860***	0.0309***		0.0618***	0.0474***
		(6.315)	(7.793)		(8.141)	(5.979)
Board		0.0686	0.0022		0.0027*	0.0070***
		(1.266)	(1.595)		(1.923)	(2.596)
Big10		0.0116	0.0008		–0.0056	–0.0034
		(0.078)	(0.246)		(–1.317)	(–0.539)
Idr		1.9453	0.0262		0.0789*	0.0834
		(1.278)	(0.770)		(1.870)	(1.229)
Insinvestor		0.0037	0.0001		0.0003***	0.0001
		(0.835)	(0.452)		(3.290)	(0.550)
Top1		–0.0239***	–0.0005**		–0.0007***	–0.0010**
		(–3.596)	(–2.425)		(–4.362)	(–2.500)
Dual		–0.0954	–0.0036		–0.0041	–0.0127*
		(–0.568)	(–0.975)		(–0.869)	(–1.718)
Auchange		0.2135	0.0026		0.0092**	0.0069*
		(1.625)	(1.251)		(2.289)	(1.676)
Autenure		–0.0274*	–0.0001		–0.0015***	–0.0013*
		(–1.909)	(–0.411)		(–3.885)	(–1.917)
Soe		–0.6133***	–0.0018		–0.0404***	–0.0162
		(–3.012)	(–0.223)		(–8.185)	(–0.996)
Constant	–5.4651***	3.9492**	0.3041***	1.0365***	1.3736***	1.3418***
	(–7.771)	(2.079)	(4.658)	(468.835)	(28.677)	(10.286)
Firm FE	No	No	Yes	No	No	Yes
Industry FE	Yes	Yes	No	Yes	Yes	No
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	20,382	20,382	19,798	20,413	20,413	19,798
Pseudo R^2/*Adj_*R^2	0.0052	0.0895	0.3190	0.0067	0.0772	0.2255

Notes: Standard errors are corrected for heteroskedasticity and clustering at the firm level (t-statistics are given in parentheses). ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

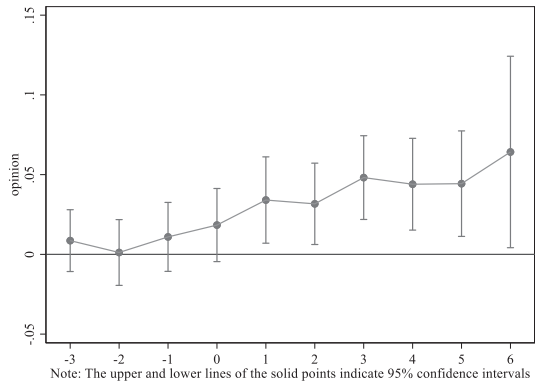

Fig. 2. Parallel trend test: Audit quality (*Opinion*).

4.2. Regression analysis

Table 3 lists the regression results for the impact of IID on audit quality. Columns (1) and (2), and columns (4) and (5), respectively, present the regression results with and without the control variables, controlling for industry-year fixed effects. Columns (1) and (2) present the regression results of the logit model, and columns (3)–(6) present the regression results of the OLS model.[4] The regression results for both measures of audit quality show that IID ($Post_{i,t}$) has a significant positive effect on audit quality ($Opinion_{i,t} and AQ_{i,t}$). The estimation method of the average marginal effect indicates that the implementation of the guidelines by firms increases the probability of a non-standard audit opinion from the auditor by 18.928%, and the six-dimensional audit opinion ($AQ_{i,t}$) increases by 0.098% toward an unavailable opinion. These results indicate that IID can significantly improve the audit quality of firms, supporting H1.

In terms of control variables, *Size*, *Roa*, *Cash*, *Inv* and *Top1* are significantly negatively related to audit quality. Moreover, *Lev* and *Loss* are significantly positively related to audit quality, which is generally consistent with the findings of previous studies (Reichelt and Wang, 2010; Minutti-Meza, 2013; Johl et al., 2021).

