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Governance effects of digital transformation: From the perspective of accounting quality

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Governance effects of digital transformation: from the perspective of accounting quality

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ABSTRACT

With the rapid development of digital economy and technology in China, we research on whether corporate digital transformation in traditional industries can improve accounting quality as well as corporate governance. Our findings suggest that, firms proceeding more digital transformation have lower degree of earnings management and higher degree of accounting qualities. Digital transformation can improve accounting quality by reducing three types of agency costs. Specifically, digital transformation can improve corporate internal control, as well as attract more analyst tracking, to improve accounting qualities. Additional analysis suggests that, the governance effects of corporate digital transformation are more prevails in non-state firms, or weak information quality firms, as well as in long-term oriented firms. Corporate digital transformation can decrease real earnings management and stock price synchrony, increase accounting quality, reveals a positive governance effect.

KEYWORDS

Digital transformation;
accounting quality;
corporate governance

1. Introduction

Digital Economy has become the most important competitive strategy for both China and all over the countries (“Digital Economy Situation Analysis 2020–2021”, National Research Center for Industrial Information Security and Development). During the last decades, with the rapid development of digital technologies, such as Artificial Intelligence, Internet Plus, Big Data, Cloud Computing, and Machine Learning, etc. (Xie et al., 2021), Chinese Digital Economy is far more ahead of many other countries. In the mode of Digital Economy, data has become a new element of production, corporations need to apply digital technology generally to all aspects of its business process, in another word, to carry out digital transformation.

It has been proved that digitally driven technologies, including Artificial Intelligence, Internet Plus, Big Data, Cloud Computing, and Machine Learning, are bringing a new wave of transformation on both macro- and micro-economic societies. From the macro perspective, relevant studies confirm that new technologies such as the Internet (Huang et al., 2019), Artificial Intelligence (Y. B. Chen et al., 2019), and Big Data (Li et al., 2020) can

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drive technological upgrade, reduce accumulated social transaction costs and resource misallocation, improve risk prediction, facilitate innovation of business model, thereby significantly improving total factor productivity as a whole. From the meso-industry perspective, the spread of digital finance can facilitate residential consumption, improve the efficiency of capital allocation, and thus promote real economic growth (Huang & Huang, 2018; Zhang et al., 2020).

Along with the deep use of digital technology in China, research on how digital technology affect corporate decision is becoming a hot topic. Existing evidence shows that digital technology can affect investment and corporate valuation (W. Chen & Srinivasan, 2020). Nevertheless, researches on how to measure the corporate digital transformation and discuss its economic consequence are still at a very early stage. For traditional companies, digital transformation can not only standardise data and information within the corporation, thus reduces information asymmetry for external markets, but also enables deep analyse of information and data, for corporate refined management and scientific decision-making. Thus, how can digital transformation be an effective mechanism to ease corporate agency problems and improve governance?

This paper choose A-share listed firms from year 2008 to 2018 with traditional industries as samples. Referring definition and measurement of corporate digital transformation from W. Chen and Srinivasan (2020), we read and analyse classification of digital technology based on governmental policies, industrial reports, formed a digital technology dictionary. Then we use PYTHON textual analysis to mining digital technology words from Management Analysis and Discussion or Report of Director Boards in corporate annual report, as well as manual verification. Based on specific set of data, we research on whether traditional firm's digital transformation can improve accounting quality, thereby realising governance effect.

We document several findings. First, we report that firms proceeding more digital transformation have lower degree of earnings management and higher degree of accounting qualities. Second, in terms of the mechanism of agency theory, digital transformation can improve accounting quality by reducing three types of agency costs. In terms of the specific path of effect, digital transformation can improve corporate internal control, as well as attract more analyst tracking, to improve accounting qualities. Additional analysis suggests that, the governance effects of corporate digital transformation are more prevails in non-state firms, or weak information quality firms, as well as in long-term oriented firms. Corporate digital transformation can decrease real earnings management and stock price synchrony, increase accounting quality, reveals a positive governance effect.

We make two main contributions to the literature. First, with the rapid development of digital economy and technology, this paper provides evidence for a new perspective on the economic consequences of corporate digital transformation. Corporate digital transformation has been getting more and more attention, but mostly at a macro or qualitative level (Y. B. Chen et al., 2019; Li et al., 2020; Xie et al., 2021). Evidence shows that corporate digital transformation may be just a kind of market value management (Zhao et al., 2020), thus non-substantial digital transformation may cause market overreaction (S. F. Cheng et al., 2019). Related researches are only in an exploratory stage. We not only design a more comprehensive and scientific measurement of corporate digital transformation, but also analyzes and tests how it affects corporate governance from agency theory and

specific path of mechanisms. Therefore, this paper is an important addition to the existing literature in the field of digital technology impact and corporate behaviour decisions, which is still in the exploratory stage. Second, we expand the literature on corporate governance. How to improve corporate governance is quite a hot issue, related studies are widely and deeply involved in different perspectives, but few focus on how technology affects corporate governance. We demonstrate that corporate digital transformation can improve accounting quality and optimise corporate governance by reducing agency costs, optimising internal control, and attracting analysts' tracking from both theoretical mechanisms and specific effect paths, which is an important complement to corporate governance.

2. Literature and hypothesis

2.1. Digital transformation

Digital technologies, including artificial intelligence, Internet plus, big data, cloud computing, machine learning, etc., is setting off a new wave of reformation in macro economy and micro enterprises (Xie et al., 2021). The impact of digital economy on corporate decision is gradually attracting academic attention. It is generally believed that digital technologies have a profound impact on corporate operations, investment, and value creation (W. Chen & Srinivasan, 2020). McKinsey & Company (2017) points out that corporate digitalisation includes asset digitalisation, operation digitalisation and labour digitalisation in their Research Report on the digitalisation level of 22 industries in China. More attention is paid to the digitalisation driven by data technologies of high-tech companies (W. Chen & Srinivasan, 2020). With the continuous deepening and popularisation of digital technology, it can be applied at a lower cost (Brynjolfsson et al., 2019), thus more and more traditional companies begin to actively implement the digital technologies. The biggest advantage of digital transformation is that it can improve the operational efficiency of different types of companies through digital applications. Therefore, digital transformation can ultimately help enterprises to create value.

The research on the economic consequences of digital transformation is a hot topic. First, in the field of corporate value and performance, many studies have pointed that the companies using a certain type of digital technologies, such as big data, internet plus, cloud computing, can improve operational efficiency (W. Chen & Srinivasan, 2020), affect the degree of differentiation of companies (Yang & Liu, 2018), strengthen foreign investment (Yang & Bi, 2019), and improve product innovation (Qi & Xiao, 2020). All these leads to and improve the return on assets and corporate value. Second, in the field of innovation ability, Chen, Zeng et al. (2020) points out that application of big data inspires the innovation of companies in behavioural insight, risk prediction, business model and so on. At the same time, higher data analysis ability always leads to higher innovation and output of the companies (Wu et al., 2020). Shen and Yuan (2020) points out that companies' internet transformation can reduce information transaction costs and generate information spillover, thereby improving innovation ability. Third, in the field of corporate operation and governance, the application of digital technologies can optimise companies' decision-making (Liu et al., 2020; P. Xu & Xu, 2020). Digital technologies also improve supply chain agility (Gong et al., 2021; Sun et al., 2019). The application of digital

technologies such as blockchain and big data can promote corporate governance (Yermack, 2017; Zhu, 2019), affect strategic management (Chen et al., 2020) and human resource management (Xie et al., 2021), promote the development of management accounting (Zeng & Xu, 2020), thus reduce financing constraints (Chod et al., 2020). Finally, considering the market reaction, when companies disclose more information about internet plus, big data, blockchain, market investors will have a significantly positive (Cahill et al., 2020) or even excessive positive (S. F. Cheng et al., 2019) reaction. Although this has brought higher abnormal returns, it also shows that the companies have the motivation of strategic speculation and market value management, which increases the risk of stock price crash (Zhao et al., 2020).

Although the research on the economic consequences of digital transformation have made some progress, most of them only focus on a certain type of digital technologies, take all firms as the research objectives, and fail to split the digital transformation of traditional industries. In addition, existing studies are more based on macro level or qualitative analysis, and large sample evidence from the perspective of micro firms is still very scarce.