4.3. Robustness tests

4.3.1. Parallel trend test

The parallel trend assumption is a key aspect of the DID approach. To verify that the parallel trend assumption is satisfied, the study constructs Model (2), based on previous research (Beck et al., 2010), to conduct a staggered DID parallel trend test for the different periods in which the policy is implemented. This test helps to determine whether the trends in audit quality changes between the treatment and control groups are consistent for the years prior to the year of the audit.

$$Opinion_{i,t}/AQ_{i,t} = \beta_0 + \beta_1 \sum_{t=1}^{t=3} Treat_i * Before_{i,t} + Treat_i * Current_{i,0} + \beta_1 \sum_{t=1}^{t=6} Treat_i * After_{i,t} + \beta_2 Controls_{i,t} + \beta_3 \sum Firm_{i,t} + \beta_4 \sum Year_{i,t} + \varepsilon_{i,t} \quad (2)$$

In Model (2), $Before_{i,3}$ to $Before_{i,1}$, $\text{Current}_{i,0}$ and $After_1$ to $After_6$ are, respectively, interacted with the cross-multiplication term $Treat_i$. They are defined as 3 years before, the year of and 6 years after the implementation of the guidelines, respectively. The results of the parallel trend test for the two measures of audit

[4] Column (3) of Table 3 provides the results of the OLS model to control for firm-year fixed effects if the loss of sample observations is severe when controlling for firm-year fixed effects using the logit model. The results are also largely consistent when controlling for firm-year fixed effects using the logit model.

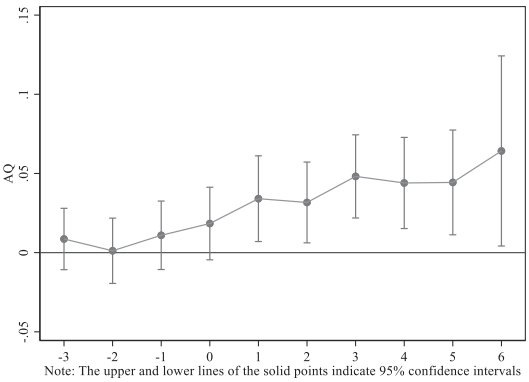

Fig. 3. Parallel trend test: Audit quality (AQ).

Table 4
Robustness testing: Alternative measures of the main variables.

	Restatement	*Restatement*	*Restatement*
	(1)	(2)	(3)
Post	–0.3305***	–0.3282***	–0.0276**
	(–2.935)	(–2.914)	(–2.371)
constant	–2.4475***	–1.4705*	–0.0874
	(–8.377)	(–1.831)	(–0.494)
Controls	No	Yes	Yes
Firm FE	No	No	Yes
Industry FE	Yes	Yes	No
Year FE	Yes	Yes	Yes
N	15,535	15,535	15,024
Pseudo R^2/*Adj_*R^2	0.0105	0.0264	0.0832

Notes: Standard errors are corrected for heteroskedasticity and clustering at the firm level (t-statistics are given in parentheses). ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

quality, namely *Opinion* and AQ, are reported in Figs. 2 and 3, respectively. Given the high correlation coefficient of 0.8417 between the two measures of audit quality, the parallel trend plots for the two dependent variable measures are similar. Figs. 2 and 3 show that the differences in IID and audit quality are not significant between the treatment and control groups in the 3 years prior to the implementation of the IID guidelines. There is a significant improvement in audit quality in the treatment group after the implementation of the guidelines, with the significance of industry disclosure gradually increasing over the 6 years after implementation. These findings confirm the effectiveness of the guidelines in improving audit quality, and the parallel trend assumption is satisfied.

4.3.2. Alternative measures of the main variables

A robustness test is conducted by replacing the measure of audit quality with the measure of financial restatement ($Restatement_{i,t}$) in the current year, in line with Rajgopal et al. (2021). The value of $Restatement_{i,t}$ is 1 if the firm has a financial restatement in the current year and 0 otherwise. The regression results are shown in Table 4. The results indicate that IID remains significantly positively related to audit quality with a decrease in the probability of a firm having a financial restatement. The results of the robustness test support the main findings reported in Table 3 and provide further evidence of the effectiveness of IID in improving audit quality.[5]

[5] Columns (1) and (2) in Table 4 list the results after controlling for industry-year fixed effects using the logit model for regression, and column (3) lists the OLS model results after controlling for firm-year fixed effects when too many sample observations are lost using the logit model. The results are also largely consistent when controlling for firm-year fixed effects using the logit model.

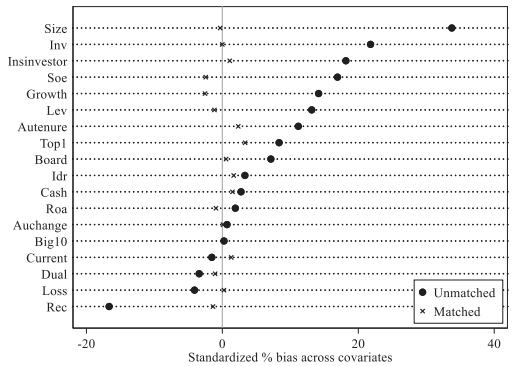

Fig. 4. Cross-sectional PSM equilibrium test.