2.2. Corporate governance effect of digital transformation: from the perspective of accounting quality

The fundamental problem of corporate governance is the principal–agent problem under the condition of asymmetric information. The disclosure of accounting information is helpful for external market stakeholders to evaluate stewardship of managers. Therefore, we analyse whether the digital transformation has corporate governance effect from the perspective of accounting quality. The existing studies believe that the poor accounting quality is usually manifested in higher earnings management. In essence, earnings management still lies in the principal–agent problem (Watts & Zimmerman, 1986), so we first analyse it from the agency theory mechanism.

2.2.1. Mechanism analysis based on agency problem

First, we analyse the impact of equity and debt agency cost. Under the modern enterprise system with the separation of ownership and management rights, the efforts of executives cannot be directly measured. Therefore, accounting earnings are widely used to measure executives' entrusted responsibility and formulate executives' compensation contracts (Jensen & Meckling, 1976). At the same time, creditors also use earnings information to supervise debtors, and evaluate whether debtors can fulfill their repayment obligations in time. When the earnings quality is not high or the solvency is poor, creditors may increase financing costs. For executives, earnings information is not only closely related to their own compensation contracts, but also related to the financing cost of liabilities. When lack of effective supervision, executives are motivated to manipulate earnings by adjusting accounting policies and other means. We believe that the possible explanations for digital transformation to improve the accounting quality by reducing the agency costs of equity and debt are as follows:

On the one hand, companies can use digital technologies to standardise and automate the processing of internal data and compress the space of executives' earnings manipulation. The first step of the corporate digital transformation is to establish a data sharing

centre, through which the finance date can be accurately calculated, and then extended to the centralised and standardised processing of operation and process data. Automated and standard data not only help to improve the quality of basic financial data of firms, reduce the information asymmetry between companies and shareholders or creditors, but also inhibit executives' free decision of accounting data or accounting policies, thereby compressing the space for earnings management.

On the other hand, digital technologies are conducive to reducing the motivation of executives to manipulate earnings. With the help of data-driven in all links, companies can conduct in-depth analysis of the collected information, and implement refined management and scientific decision-making. Managers at all levels can make full use of the data, which can be quickly transformed into decisions of financial management, supply chain management, human resource management and terminal sales, and then optimise the environment and results of decisions (P. Xu & Xu, 2020). At the same time, data technologies can stimulate the companies' innovation in behavioural insight, risk prediction and business model (Chen et al., 2020), and improve the agility of the supply chain (Gong et al., 2021; Sun et al., 2019). The higher data analysis ability leads to more innovation and output of company (Wu et al., 2020). In a word, digital technologies are conducive to improving the corporate performance by improving the scientific decision-making and stimulating innovation, then the intrinsic motivation of executives to manipulate earnings management decreases. Therefore, when the motivation and space for executives to manipulate earnings are suppressed, the agency cost of equity and debt are alleviated, digital transformation make the corporate governance effect on accounting quality.

Second, we analyse the impact of agency problem between major and minority shareholders. The high concentration of companies' equity is particularly prominent in China. The existence of major shareholders, on the one hand, can supervise senior executives and optimise corporate governance (Shleifer & Vishny, 1986). On the other hand, major shareholders may use control rights to transfer interests and damage the interests of minority shareholders (La Porta et al., 1998). Evidences show that the controlling shareholders in China's capital market often tunnel listed companies through related transactions, funds occupation and other means (Pan & Yu, 2014; Zhou & Chen, 2006). In order to prevent minority shareholders from identifying tunnelling, major shareholders generally use earnings manipulation to gloss over the financial data, which leads to the reduction of accounting quality (Fan & Wong, 2002; Tong & Wang, 2007). As mentioned above, under digital transformation, the standardisation and automatic processing of accounting of subsidiaries within the company will also significantly reduce the space for controlling shareholders to conduct related transactions or manipulate earnings, and make governance effect on the accounting quality. Therefore, we providing the following hypothesis:

H1: The more company applied digital transformation, the better its accounting quality is.

H2: Digital transformation improves corporate accounting quality by reducing agency costs.

2.2.2. Specific paths analysis

Based on the analysis of the mechanisms of agency theory, the more important question is: through which specific paths in corporate governance does digital transformation

affect and thus achieve its corporate governance effects on accounting quality? We analyse both internal and external corporate governance, respectively.

We firstly argue that digital transformation can improve corporate internal control, thus achieve corporate governance effects. Internal control system is an important part of the accounting system (Wang et al., 2015). If internal control of listed company is inadequate or defective, it usually means that there is misrepresentation of accounting by managements manipulating accounting for self-interest purposes (Qi et al., 2010). Conversely, high-quality internal control can improve the accounting quality (Dong & Chen, 2011). The application of digital technologies can not only improve financial control through digital information sharing centre, but also improve operative control. In addition, intelligent technologies can improve corporate management efficiency in productive process. Technologies such as neural network analysis can also help companies automatically monitor and identify internal control flaws, deep learning algorithms helps to solve complex problems that are difficult to directly and simply quantify in the companies' internal control (Gu & Shen, 2019). Therefore, digital transformation can reduce the manipulation of accrued earnings by optimising corporate internal control.

We secondly argue that corporate digital transformation is able to attract more analysts' tracking and thus achieve corporate governance effects. Analysts play the role of information intermediary between companies and external stakeholders, analysing reports, predicting earnings, stock ratings and recommendations, so as to reduce information asymmetry, thus reduce agency conflict. Existing studies have pointed out that analysts' tracking will directly increase the cost of managements' opportunistic behaviour, thus inhibiting earnings management (Hong et al., 2014), thus actively making the effects of external corporate governance (T. Chen et al., 2015). Due to the importance of digital economy development in China, when companies start to apply digital technologies, they tend to receive more tracking from analyst, and become the key object of analyst. This will virtually strengthen the corporate governance role of analysts for digital transformation companies, and then optimise the accounting quality. Therefore, we providing the following hypothesis:

H3: Digital transformation improves corporate accounting quality by improving internal control.

H4: Digital transformation improves corporate accounting quality by attracting more analyst tracking.

3. Sample, research design, and descriptive statistics

3.1. Data sources and sample selection

Since 2008, the China's model of economic growth has gradually changed, new economic forms have gradually emerged, and digital technologies have gradually started to be used after the financial crisis. We select Chinese A-share firms from 2008 to 2018 as the initial sample. This paper focuses on the digital transformation of non-technology traditional industry firms, and therefore according to Lu and Dang (2014), we removed technology-

intensive industries from the initial sample. Then, we removed financial firms and firms with an asset–liability ratio greater than 1. The final sample has 15,592 firm-years. The data of digital transformation are obtained from the audited annual reports (10-K report) of listed firms. We design variables of digital transformation by manual reading, text analysis and other multiple perspective methods, as described in the variable design. All other firm-level data are obtained from the China Securities Market and Accounting Research (CSMAR) database.

3.2. Variable design

3.2.1. Digital transformation

It can be seen from the prior literature, most studies use digital technology indicators at the regional level (such as Internet and Internet Finance) data to estimate the degree of digital technology application of firms in this region, but considering the heterogeneity of industries and firms, such estimation methods are very biased. In fact, although many traditional firms in China have begun or deeply implemented digital transformation, and in recent years, the Accounting Standards Committee has repeatedly demonstrated how digital technology-related assets can be included in the standard disclosure system, so far, regulators have not required firms to disclose specific information about digital transformation. At present, some studies use announcements or annual reports of firms as text sources to measure the application of digital technology by companies. For example, S. F. Cheng et al. (2019) uses blockchain information disclosed in the 8-K report of listed companies to measure the application of blockchain; Yang and Bi (2019) and Zhao et al. (2020) use the Internet related information disclosed in the firms' annual report to measure the application of Internet technology. In the context of the rapid development of digital economy, companies naturally tend to actively disclose information about the application of digital technology. Therefore, according to W. Chen and Srinivasan (2020), we use the Management's Discussion and Analysis (MD&A) of the firms' audited annual report (10-K report) as the text source, and use the method of text analysis to design variable of the firms' digital transformation. However, we still need to consider two important issues.