4.3.3. Propensity score matching

To address possible endogeneity issues, such as reverse causality and omitted variables, the propensity score matching and differences-in-differences (PSM-DID) method is adopted to construct a sample of firms matched with specific firms implementing the guidelines. Two main concepts are considered for PSM. The first is cross-sectional matching, which treats panel data as cross-sectional data before matching. The second is period-by-period matching, which matches data on a year-by-year basis. The specific matching process is as follows. First, all control variables in Model (1) are selected as covariates. Second, different matched datasets are obtained according to the two matching methods: the radius is set to 0.05 and the 1:2 nearest neighbor matching method without replacement is adopted. For cross-sectional matching, the nearest neighbor matching method is used to find the best control group for the guideline pilot enterprises that meet the common support conditions. The non-common aspects are removed to obtain a new dataset. For period-by-period matching, the guideline pilot enterprises are matched year by year, and the year-by-year data are then vertically merged to form a new dataset. Third, the two sets of data are tested separately for balance to check matching effectiveness. The cross-sectional matching effects of the two audit quality measures ($Opinion_{i,t} and AQ_{i,t}$) are shown in Fig. 4. The standardized mean deviation of all matched variables after matching is less than 5%, which satisfies the criterion of less than 10%, indicating that the PSM process satisfies the requirement of the balance test. Fourth, the post-PSM data are used to re-estimate the impact of IID on audit quality. After controlling for firm-year fixed effects, the regression results are as shown in columns (1)–(4) of Table 5. Regardless of whether cross-sectional matching or period-by-period matching is selected for PSM, the relationship between IID and audit quality ($Opinion_{i,t} and AQ_{i,t}$) shows a significant positive correlation, and the baseline findings of this study hold.

4.3.4. Placebo test for changed policy shocks

Although the quasi-natural experiment controls for firm characteristics related to IID implementation, there may still be unobservable potential factors that affect the assessment of the guidelines' effectiveness. To ensure the robustness of the policy estimates, the guideline pilot industries are randomized and the policy shock is repeated 500 times to obtain the kernel density of 500 sets of *Post* values and their *p*-values, with $Opinion_{i,t}$ as the dependent variable. The results, depicted in Fig. 5, show that the coefficients after 500 random shocks are mainly concentrated around 0,[6] and the *p*-values are significantly less than 0.1 only 47 times, which is a small percentage of the total number of observations, namely 20,413. The regression results obtained after a particular randomized policy shock are shown in columns (5) and (6) of Table 5, where *Random*Post* is no longer significant. This indicates that the effect of the policy is not significantly influenced by underlying factors, and the main regression results are somewhat robust.

[6] The coefficients and *p*-values after 500 random shocks with $AQ_{i,t}$ as the dependent variable are generally consistent with the results reported in Fig. 5 with $Opinion_{i,t}$ as the dependent variable, and they are not repeated due to space constraints.

Table 5
Robustness tests: PSM-DID and placebo test.

	PSM-DID				Placebo test	
	Opinion	*Opinion*	*AQ*	*AQ*	*Opinion*	*AQ*
	Cross-sectional matching	Year-by-year matching	Cross-sectional matching	Year-by-year matching	Randomization policy shocks	
	(1)	(2)	(3)	(4)	(5)	(6)
Post	0.0140***	0.0153***	0.0174**	0.0192*		
	(3.1931)	(2.634)	(1.9840)	(1.737)		
*Random*post*					0.0036	0.0094
					(1.221)	(1.571)
Constant	0.3008***	0.3118***	1.3447***	1.3859***	0.3013***	1.3365***
	(4.6045)	(2.621)	(10.2967)	(6.159)	(4.613)	(10.244)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	No	No	No	No	No	No
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	19,793	20,294	19,793	20,294	19,798	19,798
Adj_R^2	0.3182	0.0594	0.2252	0.0609	0.3187	0.2254

Notes: Standard errors are corrected for heteroskedasticity and clustering at the firm level (t-statistics are given in parentheses). ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

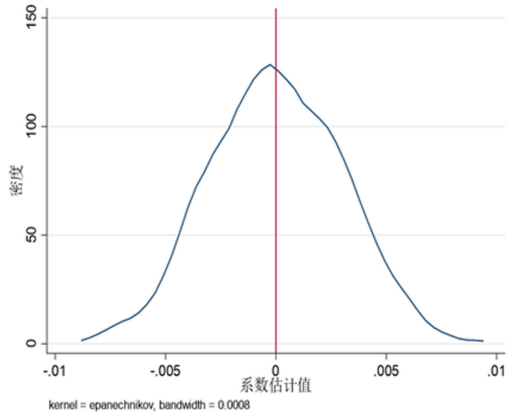

Fig. 5. Distribution of coefficient estimates for randomized policy shocks.

Table 6
Single-industry information disclosure and audit quality.

	Opinion (1)	*Opinion* (2)	*Opinion* (3)	*AQ* (4)	*AQ* (5)	*AQ* (6)
Post	0.5426**	0.5876**	0.0111**	0.0115*	0.0137**	0.0154*
	(2.270)	(2.320)	(2.268)	(1.649)	(2.027)	(1.720)
Constant	–5.5576***	3.7269*	0.3281***	1.0352***	1.3843***	1.2974***
	(–7.275)	(1.781)	(4.483)	(463.079)	(28.351)	(9.754)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	No	No	No	No	No	No
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	16,767	16,767	16,281	16,798	16,798	16,281
Adj_R^2	0.1440	0.3121	0.3259	0.0067	0.0767	0.2509

Notes: Standard errors are corrected for heteroskedasticity and clustering at the firm level (t-statistics are given in parentheses). ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

4.3.5. Excluding sample companies operating in cross-industry activities

Cross-industry business development is common practice among enterprises classified by the China Securities Regulatory Commission (CSRC) but may not be fully reflected in the industry classification of a company registered with the CSRC, leading to biased research designs. To address this issue, companies with multiple main business operations are removed, while those with a single main business operation are retained to ensure that the sample companies operate in a single industry. The impact of IID on audit quality in companies operating in a single industry is re-tested. The regression results based on the subsample without enterprises operating across industries are reported in Table 6. IID is still found to be significantly positively related to audit quality at the 10% or 5% level, indicating that the results of the main regression are somewhat robust after taking into account firms that operate in different industries. In summary, these findings suggest that the implementation of the IID guidelines can improve audit quality in companies with and without multiple main business operations.

5. Further analysis

The main tests and robustness tests confirm that IID can significantly improve the audit quality of firms, excluding the strategic and selective disclosure of industry information that leads to information redundancy. According to the hypothesis development framework, IID contributes to audit quality by affecting auditor independence, auditor professionalism and audit effort.

Table 7
Mechanism test: IID quantity and quality, audit fees and audit hours.

	Hangyeword (1)	*Nohangye* (2)	*TiEud* (3)	*Auditfee* (4)	*Audittime* (5)
Post	0.040***	0.025***	0.009***	1.2834**	0.0110
	(3.699)	(3.766)	(2.578)	(2.397)	(1.513)
Constant	1.757***	2.323***	1.207***	481.6392***	3.2236***
	(10.753)	(23.034)	(22.244)	(24.919)	(29.905)
Controls	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
N	19,045	19,045	17,240	19,798	19,749
Adj_R^2	0.743	0.819	0.407	0.8320	0.3065

Notes: Standard errors are corrected for heteroskedasticity and clustering at the firm level (t-statistics are given in parentheses). ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

If IID reduces auditor independence, auditors should be less likely to issue a non-standard unqualified opinion after the issuance and implementation of the guidelines. However, the main regression analysis of IID and audit quality confirms that IID ($Post_{i,t}$) is significantly positively related to audit quality ($Opinion_{i,t}/AQ_{i,t}$). In other words, after IID, auditors issue more non-standard unqualified opinions, which in turn increases auditor independence and enhances firms' audit quality. This suggests that IID enhances audit quality by increasing auditor independence. To further analyze the mechanism of the effect of IID on audit quality and test for related heterogeneity, we consider two channels in this study: auditor professionalism and audit effort.