The first important issue is that the firm often uses multiple digital technologies at the same time in the process of digital transformation. If only one type of technology is considered according to the existing studies, it is likely to miss a large number of research objects that are also undergoing digital transformation. At the same time, the application of a single kind of digital technology, such as 'Information System', 'Financial Sharing', 'Internet application', is difficult to accurately represent the company's digital transformation (Yuan et al., 2021). Therefore, referring to W. Chen and Srinivasan (2020), we consider the comprehensive application of different types of digital technology by firms. To establish the main indicators of the firms' digital transformation, the steps are as follows:

The first step is to identify digital technology categories. We read a large number of research reports and academic papers published by various research institutions, practitioners and academics in recent years. On this basis, we also extract the relevant policies issued by the State Council and local governments at all levels to help categorise digital

technology¹. Finally, we select eight types of digital technology: Intelligentization, Digitisation, Automation, Artificial Intelligence, Machine Learning, Cloud Computing, Big Data, and Blockchain².

The second step is manual reading to classify and summarise the dictionary. Considering the complexity of Chinese sentences, we do not use machine learning methods, but read manually to classify and summarise the dictionary based on the already identified digital technology categories. Based on the text source of the annual report, such as MD&A and the report of the board of directors, we take the select eight categories of digital technology as the basic dictionary. On this basis, we organise two groups of members to select 100 annual reports for manual reading, and put the relevant roots in the text into different categories of digital technology. Then, we summarise the words obtained from the two groups, and the other group will increase or decrease the word roots by combining the existing research reports, references, Internet dictionaries, etc. The word roots included in the eight types of digital technology are finally obtained, and a digital technology dictionary is established, as shown in Table 1.

The third step is text analysis. Using Python software and 'Jieba' word segmentation algorithm, we add the manually screened word roots to the word database of the 'Jieba' algorithm. Then we divide the relevant text source in the annual reports of listed firms from 2008 to 2018 into words, and calculate the number of words in each type of digital technology in the firm-year level. We design two main variables for digital transformation at the firm-year level: (i) An indicator variable for implementing digital technology (*DIGI_DUM*), i.e. An indicator variable that equals 1 if the above-mentioned word roots

Table 1. Digital transformation – lists of word roots.

Types	Composition
Intelligenization	8 intelligenization related word roots.
Digitisation	15 digital related word roots.
Automation	10 automation related word roots.
Artificial Intelligence	15 artificial intelligence and technology related word roots.
Machine Learning	16 machine learning and technology related word roots.
Cloud Computing	8 cloud computing related word roots.
Big Data	24 big data related word roots.
Blockchain	5 blockchain technology related word roots.

¹The main research reports we refer to include: 'Digital Economy Situation Analysis 2020–2021', National Center for Industrial Information Security and Development Research; 'Future Economy White Paper 2021'; 'Digital Economy Industry Development Index', Technology Innovation Center for Big Data Analytics, Beijing Institute of Big Data; "Digital Economy and its Core Industries Statistical Classification (2021), National Bureau of Statistics; 2019 Accenture China Enterprise Digital Transformation Study, Accenture; China Digital Economy Report, McKinsey; etc. The referenced academic papers are listed in the references and will not be repeated. The referenced government policy documents include the 12th Five-Year Plan, 13th Five-Year Plan, 14th Five-Year Plan of the State Council and local governments at all levels, government work reports, and various central and local government related policy documents such as 'Guidance on Actively Promoting Internet+ Action', 'Industrial Planning for Big Data Development', and 'Development Planning for New Generation Artificial Intelligence'. These research reports or documents, we use both manual reading classification, text extraction methods to determine the category of digital technology. The main text will not be repeated.

²Our comprehensive selection of digital technology categories also includes informatization and the Internet. Considering the early use of these technologies in China, it is difficult to proxy advanced digital technologies in the context of the new economy. For example, the Internet was used very early, but it has only been deeply integrated with the traditional economy since 2014, so we did not include these technologies.

obtained from text analysis, otherwise it is 0; (ii) An degree variable for implementing digital technology (*DIGI_WORD*), that is, the number of words obtained from text analysis plus 1, and then take logarithm.

The second important issue is that even if we extract textual information from the annual report on digital technology-related content, it does not represent the real extent of firm's digital transformation. Firms may strategically disclosure digital related information to attract external market attention. Meanwhile, digital transformation is a dynamic process, the dynamic and sustainable impact of transformation also need to be considered. We further designed more digital transformation variables, including two perspectives which will be explained in the part of Empirical Results.

According to the firm-year distribution of digital transformation as shown in [Table 2](#), the digitisation samples accounted for 43.60% from 2008 to 2018, and the number of digital transformation firms and the proportion of the trend is basically increasing year by year. Since 2014, the government work report of the State Council has repeatedly mentioned the development of 'Big Data, Cloud Computing, Artificial Intelligence, Internet of Things' and other digital technologies, indicating that digitalisation has risen to the national strategic level.³ With the national attention to digital technology, a large number of companies have carried out digital transformation. The proportion has increased significantly since 2014, and reached 75.21% in 2018, indicating that a large number of non-technical traditional firms in China have gradually carried out digital transformation.

3.2.2. Accounting quality

We measure discretionary accrued profits by cross-sectional modified Jones model (Dechow et al., 1995).

$$\frac{TA_{i,t}}{Asset_{i,t-1}} = \alpha_0 + \alpha_1 \frac{1}{Asset_{i,t-1}} + \alpha_2 \frac{\Delta Sale_{i,t} - \Delta REC_{i,t}}{Asset_{i,t-1}} + \alpha_3 \frac{PPE_{i,t}}{Asset_{i,t-1}} + \varepsilon \quad (1)$$

where $TA_{i,t}$ is total accrued profit, calculated as operating income less cash flows from operating activities. $Asset_{i,t-1}$ is total assets of firm i at the end of year $t-1$, $\Delta Sale_{i,t}$ is the

Table 2. Distribution of the sample of digital transformation.

Year	<i>DIGI_DUM</i> = 0		<i>DIGI_DUM</i> = 1		Total
	Number of samples	Percentage	Number of samples	Percentage	
2008	627	71.33%	252	28.67%	879
2009	752	80.00%	188	20.00%	940
2010	940	86.64%	145	13.36%	1,085
2011	950	76.31%	295	23.69%	1,245
2012	1,012	76.67%	308	23.33%	1,320
2013	896	71.22%	362	28.78%	1,258
2014	489	37.85%	803	62.15%	1,292
2015	681	46.04%	798	53.96%	1,479
2016	839	49.67%	850	50.33%	1,689
2017	1,051	48.70%	1,107	51.30%	2,158
2018	557	24.79%	1,690	75.21%	2,247
Total	8,794	56.40%	6,798	43.60%	15,592

³www.sohu.com/a/300254585_398084

change in sales of firm i in year t , $\Delta REC_{i,t}$ is the change in accounts receivable of firm i in year t , and $PPE_{i,t}$ is net property, plant, and equipment of firm i in year t . The variables are scaled by the total assets in year $t-1$. Eq. (1) is a cross-sectional estimate for each industry-year portfolio. Using the parameters estimated from Eq. (1), the discretionary accruals are calculated as the difference between the total accruals and the projected value of the assumed 'normal' accruals. We use the absolute value of the discretionary accruals ($|DA_{i,t}|$) to measure the accrued earning management. It has been argued in the literature that the larger the absolute discretionary accruals, the higher the level of earning management, that is, the lower the accounting quality. We also use the modified Dechow and Dichev model (Dechow & Dichev, 2002; Dechow et al., 2011; Jones et al., 2008) and the performance-adjusted modified Jones model (Kothari et al., 2005) to measure discretionary accrued profits, and the regression results are similar. For the sake of brevity, we mainly report the results for discretionary accrued profits estimated with the modified Jones model and include variables that can be substituted to estimate the level of earning management as robustness tests.

3.3. Research design

3.3.1. Digital transformation and accounting quality

To test the main hypothesis that the impact of digital transformation on firms' accrued earning management, the following model was constructed.

$$\begin{aligned} |DA_{i,t}| = & \beta_0 + \beta_1 DUGI_DUM_{i,t-1}(DUGI_WORD_{i,t-1}) + \beta_2 SIZE_{i,t-1} + \beta_3 LEV_{i,t-1} + \beta_4 AGE_{i,t-1} \\ & + \beta_5 MSHARE_{i,t-1} + \beta_6 BORADSIZE_{i,t-1} + \beta_7 TOP1_{i,t-1} + \beta_8 IND_{i,t-1} + \beta_9 DUAL_{i,t-1} + \beta_{10} INSSHARE_{i,t-1} \\ & + \beta_{11} ROE_{i,t-1} + \beta_{12} AGE + \beta_{13} BIG10_{i,t-1} + \beta_{14} GROWTH_{i,t-1} + \beta_{15} TQ_{i,t-1} + \varepsilon \end{aligned} \quad (2)$$

Where $DUGI_DUM_{i,t-1}$ is an indicator variable that equals 1 for the firm i is digitalised in year $t-1$, and 0 otherwise; and $DUGI_WORD_{i,t-1}$ is the degree of digitalisation, that is, the number of words of eight types of digital technology plus 1, and then take logarithm; and accrued earning management ($|DA|$) is measured by the absolute value of discretionary accruals. W. Chen and Srinivasan (2020) examine the impact of digitalisation on corporate performance by lagging it by one or even several periods. Considering that the implementation of digital transformation may also have a lag effect on the accounting quality, we lag digital variable for one period, which alleviates the possible endogenous problem to a certain extent.