5.1. Auditor professionalism: IID quantity and quality

To verify whether the implementation of the IID guidelines can improve audit quality by increasing the quantity and quality of industry-related information disclosed by enterprises, we first obtain 500 annual reports by stratifying the sample according to the 2012 industry classification of the CSRC for the 2010–2021 period. These reports are manually read and keywords related to IID are obtained.[7] Next, we use Python software to search the annual reports of all sample companies covering the 2010–2021 period for two types of text related to industry information: (1) the frequencies of 755 phrases or terms containing the word "industry," such as "sunrise industry" and "traditional industry," expressed in terms of *Hangyeword*; (2) the frequencies of 977 related phrases or words that do not contain the word "industry" but have obvious industry information and industry connotations, such as "leader" and "monopoly position," expressed in terms of *Nohangye*. In the annual report, the more frequent the occurrence of these two types of text containing industry information, the more industry information is disclosed. We use these data to determine whether there is a significant increase in the amount of industry information disclosed after the implementation of the guidelines. The regression results are reported in Table 7, which shows that the number of words with industry-related information disclosure connotations increases significantly after the implementation of the guidelines. This indicates that the promulgation of the guidelines promotes the disclosure of more industry information.

In addition to the quantity of industry-related information disclosed, the quality of such information is important in evaluating the impact of IID on audit quality. Studies show that capital markets respond positively to text similarity in the management discussion and analysis sections of financial reports (Brown and Tucker, 2011). Moreover, higher 10-K text similarity is associated with significantly lower earnings volatility and stock trading volumes for firms, and the overreaction of the capital market to repetitive information can cause earnings reversals (Tetloc, 2011). This suggests the importance of the information content of annual

[7] By manually searching for keywords directly related to the word "industry" and keywords that do not contain the word "industry" but have obvious industry comparison implications, 2,056 keywords related to industry information disclosure are ultimately obtained after aggregating and removing duplicate keywords; these include "industry information," "peer information" and "industry information.".

Table 8
IID quantity and audit quality.

	Opinion Large quantity of disclosures (1)	*Opinion* Small quantity of disclosures (2)	*AQ* Large quantity of disclosures (3)	*AQ* Small quantity of disclosures (4)
Post	0.0205***	0.0121	0.0172**	0.0181
	(3.195)	(1.543)	(2.082)	(1.504)
Constant	0.2899***	0.1505	1.2755***	1.4737***
	(2.697)	(1.323)	(17.735)	(23.105)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	9,920	9,182	9,920	9,182
Adj_R²	0.3245	0.3564	0.1720	0.2918
Pdiff		–0.008***		–0.003**

Notes: Standard errors are corrected for heteroskedasticity and clustering at the firm level (t-statistics are given in parentheses). ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

reports. To measure IID quality, we use the text similarity approach. First, using Python, we obtain sentences containing the keywords from the annual reports of the sample firms to form the text of the relevant IID. Then, we process the text with *jieba* subscripts to remove punctuation marks and redundant numbers. We compare the Euclidean distance in the IID text vector of the current year and the previous year of an enterprise, with reference to Matsumura et al. (2006) and Ho et al. (2014). This indicates the degree of similarity between the texts of the IID of the same enterprise in the current year and previous year, after the issuance of the guidelines, as a proxy for the quality of IID in the current year.

Specifically, before calculating text similarity, we use the term frequency–inverse document frequency (TF-IDF) weighting technique to transform the text into a vector, and the Euclidean distance of the IID text vector is measured ($TiEud_{ij} = \sqrt{\sum_k (X_{ik} - X_{jk})^2}$). Large Euclidean distance values indicate greater distance between the two text vectors, lower similarity between the papers and greater textual information content. We use these data to test whether the quality of the industry information disclosed by companies improves after IID. The regression results are reported in column (3) of Table 7, which shows that the Euclidean distance value of the disclosed industry information increases significantly after the implementation of the guidelines. This indicates that the promulgation of the guidelines increases the quality of the industry information disclosed by enterprises to the public.

5.2. Audit effort: Audit fees and audit hours

The implementation of the guidelines is innovative, mandatory, universal and legitimate, leading both auditors and enterprises to pay attention to and increase their investment in audit effort. With reference to Bills et al. (2016) and Gong et al. (2016), we test the impacts of IID by using the natural logarithm of audit fees to represent audit effort (*Auditfee*) and the natural logarithm of audit hours to represent audit time (*Audittime*).[8]

The regression results are reported in columns (4) and (5) of Table 7, which show that audit fees increase significantly after the issuance of the guidelines, while audit hours increase but not significantly. This indicates that companies pay attention to and increase their audit investments to hire more professional auditors. An increase in audit fees indicates an increase in a firm's financial investment in auditing and the importance that it places on auditing.

[8] The data are obtained from the CSMAR database. The number of audit hours is calculated as the natural logarithm of the number of days between the end of the accounting period (31 December) and the audit closing date of the following year, which is defined as the auditor's work input (*Audittime*) in the audit of the company's annual report. A longer interval means that the auditor invests more time in the audit of the annual report.