In addition, referring to prior research, we control for several aspects of firm characteristics: (i) basic firm characteristics: firm size ($SIZE$), asset-liability ratio (LEV), firm establishment (AGE), return on net assets (ROE), firm growth ($GROWTH$), market value to total assets ratio (TQ); (ii) corporate governance characteristics: executive shareholding ratio ($MSHARE$), number of board of directors ($BORADSIZE$), shareholding ratio of the largest shareholder ($TOP1$), percentage of independent directors (IND), combination of chairman and general manager ($DUAL$), institutional shareholding ratio ($INSSHARE$); (iii) corporate

audit characteristics: top 10 auditing firms (*BIG10*). We also control for industry⁴ with year fixed effects.

3.3.2. Mechanism test

We argue that the possible mechanism inherent in the digital transformation of firms to improve the accounting quality lies in the reduction of equity agency costs, debt agency costs and control agency costs. In terms of specific path analysis, we argue that digital transformation may improve accounting quality by improving internal control and attracting analysts' attention. According to Baron and Kenny (1986), Wen et al. (2004), and Wen and Ye (2014), we use the mediating effect to test various types of agency costs and specific path.

For the measurement of agency costs of equity, according to Jame et al. (2000), we use the management expense ratio (*MFEE*) and investment efficiency (*INVEST*) as proxy variables for the management agency costs. For the measurement of agency costs of debt, Jensen and Meckling (1976) argue that rational bond investors are aware that the shareholders/managers of the firm will probably harm the interests of bondholders. Therefore, the interest expense ratio (*INTEREST*), as the cost of debt financing, has become an important indicator to measure the cost of debt agency. For the measurement the agency costs of control, according the prior literature, we use related related party transaction (*RPT*), fund occupation (*OTHERRECE*) and the degree of separation of two powers (*SEPERRATION*) to measure the agency cost of control.

For the specific path analysis, we use the internal control index provided by the DIB internal control and risk management (DIB) database to proxy for internal control quality (*IC*) and the number of analysts tracking to proxy for analyst attention (*ANALYST*), and then test-specific paths using the mediating effect method.

We use following models to test mediating effect.

$$INTERMEDIARY_{i,t} = \gamma_0 + \gamma_1 DUGI_DUM_{i,t-1} + \gamma CONTROL + \eta \quad (3)$$

$$|DA_{i,t}| = \beta_0 + \beta_1 DUGI_DUM_{i,t-1} + \theta_1 INTERMEDIARY_{i,t} + \beta CONTROL + \varepsilon \quad (4)$$

where *INTERMEDIARY* is: (i) equity agency cost: management expense ratio (*MFEE*) and investment efficiency (*INVEST*); (ii) debt agency cost: interest expense ratio (*INTEREST*); (iii) control agency cost: related party transaction (*RPT*), fund occupation (*OTHERRECE*) and the degree of separation of two powers (*SEPERRATION*); (iv) internal control (*IC*); and (v) analyst attention (*ANALYST*).

According to Baron and Kenny (1986) and Wen et al. (2004) test method of mediating effect mechanism, we tests the coefficients γ_1 and θ_1 in model (3) and model (4) in turn. If both are significant, it means that the impact of firm's digital transformation on accounting quality is at least partly realised through intermediary variables. If only one of the coefficients γ_1 and θ_1 is significant, the presence of a mediating effect needs to be tested by Sobel (1982). The specific variables are explained as shown in Table 3 below.

⁴This article uses the China Securities Regulatory Commission (CSRC) industry classification, with two-digit codes for manufacturing and one-digit codes for other industries.

Table 3. Definitions of key variables.

Variable	Variable Definition
Explained variables	
DA	Accrued earning management. The specific definition is shown in the variable design above.
DA_PA	Accrual earning management. The specific design refers to Kothari et al. (2005) to estimate the Jones model after performance adjustment.
DD	Accrual earning management. The specific design refers to modified Dechow and Dichev model (Dechow & Dichev, 2002) to estimate the accounting quality.
COMPACC	Comparability of financial statements.
RM	Real earning management.
SYN	Stock price synchronisation.
Explanatory variables	
DIGI_DUM	An indicator variable that equals 1 for the firm is digitalised, and 0 otherwise. The specific definition is shown in the variable design above.
DIGI_WORD	The total number of words involved in digitisation in the annual report of the firm is added by 1 and then the natural logarithm is taken.
Intermediate variables	
MFFEE	Administrative expenses divided by revenue.
INVEST	Investment efficiency is calculated according to Richardson et al. (2005), and then taken absolute value.
RPT	Related party transaction is the total amount of related transactions divided by revenue.
OTHERRECE	Fund occupation is net other receivables divided by total assets.
SEPERRATION	The degree of separation of the control right and the cash flow right.
INTEREST	Interest expense ratio is divided by the total of long-term borrowings, short-term borrowings and bonds payable.
IC	Internal control index provided by the DIB database is added by 1 and the natural logarithm is taken.
ANALYST	Analysts attention is the number of analysts followed added by 1, and the natural logarithm is taken.

Table 4. Descriptive statistics of key variables.

Variable	Obs	Mean	SD	Min	P25	Median	P75	Max
DA	15,592	0.058	0.061	0.001	0.018	0.040	0.076	0.342
DA_PA	15,592	0.056	0.056	0.001	0.018	0.040	0.075	0.315
DD	13,292	0.062	0.053	0.001	0.023	0.049	0.086	0.308
COMPACC	12,057	-0.005	0.003	-0.023	-0.006	-0.004	-0.003	0.000
RM	14,003	0.014	0.205	-0.684	-0.085	0.030	0.136	0.509
SYN	15,591	-0.213	0.961	-3.416	-0.751	-0.118	0.431	1.916
DIGI_DUM	15,592	0.436	0.496	0.000	0.000	0.000	1.000	1.000
DIGI_WORD	15,592	0.753	1.111	0.000	0.000	0.000	1.099	5.075
MFFEE	15,592	0.098	0.110	0.009	0.043	0.074	0.115	1.132
INVEST	14,331	0.053	0.062	0.000	0.015	0.033	0.064	0.358
INTEREST	12,998	0.073	0.090	0.002	0.039	0.056	0.076	0.826
RPT	14,129	1.023	1.913	0.000	0.127	0.443	1.080	14.010
OTHERRECE	15,592	0.018	0.034	0.000	0.003	0.008	0.019	0.393
SEPERRATION	15,592	0.052	0.078	0.000	0.000	0.000	0.093	0.288
IC	15,581	6.275	0.927	2.300	6.421	6.505	6.559	6.904
ANALYST	15,592	1.440	1.187	0.000	0.000	1.386	2.485	4.190

3.4. Descriptive statistics and univariate analysis

We report the descriptive statistics of the main variables in Table 4. The mean value of DIGI_DUM is 0.436, which indicates that in China about 43.60% of traditional firms are undergoing digital transformation between 2008 and 2018. In addition, the mean value of DIGI_WORD is 0.753, while the maximum value is 5.075, indicating that there is a large difference in the degree of digitisation of each firm. The mean value of |DA| is 0.058 and the median value is 0.040, this result is lower compared to the empirical data of J. Chen and Xu (2019), the possible reason is that J. Chen and Xu (2019) use the financial data of China's listed companies from 2007 to 2016 for estimation, which indicates that after 2016

Table 5. Univariate analysis of key variables.

Variable	<i>DIGI_DUM</i> = 0		<i>DIGI_DUM</i> = 1		Difference in Means
	Obs	Mean	Obs	Mean	
<i>DA</i>	8,794	0.061	6,798	0.055	0.006***
<i>COMPACC</i>	7,382	-0.0049	4,675	-0.0047	-0.0003***
<i>RM</i>	8,292	0.022	5,711	0.003	0.019***
<i>SYN</i>	8,794	-0.233	6,797	-0.188	-0.045***
<i>DA_PA</i>	8,794	0.059	6,798	0.053	0.006***
<i>DD</i>	8,210	0.066	5,082	0.056	0.010***

with the accounting system and external regulation continuous improvement, the accounting quality has also been improved to some extent.