Some studies use the natural logarithm of audit fees as a proxy for audit quality (DeAngelo, 1981; Dao et al., 2012; Rajgopal et al., 2021), suggesting that the more a firm spends on auditing, the higher its audit quality. This demonstrates that audit fees are one of the channels through which IID affects audit quality.

5.3. Cross-sectional analysis

In this section, we conduct further analysis to examine whether the impact of IID on audit quality varies by auditor characteristics, whether the tone of IID is negative and the industry in which the firm operates. By examining these factors, we enhance our understanding of the mechanisms underlying the impact of IID on audit quality and identify potential moderating factors that affect the relationship between IID and audit quality. In the following sections, we report the results of the cross-sectional analysis and discuss their implications for our findings.

5.3.1. IID quantity and quality

To further investigate the relationship between IID quantity and audit quality, we divide the sample firms into a high-IID group and a low-IID group based on the mean frequency of the word "industry." We then examine whether the improvement in audit quality is affected by the number of IIDs. Table 8 shows that IID is significantly positively related to audit quality in the high-IID group but not in the low-IID group. Moreover, the between-group coefficient difference test indicates that the difference in the relationship between IID and audit quality is significant between the two groups. This suggests that the greater the amount of industry information disclosed, the more likely the auditor is to issue a non-standard audit opinion, indicating higher audit quality. This confirms that increased auditor professionalism due to IID contributes to the effect of IID on audit quality. If the industry information disclosed is informative and contributes to the auditor's cumulative knowledge, the greater the quantity or the higher the quality of IIDs, the greater the improvement in audit quality.

To further investigate the relationship between IID quality and audit quality, we divide the sample firms into high and low groups based on the mean Euclidean distance of the IID text. The regression results are reported in Table 9. After controlling for firm-year fixed effects, we find that IID is significantly positively related to audit quality in the groups with lower similarity (higher industry information quality), but not in any of the groups with higher similarity (lower industry information quality). Furthermore, the IID quality groupings all pass the between-group coefficient difference test (*Pdiff*) at the 1% level. Lower similarity of IID texts indicates a greater difference in industry information texts between the current year and the previous year of the guidelines' implementation, leading to the disclosure of more valid industry information and the higher validity of the information obtained by the auditor. This, in turn, leads to higher-quality audits. These

Table 9
IID quality and audit quality.

	Opinion Low similarity (1)	*Opinion* High similarity (2)	*AQ* Low similarity (3)	*AQ* High similarity (4)
Post	0.0207***	0.0012	0.0335**	−0.0049
	(3.180)	(0.172)	(2.433)	(-0.402)
Constant	0.4422***	0.1525	1.4948***	1.0770***
	(4.634)	(1.387)	(7.420)	(5.520)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	11,251	7,443	11,251	7,443
Adj_R²	0.3495	0.2756	0.2155	0.2437
Pdiff		–0.020***		–0.038***

Notes: Standard errors are corrected for heteroskedasticity and clustering at the firm level (t-statistics are given in parentheses). ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Table 10
Audit institutions and audit quality.

	Opinion Top Ranking (1)	*Opinion* Bottom Ranking (2)	*AQ* Top Ranking (3)	*AQ* Bottom Ranking (4)
Post	0.0197***	0.0099	0.0320**	0.0068
	(2.724)	(1.634)	(2.033)	(0.650)
Constant	0.4294***	0.0545	1.5962***	1.0232***
	(4.001)	(0.537)	(6.822)	(5.832)
Controls	Yes	Yes	Yes	Yes
Firm FE	No	No	Yes	Yes
Industry FE	Yes	Yes	No	No
Year FE	Yes	Yes	Yes	Yes
N	9,159	8,999	9,159	8,999
Adj_R²	0.3556	0.3666	0.2610	0.2414
Pdiff		–0.010*		–0.026**

Notes: Standard errors are corrected for heteroskedasticity and clustering at the firm level (t-statistics are given in parentheses). ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Table 11
Auditor industry expertise and audit quality.