Then, we distinguish the samples into two groups for comparison between firms with and without digital transformation. In Table 5, it can be seen that the mean values of accrual earning management (*|DA|*, *|DA_PA|*, *|DD|*) are significantly lower in group of samples with digital transformation than the samples without digital transformation. The comparability of financial statements (*COMPACC*) is significantly higher in group of samples with digital transformation. The level of true earning management (*RM*) is also significantly lower in group of samples with digital transformation. These preliminary evidences all show that the accounting quality is relatively higher for firms with digital transformation.

4. Empirical results

4.1. Baseline regression

We report the multivariable regression results of Eq. (2) in Table 6. Column (1) and (2) present the regression results without control variables. The coefficients of *DIGI_DUM* and *DIGI_WORD* are both significantly negative at the 1% level, preliminary verifying that digital transformation of traditional firms is beneficial to curb accrued earning management and improve the accounting quality. Column (3) and (4) present the regression results with control variables. The coefficients of *DIGI_DUM* and *DIGI_WORD* are still both significantly negative at the 1% level, indicating that the results remain robust after excluding the effects of other relevant variables. The above results suggest that digital transformation reduces management's ability and motivation to manipulate earning by reducing information asymmetry and optimising management's decision, thereby inhibiting the level of accrued earnings management, which supports the hypothesis H1.

4.2. Re-discussion on digital transformation

The previous empirical results have supported our key point, that is, digital transformation of traditional firms can improve accounting quality. However, as mentioned before, even if we extract textual information from the annual report on digital technology-related content, it does not represent the real extent of firm's digital transformation. We further designed more digital transformation variables, including the following two perspectives.

Table 6. Digital transformation and accounting quality.

	(1)	(2)	(3)	(4)
	DA	DA	DA	DA
<i>DIGI_DUM</i> _{<i>t</i>-1}	-0.006*** (-5.184)		-0.005*** (-4.234)	
<i>DIGI_WORD</i> _{<i>t</i>-1}		-0.002*** (-4.281)		-0.002*** (-4.111)
<i>SIZE</i> _{<i>t</i>-1}			-0.006*** (-8.225)	-0.006*** (-8.285)
<i>LEV</i> _{<i>t</i>-1}			0.032*** (8.456)	0.032*** (8.523)
<i>AGE</i> _{<i>t</i>-1}			-0.000 (-0.107)	-0.000 (-0.173)
<i>MSHARE</i> _{<i>t</i>-1}			-0.005 (-1.324)	-0.005 (-1.253)
<i>BORADSIZE</i> _{<i>t</i>-1}			-0.001** (-2.343)	-0.001** (-2.374)
<i>TOP1</i> _{<i>t</i>-1}			-0.003 (-0.793)	-0.004 (-0.833)
<i>IND</i> _{<i>t</i>-1}			0.010 (0.814)	0.010 (0.823)
<i>DUAL</i> _{<i>t</i>-1}			0.002 (1.636)	0.002 (1.635)
<i>INSSHARE</i> _{<i>t</i>-1}			-0.005* (-1.882)	-0.005* (-1.858)
<i>ROE</i> _{<i>t</i>-1}			-0.025*** (-4.693)	-0.025*** (-4.650)
<i>BIG10</i> _{<i>t</i>-1}			-0.004*** (-3.514)	-0.004*** (-3.518)
<i>GROWTH</i> _{<i>t</i>-1}			0.006*** (4.488)	0.006*** (4.474)
<i>TQ</i> _{<i>t</i>-1}			0.003*** (5.463)	0.003*** (5.511)
<i>_cons</i>	0.073*** (15.999)	0.072*** (15.923)	0.179*** (11.351)	0.179*** (11.398)
<i>INDUSTRY</i>	YES	YES	YES	YES
<i>YEAR</i>	YES	YES	YES	YES
<i>N</i>	15,592	15,592	15,592	15,592
<i>adj. R²</i>	0.038	0.038	0.073	0.073

The reported t-statistics are based on robust standard errors adjusted for firm-level clustering. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

4.2.1. Redesign of digital transformation

First, if firms disclose a few words about digital technologies in their annual reports in order to follow trends or gimmicks (S. F. Cheng et al., 2019; Zhao et al., 2020) and other factors, it may affect our main findings. For this reason, we redesign two variables, *DIGI_DUM_ABJUST* and *DIGI_WORD_ABJUST*. The main change of *DIGI_DUM_ABJUST* compared with *DIGI_DUM* is to adjust the dummy variable from 1 to 0 when the number of digital technologies words in the samples is small (less than or equal to 5 times). Similarly, *DIGI_WORD_ABJUST* compared with *DIGI_WORD* adjust the value of the samples with fewer occurrences of digital technology words (less than or equal to 5 times) to 0, while the others remain unchanged. We report the regression results in columns (1) to (4) of Table 7. The coefficients of *DIGI_DUM_ABJUST* and *DIGI_WORD_ABJUST* are both significantly negative at the 1% level, indicating that the empirical results are robust⁵.

⁵We also adjust the number of digital technologies words in the annual report less than or equal to 1 time and less than or equal to 3 times respectively, and the regression results remain robust.

Table 7. Redesign of digital transformation.

	Drop Few Digital Words Disclosures			Grade Variable			Excluding Strategic Disclosures			Digital Patents		Control Total Words of Annual Report		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
<i>DIGI_DUM_ABIJUST_{t-1}</i>		-0.006*** (-3.630)	-0.005*** (-2.849)											
<i>DIGI_WORD_ABIJUST_{t-1}</i>			-0.002*** (-2.944)	-0.002*** (-2.463)										
<i>DIGI_GRADE_{t-1}</i>					-0.002*** (-4.308)	-0.002*** (-3.832)								
<i>DIGI_DUM_DS_{t-1}</i>							-0.005*** (-3.749)	-0.003** (-2.137)						
<i>DIGI_WORD_DS_{t-1}</i>									-0.002*** (-3.721)	-0.002*** (-2.901)				
<i>DIGI_PATENT</i>											-0.007* (-1.769)	-0.009** (-2.241)		
<i>DIGI_DUM_{t-1}</i>													-0.005*** (-4.037)	
<i>DIGI_WORD_{t-1}</i>														-0.002*** (-3.483)
<i>TOTALWORD_{t-1}</i>														0.002 (0.926)
CONTROLS	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	YES	YES
INDUSTRY	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
YEAR	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	15,592	15,592	15,592	15,592	15,592	15,592	15,592	15,592	15,592	15,592	15,592	15,592	15,592	15,592
adj. R ²	0.034	0.072	0.034	0.072	0.034	0.073	0.034	0.071	0.034	0.072	0.033	0.072	0.072	0.072

Second, according to W. Chen and Srinivasan (2020), we set the grade variable of digital transformation (*DIGI_GRADE*). Specifically, for the samples with digital technologies words appearing more than 0 times, the number of digital technologies words is sorted according to each industry in each year, then we set 3 grades from small to large. The more words appear in the digital transformation, the higher the grade is. The samples without digital technologies words in that year are set to 0. We report the regression results in columns (5) to (6) of Table 7. The coefficients of *DIGI_GRADE* is also significantly negative.

Third, we exclude cases where firms are not undergoing substantial digital transformation. In order to measure digital transformation more reliably and accurately, we manually read all related texts of all samples from their annual reports. We exclude digital information in the annual report related to the firms' description of forward-looking trends, economic environment or industry development, as well as information on the implementation of digital technologies by the firms' upstream suppliers or downstream customers. We design variable *DIGI_DUM_DS* that adjusts the value of *DIGI_DUM* from 1 to 0, if the samples are identified as non-substantial technology transformation (strategic disclosure). Similarly, *DIGI_WORD_DS* is adjusted the value of *DIGI_WORD* from the original number to 0, if the samples are identified as non-substantial technology transformation. We report the regression results in columns (7) to (10) of Table 7. The coefficients of *DIGI_DUM_DS* and *DIGI_WORD_DS* are still significantly negative.