	Opinion Outstanding industry expertise (1)	*Opinion* Lack of industry expertise (2)	*AQ* Outstanding industry expertise (3)	*AQ* Lack of industry expertise (4)
Post	0.0229***	0.0071	0.0243*	0.0069
	(3.133)	(1.197)	(1.739)	(0.575)
Constant	0.2755***	0.2789***	1.0205***	1.4591***
	(2.591)	(3.021)	(5.012)	(7.710)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	8,448	11,021	8,448	11,021
Adj_R²	0.2655	0.3675	0.2104	0.2607
Pdiff		–0.032***		–0.017*

Notes: Standard errors are corrected for heteroskedasticity and clustering at the firm level (t-statistics are given in parentheses). ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

findings confirm that high-quality IID increases auditor professionalism, which contributes to the effect of IID on audit quality.

5.3.2. Audit institutions and auditor characteristics

In addition to IID quantity and quality, the ranking of audit firms can affect auditor professionalism, which in turn may affect audit quality. The ranking of audit firms has a strong reputational effect, as audit firms such as the international "Big Four" or domestic "Top Ten" build a reputation and receive reputational rents due to their high rankings. This provides material security and reputational incentives for audit firms and auditors to perform their audit work. Moreover, the disclosure of industry information greatly enhances the ability of auditors to identify and report problems and improves audit efficiency and audit quality (Chan and Wong, 2002).

Table 12
IID tone features.

	Opinion Positive tone (1)	*Opinion* Negative tone (2)	*AQ* Positive tone (3)	*AQ* Negative tone (4)
Post	0.0139	0.0193***	0.0113	0.0327**
	(1.426)	(2.844)	(0.712)	(2.485)
Constant	0.3763	–0.0577	1.4193***	0.7350***
	(1.641)	(–0.404)	(3.281)	(3.078)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	8,473	8,594	8,473	8,594
Adj_R²	0.3237	0.2209	0.2681	0.2442
Pdiff		–0.005***		–0.021**

Notes: Standard errors are corrected for heteroskedasticity and clustering at the firm level (t-statistics are given in parentheses). ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Furthermore, auditor ranking combines various factors, such as the competence of all auditors, and the greater the auditor's competence, the stronger their ability to obtain valid information (Reichelt and Wang, 2010). Similarly, the stronger the auditor's ability to obtain effective information after IID, the more significant the improvement in the audit quality of the firm. To examine the impact of auditor ranking on the relationship between IID and audit quality, we divide audit firms into top- and bottom-ranking auditors,[9] based on the median of their overall score. The results of the sub-group regressions are presented in Table 10. After controlling for firm-year fixed effects, the effect of IID on audit quality is found to be more pronounced in the top-ranking auditor sub-group than in the bottom-ranking sub-group. The between-group coefficient differences across auditor size sub-groups are at least at the 10% level (*Pdiff*).

Auditors with industry expertise have a professional advantage in their audit work and can capture more valid information about the industry after the issuance of the guidelines than other auditors. Additionally, companies with greater auditor industry expertise tend to have higher audit quality than those with less (Cohen et al., 2014). To measure auditor industry expertise, we use the proportion of the audit client's total assets to all assets in the client firm's industry (IPSA). A value of 1 is assigned when the IPSA is greater than the mean, indicating that the auditor has industry expertise and 0 otherwise. Table 11 presents the results after controlling for firm-year fixed effects. The results indicate that IID is significantly positively related to audit quality in the sub-group with greater auditor industry expertise, and it is not significant in the sub-group in which industry expertise is lacking. As shown in Table 11, the between-group coefficient differences are at least at the 10% level (*Pdiff*). These findings suggest that auditor industry expertise plays a critical role in the relationship between IID and audit quality.

5.3.3. Tone and industry-specific features of IID

Besides the factors discussed above, the characteristics of the industry information disclosed by firms themselves may influence audit quality. Thus, we analyze whether there are differences in the impact of IID on audit quality in the context of different tones and industry characteristics.

Compared with standardized financial information, the disclosure of industry operating information, a type of non-standardized textual information, can provide a better complementary explanation and convey greater information content (Baginski et al., 2016). However, as textual information is not subject to disclosure rules or auditing procedures, it has relatively low transmission and violation costs. It can be easily manipulated by

[9] The ranking of audit firms is based on their audit income, asset valuation income, number of certified public accountants, completion rate of training, number of reserve candidates for leading talent, minus points, number of branch offices, number of practitioners, business income per capita, number of partners, number of persons aged below 30, number of persons aged 30–50, number of persons aged above 50, number of persons with a Master's degree or above and number of persons with a Bachelor's degree or below, with corresponding weights to obtain a comprehensive score.

Table 13
IID and audit quality for firms with different levels of R&D expenditure.