Fourth, in order to further identify whether traditional firms are undergoing substantial digital transformation, we use whether there are digital patents in the patents applied by firms to represent the digital transformation. Therefore, we design the digital patent variable (*DIGI_PATENT*) which is an indicator variable that equal 1 for observations with digital patents, and 0 otherwise. We report the regression results in columns (11) to (12) of Table 7. The *DIGI_PATENT* coefficient is significantly negative.

Finally, we consider the impact of the total words of annual report. The extent of digital transformation disclosure may be influenced by total words in annual report. Therefore, we further control total words of annual report (*TOTALWORD*). Columns (13) and (14) in Table 7 show the regression results, where the coefficients of *DIGI_DUM* and *DIGI_WORD* are significantly negative.

4.2.2. The dynamic and continuous effect of digital transformation

After firm begins the digital transformation process, can we observe consistently improvement of firm's accounting quality? We design the variable *DIGI_POST* which is an indicator variable that equal 1 for firms after implementing digital technologies, and 0 for the firms before implementing digital technologies or never implementing digital transformation. Meanwhile, in order to test the dynamic process of digitalisation, we divide the samples into three groups: first is full sample; second excludes firms that never implement digital transformation; third is based on the second sub-group, excludes firms that always implement digitalisation.

We report the univariate test in PANEL A of Table 8, the mean values of $|DA|$ are significantly lower for all three digital transformation groups than without transformation in this design of digitalisation's dynamic process.

Then, regression tests are reported in PANEL B of Table 8. The coefficients of *DIGI_POST* in columns (1) to (3) are all significantly negative, indicating that compared with before

Table 8. The dynamic and continuous effect of digital transformation.

Variable	<i>DIGI_POST</i> = 0		<i>DIGI_POST</i> = 1		Difference in Means
	Obs	Mean	Obs	Mean	
PANEL A Univariate Tests					
(1) Full samples					
<i>DA</i>	3578	0.068	12,014	0.057	0.011***
(2) Exclude the samples that never implementing of digital technologies					
<i>DA</i>	3578	0.068	9029	0.057	0.011***
(3) On the basis of (2) and then exclude samples that always implementing of digital technologies					
<i>DA</i>	3098	0.066	9029	0.057	0.009***
			(1)	(2)	(3)
PANEL B Regression Tests					
			Full samples	Exclude the samples that never implementing of digital technologies	On the basis of (2) and then exclude samples that always implementing of digital technologies
<i>DIGI_POST</i> _{<i>t</i>-1}			<i>DA</i> -0.004** (-1.967)	<i>DA</i> -0.006*** (-3.125)	<i>DA</i> -0.004* (-1.880)
<i>CONTROLS</i>			YES	YES	YES
<i>INDUSTRY</i>			YES	YES	YES
<i>YEAR</i>			YES	YES	YES
<i>N</i>			15,592	12,607	12,127
<i>adj. R</i> ²			0.071	0.070	0.067
				(1)	(2)
				<i>DA</i>	<i>DA</i>
PANEL C Retests: Dynamic Process of Substantial Digital Transformation					
<i>DIGI_POST_1</i> _{<i>t</i>-1}				-0.002* (-1.897)	
<i>DIGI_POST_2</i> _{<i>t</i>-1}					-0.004* (-1.778)
<i>CONTROLS</i>				YES	YES
<i>INDUSTRY</i>				YES	YES
<i>YEAR</i>				YES	YES
<i>N</i>				15,592	15,592
<i>adj. R</i> ²				0.068	0.077

digital transformation, the level of accrued earnings management can be significantly reduced after digital transformation. This result proves our key point that digital transformation can improve the accounting quality from the dynamic and continuous process during the subsequent period of transformation.

Finally, we retest whether firms applied a substantial digital transformation. We exclude the non-substantial digital transformation and design variable. Specifically, we exclude the strategic disclosure of digital technology by manually reading the annual report, and then design *DIGI_POST_1*, an indicator variable that equal 1 for after the substantial digital transformation of firms as 1, and 0 otherwise. Then, we design *DIGI_POST_2* which is also an indicator variable that equal 1 for after having digital patents, and 0 otherwise. The results in PANEL C of Table, the coefficients of *DIGI_POST_1* and *DIGI_POST_2* are both significantly negative.

4.3. Robustness tests

Replace the Variable of Accrued Earning Management. We use the performance-adjusted modified Jones model ($|DA_PA|$, Kothari et al., 2005) and the modified Dechow and Dichev model ($|DD|$, Dechow & Dichev, 2002; Dechow et al., 2011; Jones et al., 2008) to measure discretionary accrued profits as well. The results are reported in columns (1) to (4) of Table 9, and the coefficients of $DIGI_DUM$ and $DIGI_WORD$ are generally consistent.

Instrumental Variable. Considering samples of digital transformation may not be random, thus lead to sample selection bias. We use the Peking University Digital Inclusive Finance Index ($PKU-DFIIC$)⁶ as instrumental variable to regress the 2SLS two-stage model. As shown in column (5)-(6) of Table 9, the results keep robust.

Heckman Test. We use Heckman two-stage regression to solve the problem of sample self-selection. The results are shown in columns (7)-(8) of Table 9. It can be seen that the coefficient of $DIGI_DUM$ after adding IMR is still significantly negative.

Propensity Score Matching (PSM). In order to overcome the possible causal relationship between Digital Transformation and accounting quality, as well as the possible problem of missing variables, we use PSM for retest. The results are reported in column (9) of Table 9, the coefficient of $DIGI_DUM$ is still significantly negative.

Firms Fixed Effects. We control firms fixed effects based on the main model Eq. (2), reported in column (10) of Table 9, the result keeps consistently.

Excluding the Influence of Accounting Standards Revision. Since 2014, Chinese Accounting Standards (CAS) have been revised more frequently than before. In order to exclude the influence of the new CAS, we design the variable $2015POST$ that value is 1 after year 2015, and 0 otherwise, reported the results in columns (11)-(12) of Table 9, the coefficients of $DIGI_DUM$ and $DIGI_WORD$ are still significant negative.

4.4. Mechanism tests⁷

We use mediating effect mechanism test according to Baron and Kenny (1986), Wen et al. (2004), and Wen and Ye (2014) to examine the internal logic of Digital Transformation to reduce accrual earning management. First, we test whether digitalisation of firms can reduce the earning management by reducing agency costs. On the specific path tests, we further examine whether digitalisation of firms can improve the quality of internal control or attract analysts' attention, which in turn reduce the earning management.

4.4.1. Mediating effect of agency costs

As described in the research design, we use the management expense ratio and investment efficiency to measure the equity agency costs. First, we report the results of the mediating effect using Eq. (3) in columns (1) and (2) of Table 10. In columns (1) and (2), the $MFEE$ and $INVEST$ are dependent variables, and the coefficients of $DIGI_DUM$ are significantly negative, indicating that Digital Transformation can alleviate the equity agency

⁶The data provided by Peking University Digital Inclusion Index ($PKU-DFIIC$) starts in 2011, so the samples of periods of 2008–2010 is missing.

⁷It should be noted that the results of the above mediating mechanism regressions, we have implemented the same tests using the variable ($DIGI_WORD$), and the regression results remain robust and are not reported due to the structure and length of the article.

Table 10. Mediating effect tests for agency costs.

	Mediating Effect Tests:Eq.(4)											
	Equity and Debt Agency Costs			Control Agency Costs			Equity and Debt Agency Costs			Control Agency Costs		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
<i>MFEF</i>	<i>INVEST</i>	<i>INTEREST</i>	<i>RPT</i>	<i>OTHERRECE</i>	<i>SEPERRATION</i>	<i>DA</i>	<i>DA</i>	<i>DA</i>	<i>DA</i>	<i>DA</i>	<i>DA</i>	<i>DA</i>
<i>DIGL_DUM_{t-1}</i>	-0.006*** (-2.743)	-0.002* (-1.647)	-0.004** (-2.170)	-0.073** (-2.180)	-0.001* (-1.686)	0.020 (0.134)	-0.005*** (-4.368)	-0.004*** (-3.359)	-0.005*** (-4.358)	-0.004*** (-3.532)	-0.004*** (-4.126)	-0.005*** (-4.234)
<i>MFEF</i>						0.028*** (2.842)						
<i>INVEST</i>							0.098*** (8.476)					
<i>INTEREST</i>								0.025*** (3.536)				
<i>RPT</i>									0.003*** (5.615)			
<i>OTHERRECE</i>										0.149*** (6.000)		
<i>SEPERRATION</i>											0.000 (0.485)	
<i>CONTROLS</i>	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
<i>INDUSTRY</i>	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
<i>YEAR</i>	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
<i>N</i>	15,592	14,331	12,998	14,129	15,592	15,692	14,331	12,998	14,129	15,592	15,592	15,592
<i>adj. R²</i>	0.217	0.060	0.033	0.148	0.099	0.096	0.086	0.079	0.081	0.080	0.080	0.073