	Opinion High R&D (1)	*Opinion* Low R&D (2)	*AQ* High R&D (3)	*AQ* Low R&D (4)
Post	0.0006	0.0375***	–0.0018	0.0525**
	(0.109)	(2.740)	(–0.175)	(2.011)
Constant	0.3587**	0.2290	1.7658***	0.7482
	(2.101)	(0.867)	(4.198)	(1.587)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	7,914	7,457	7,914	7,457
Adj_R²	0.3283	0.3122	0.2509	0.2146
Pdiff		0.037***		0.054***

Notes: Standard errors are corrected for heteroskedasticity and clustering at the firm level (t-statistics are given in parentheses). ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

the managers of listed companies, becoming a means of impression management, and its reliability is difficult to discern (Huang et al., 2014). In the linguistic context of China, which values tone, the negative tone of textual information may be significantly positively related to a company's future earnings, excess stock returns and stock trading volumes (Loughran and McDonald, 2011; Davis et al., 2015; Bochkay et al., 2019). However, in markets with information asymmetry, a positive tone is not always a credible positive signal; it may be a biased signal through which managers deliberately mislead investors to conceal bad news or for other private reasons (Larcker and Zakolyukina, 2012; Huang et al., 2014). Therefore, the effect of IID tone on audit quality requires further testing.

We follow Henry and Leone (2016) and use the difference in the number of words with a positive and negative tone in IIDs divided by the sum of the two to denote the negative tone of IIDs. To examine whether the tone of IID texts affects audit quality, we divide the sample into two groups according to tone. The regression results are shown in Table 12, which indicates that IID has a significant positive relationship with audit quality in the group with a negative tone but not in the group with a positive tone. Furthermore, as shown in Table 12, the between-group coefficient difference (*Pdiff*) is at least at the 10% level. These findings suggest that IID texts with a negative tone carry greater information content and provide more valuable information for auditors' work. In contrast, IID texts with a positive tone have less valuable information, which also indicates that there is generally a degree of positive tone manipulation in IID by management. Therefore, when examining the impact of industry information on audit quality, it is important to consider IID tone.

The impact of IID on audit quality may differ across industries based on the relevance of operating information to financial information. Besides technical information, a firm's operating information mainly includes details that provide the right holder with a competitive advantage, such as information about the firm's fixed assets, sales, R&D expenditure and growth (Jefferson and Rawski, 1994). As most firms with a small proportion of fixed assets are new technology-based firms, their operating information is relatively opaque (Licht and Nerlinger, 1998), making it difficult for external institutions such as auditors to assess their business risks and investment returns. In contrast, the majority of enterprises with a large proportion of fixed assets are low value-added manufacturing enterprises, which rely more on IID than new technology-based enterprises with high added value. These two types of enterprises may therefore rely on industry information, which may impact audit quality differently. To explore this issue, we use the R&D expenditure of firms to determine whether they are technology-based firms; specifically, we consider companies' R&D expenditure as a percentage of their total expenditure.

The results of the sub-group regressions are presented in Table 13. The empirical results show that IID significantly improves audit quality in firms with low R&D expenditure, while the effect in firms with high R&D expenditure is not significant. This indicates that companies with low R&D expenditure are more likely to be manufacturing companies that rely more on industry information, while companies with high R&D expenditure are less likely to rely on industry information and mainly rely on their own proprietary technology to

achieve corporate development. Therefore, IID is more likely to improve audit quality in firms with low R&D expenditure, and the between-group coefficient differences are at the 1% level (*Pdiff*).

6. Conclusions and insights

Introduced in 2013, the reformed SSE and SZSE disclosure regulations aim to ensure the provision of more industry-related information. Using Chinese companies listed from 2010 to 2021, this study explores the impact of IID on audit quality. Our empirical results show that the implementation of the IID guidelines significantly improves audit quality. The study confirms the positive impact of IID on audit quality and demonstrates the effectiveness of the implementation of industry-specific disclosure guidelines. This suggests that regulators should continue to strengthen the implementation of the guidelines and regulate the further disclosure of industry information. Additionally, the findings show that IID can reduce audit risk and increase auditor effort, leading to higher audit quality. Overall, this study expands research on the economic consequences of IID from the perspective of audits and the factors influencing audit quality. The findings provide valuable insights for regulators, enterprises and other stakeholders in the capital markets. For regulators, the SSE and SZSE could strengthen the implementation of the guidelinesto improve the disclosure quality of industry information and to genenrate more positive spillover effect in the capital market., Besides auditors, the stakeholders would like pay more attention to enterprises' IID when making investment decisions.

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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