costs between managements and shareholders by reducing the management expenses and improving investment efficiency. Second, we report the results of the mediating effect using Eq. (4) in columns (7) and (8) of Table 10, where the dependent variables $|DA|$ and independent variables $DIGI_DUM$, $MFEE$, and $INVEST$, and the coefficients of $MFEE$ and $INVEST$ are significantly positive at the 1% level. It means that the more serious the agency problem between managements and shareholders, the higher the earning management. Third, the significance of the coefficients and their signs are used to determine whether the mediating effect holds. According to the criteria for judging the mediating effect, the coefficient of $MFEE$ is -0.006 regressed using Eq. (3) and 0.028 regressed using Eq. (4), and the coefficient of $DIGI_DUM$ is -0.005 regressed using Eq. (4), indicating that the partial mediating effect of management expense ratio as a percentage of the total effect = $-0.006 \times 0.028 / (-0.005) = 3.36\%$. Similarly, the partial mediating effect of the mediating variable investment efficiency ($INVEST$) as a percentage of the total effect = $-0.002 \times 0.098 / (-0.004) = 4.9\%$. It implies that Digital Transformation reduces the earning management of firms by reducing the equity agency cost. In addition, reducing the cost of equity agency is not the only mechanism to reduce earning management, that is, the equity agency costs achieve only a partial mediating effect.

The measure of the debt agency costs is the interest expense ratio. Similarly, first, we report the regression result of the mediating effect using Eq.(3) in column (3) of Table 10. The $INTEREST$ is the dependent variable, and the coefficient of $DIGI_DUM$ is significantly negative, indicating that Digital Transformation can alleviate debt agency problems by reducing the interest expense ratio of firms. Second, we show regression result of the mediating effects using Eq. (4) in column (9) of Table 10. The coefficient of $INTEREST$ is significantly positive at the 1% level. Third, similar to the above practice, we calculate the the mediating variable interest expense rate ($INTEREST$) partial mediating effect as a percentage of the total effect, that equals $-0.004 \times 0.025 / (-0.005) = 2\%$. It shows that Digital Transformation reduces the earning management of the firms by reducing the debt agency costs.

The measures of the control agency cost are related party transactions, capital occupation and the separation of control and cash flow power. Similarly, first, we show the results of mediating effect of Eq. (3) in columns (4), (5) and (6) of Table 10. The PRT , $OTHERRECE$ and $SEPERRATION$ are the dependent variables and the coefficients of $DIGI_DUM$ are significantly negative when the dependent variables are PRT and $OTHERRECE$. However, and coefficient of $DIGI_DUM$ is not significant when the dependent variable is $SEPERRATION$. It indicates that Digital Transformation can reduce the related party transactions and fund occupation of firms, that is, it can alleviate the tunnelling effect between major and minority shareholders, but has little impact on the change of ownership structure. Second, we report the regression results of mediating effect of Eq. (4) in columns (10), (11) and (12) of Table 10. The coefficients of RPT and $OTHERRECE$ are significantly positive. Third, similar to the above practice, the proportion of the partial mediating effect of RPT to the total effect is $-0.073 \times 0.003 / (-0.004) = 5.48\%$; the proportion of the partial mediating effect of $OTHERRECE$ to the total effect is $-0.001 \times 0.149 / (-0.004) = 3.72\%$. It shows that Digital Transformation reduces the earning management by reducing the control agency costs. In addition, the $SEPERRATION$ does not have a significant mediating effect while failing the Sobel (1982) test. It indicates that

Table 11. Mediating effect tests for specific paths.

	Mediating Effect Tests:Eq.(3)		Mediating Effect Tests:Eq.(4)	
	Internal Control	Analyst Attention	Internal Control	Analyst Attention
	(1) <i>IC</i>	(2) <i>ANA</i>	(3) <i> DA </i>	(4) <i> DA </i>
<i>DIGI_DUM</i> _{<i>t-1</i>}	0.043***	0.085***	-0.004***	-0.004***
	(2.646)	(4.954)	(-3.598)	(-3.853)
<i>IC</i>			-0.008***	
			(-10.186)	
<i>ANA</i>				-0.002***
				(-3.158)
<i>CONTROLS</i>	YES	YES	YES	YES
<i>INDUSTRY</i>	YES	YES	YES	YES
<i>YEAR</i>	YES	YES	YES	YES
<i>N</i>	15,581	15,592	15,581	15,592
<i>adj. R²</i>	0.089	0.400	0.087	0.070

digital technologies have less effect on adjustment of ownership structure in the mechanism of mediating effect.

4.4.2. Mediating effect of specific paths

According to the hypothesis analysis, we consider the quality of internal controls and the level of analyst attention as possible paths for Digital Transformation to affect agency costs and thus the accounting quality. For this purpose, we use the same mediating effect test. First, we report the results of the mediating effect using Eq. (3) in columns (1) and (2) of Table 11. The coefficient of *DIGI_DUM* is 0.043 and significant at the 1% level, with internal control (*IC*) as the dependent variable in column (1); and the coefficient of *DIGI_DUM* is 0.085 and significant at the 1% level, with analyst attention (*ANALYST*) as the dependent variable. It indicates that Digital Transformation can improve the quality of internal control and attract analyst attention. Second, we show the regression results of mediating effects using Eq. (4) in the columns (3) and (4) of Table 10, and the coefficients of *MFE* and *INVEST* are significantly negative at the 1% level. It indicates that the higher the quality of internal control or analyst concern, the lower the earning management. Again, the significance of the coefficients and their signs are used to determine whether the mediating effect holds. Partial mediation effect of internal control quality as a percentage of total effect is $0.043 \times -0.008 / (-0.004) = 8.6\%$; partial mediation effect of analyst attention as a percentage of total effect is $0.085 \times -0.002 / (-0.004) = 4.3\%$. It shows that the quality of internal control and attracting analyst attention have a partial mediating effect, supporting hypotheses H3 to H4.

5. Further discussion

We further discuss the impact of Digital Transformation on corporate governance from three perspectives: firm heterogeneity characteristics, alternative perspectives on accounting quality, and stock price synchronisation.

5.1. Heterogeneity characteristics of firms

5.1.1. Nature of property right

The ultimate controller of state-owned enterprises (SOEs) is the government. Prior studies have argued that SOEs have different incentives from non-SOEs. For example, SOEs usually have to help the government achieve social goals such as maintaining employment and alleviating poverty (H. Chen et al., 2011), which means that reporting higher earning is not the only goal of SOE managers. SOEs are often able to obtain more government subsidies, bank loans, and stock market return (Lee et al., 2014; C. S. A. Cheng et al., 2015) without relying on accounting earning. At the same time, managers of SOEs are appointed by the SASAC and usually with political purposes, so they pay more attention to reputation influence, thus to restrict the managers of SOEs from mining of firms' resources (Jiang et al., 2010). These may imply that managers of SOEs have lower incentives to actively carry out earning management. Therefore, the accounting quality in SOEs is relatively good. We expect that the Digital Transformation in SOEs will have no or less impact on the accounting quality. Meanwhile, the accounting quality of non-SOEs is relatively poor. Since the major shareholders of non-SOEs are mostly directly involved in the decision-making and operation of the firm, their shorter management levels are more likely to apply digital technologies to the management of financial data and also to use data sharing and other digital technologies, to achieve better supervision of the managers, therefore, the accounting quality of non-SOEs is more likely to improve significantly after the digitalisation.

We report the regression results in columns (1)-(4) of Table 12. The coefficients of *DIGI_DUM* and *DIGI_WORD* of non-SOEs are both significantly negative at the 1% level in columns (1) and (2); while SOEs are not significant. The difference test of *DIGI_DUM* coefficients are significant between the non-SOEs and SOEs, and *DIGI_WORD* is the same. It indicates that non-SOEs are more motivated to adopt digital technologies to improve the accounting quality.

5.1.2. Information environment

Can the transformation of digital technology promote the accounting quality of Companies in different information environments? We use the absolute value of discretionary accruals |DA| estimated by the cross-sectional modified Jones model to group firms' accounting quality according to the annual median of each industry. The results reported in columns (5)-(8) of Table 12. The *DIGI_DUM* and *DIGI_WORD* coefficients of poor information environment groups are both significantly negative at the 1% level in columns (5) and (6), indicating that the Digital Transformation is more effective in poor information environment of firms to improve the accounting quality. However, the coefficients of *DIGI_DUM* and *DIGI_WORD* of the groups with better information environment are significantly positive in columns (7) and (8). Also the differences of the coefficients between the two groups pass the test of significance. This may lie in the fact that in the absence of clear regulation of digital asset accounting in the current accounting system, the space for surplus manipulation is limited for firms with better accounting quality, however, the generation of digital assets may squeeze more space for earning management for corporate executives.



Table 12. Heterogeneity characteristics of firms.

	Non-SOEs		SOEs		Poor Information Environment		Good Information Environment		Low Long-Term Value Orientation		High Long-Term Value Orientation	
	(1) DA	(2) DA	(3) DA	(4) DA	(5) DA	(6) DA	(7) DA	(8) DA	(9) DA	(10) DA	(11) DA	(12) DA
<i>DIGL_DUM_{t-1}</i>	-0.006*** (-3.818)		-0.002 (-1.335)		-0.005*** (-3.045)		0.000* (1.686)		-0.000 (-0.008)		-0.005*** (-4.583)	
<i>DIGL_WORD_{t-1}</i>		-0.003*** (-3.712)		-0.001 (-0.998)		-0.003*** (-3.842)		0.000** (2.214)		-0.000 (-0.217)		-0.003*** (-4.392)
CONTROLS	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
INDUSTRY	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
YEAR	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
	(1) vs. (3)	(2) vs. (4)			(5) vs. (7)	(6) vs. (8)			(9) vs. (11)	(10) vs. (12)		
Chi-square	4.17	2.81			13.40	10.47			4.35	3.29		
p-value	0.041	0.094			0.000	0.000			0.032	0.075		
N	8852	8852	6740	6740	7813	7813	7779	7779	1491	1491	14,101	14,101
adj. R ²	0.069	0.069	0.082	0.082	0.073	0.074	0.001	0.001	0.064	0.064	0.073	0.073

5.1.3. Culture of long-term value orientation

Existing studies believe that firms with long-term value orientation will make the accounting system more standardised (Doupnik & Tsakumis, 2004). According to Du (2015), we use the Confucian Culture to represent the long-term value orientation of the firms, which is specifically calculated as the number of Confucius temples within 100 km of the company. Again, the sample is grouped based on the annual median for each industry and is divided into a high long-term value orientation group and a low group. The results reported columns (9)-(12) of Table 12. The coefficients of *DIGI_DUM* and *DIGI_WORD* of high long-term value orientation groups are both significantly negative at the 1% level in columns (11) and (12), while the low long-term value orientation groups in columns (9) and (10) are insignificant, indicating that the firms' culture with more obvious long-term value orientation, their Digital Transformation is more conducive to improve the accounting quality.

5.2. Other perspectives on accounting quality

5.2.1. Real earning management

In addition to accrued earning management, executives may also manipulate profits through real earning management by arranging real economic transactions, such as selling assets, reducing investments, cutting R&D expenditures, accelerating production, and selling at a discount, which not only changes the distribution of earning from period to period, but also affects the overall earning level and cash flow. We further test whether the Digital Transformation of firms inhibits the real earning management of executives. We estimate the value of real earning management according to Roychowdhury (2006) approach.

The regression results are shown in columns (1) and (2) of Table 13. The coefficients of *DIGI_DUM* and *DIGI_WORD* are both significantly negative at the 1% level when the dependent variable is real earning management (*RM*). It Indicates that the Digital Transformation of firms is not only conducive to reducing accrued earnings management through accounting policies, but also conducive to reducing managers' manipulation of earnings through real transactions.

5.2.2. Accounting comparability

Comparability of financial statements is an important attribute of accounting information that helps users to identify and understand relevant items, that is, comparability makes the same items look similar and different items look different. De Franco et al. (2011) finds

Table 13. Other perspectives on accounting quality.

	(1) <i>RM</i>	(2) <i>RM</i>	(3) <i>COMPACC</i>	(4) <i>COMPACC</i>
<i>DIGI_DUM</i> _{<i>t-1</i>}	-0.009** (-2.344)		0.0001** (2.308)	
<i>DIGI_WORD</i> _{<i>t-1</i>}		-0.009*** (-3.737)		0.0001*** (3.327)
<i>CONTROLS</i>	YES	YES	YES	YES
<i>INDUSTRY</i>	YES	YES	YES	YES
<i>YEAR</i>	YES	YES	YES	YES
<i>N</i>	14,003	14,003	12,057	12,057
<i>adj. R</i> ²	0.115	0.116	0.337	0.338

Table 14. Digital transformation and share price synchronisation.

	(1) SYN	(2) SYN
<i>DIGI_DUM</i> _{<i>t-1</i>}	-0.032** (-1.967)	
<i>DIGI_WORD</i> _{<i>t-1</i>}		-0.026*** (-2.696)
<i>CONTROLS</i>	YES	YES
<i>INDUSTRY</i>	YES	YES
<i>YEAR</i>	YES	YES
<i>N</i>	15,591	15,591
<i>adj. R</i> ²	0.199	0.199

that the comparability of financial statements can improve analysts' consensus expectations and increase the accuracy of their earnings forecasts. This shows that the comparability of financial statements provides more high accounting quality for external users such as analysts, thereby improving the information environment of firms.

According to the research methods of De Franco et al. (2011), C. Y. Xu and Liu (2014), and Tang et al. (2019), the accounting comparability financial statements between firms in the same industry is calculated, and then the calculated comparability is ranked from the largest to the smallest, and the average of the top 4 values is taken as the *COMPACC* of firm. The larger the *COMPACC* value is, the higher the comparability of financial statements.

The regression results reported in As shown in columns (3) and (4) of Table 13. The coefficients of *DIGI_DUM* and *DIGI_WORD* are both significantly positive at the 1% level when the dependent variable is comparability of financial statements (*COMPACC*). It shows that the Digital Transformation of firms also contributing to the improvement of the accounting comparability between firms in a industry.

5.3. Share price synchronisation

The accounting quality is an important factor affecting stock price synchronisation. As the accounting quality of firm improves, the information asymmetry problem is alleviated, which means that more heterogeneous information of firms can be transmitted to the capital market through earning information (Hutton et al., 2009; Jin & Myers, 2006), thereby reducing the noise in the capital market, the stock price can better reflect the intrinsic value, and the synchronisation of stock prices will also be reduced. According to Durnev et al. (2003) and Roll (1988), we measure the stock price synchronisation (*SYN*). A higher value of *SYN* indicates that the synchronisation of share price is higher and the heterogeneous information of firm's share price is less.

We report the regression results in columns (1) and (2) of Table 14. The coefficients of *DIGI_DUM* and *DIGI_WORD* are both significantly negative at the 1% level when the dependent variable is *SYN*. It indicates that while the Digital Transformation of firms promotes the accounting quality disclosed to the public, investors in the market are more able to receive more heterogeneous information about firms, reducing management's incentive to hide private information, which in turn reduces share price synchronisation and improves the information efficiency of the capital market.

6. Conclusions

Based on specific set of data, we research on whether traditional firm's digital transformation can improve accounting quality and realising governance effect.

We firstly found that firms proceeding more digital transformation have lower degree of earnings management and higher degree of accounting qualities. Secondly, digital transformation can improve accounting quality by reducing three types of agency costs. Specifically, digital transformation can improve corporate internal control, as well as attract more analyst tracking, to improve accounting qualities. Additional analysis suggests that, the governance effects of corporate digital transformation are more prevails in non-state firms, or weak information quality firms, as well as in long-term oriented firms. Corporate digital transformation can decrease real earnings management and stock price synchrony, increase accounting quality, reveals a positive governance effect.

In addition to its theoretical significance, this paper also has important policy implications. First, it provides a reference for why firms in traditional industries should make full use of digital technologies under the fast-growing digital economy. The theoretical analysis and empirical tests in this paper provide evidence that the Digital Transformation has an effect on the information quality and corporate governance, reducing agency costs, improving internal control, and attracting more analysts' tracking, so as to build an effective trust mechanism between firms and the external market. At the same time, we provide a reference for external market stakeholders to properly evaluate digital transformed companies. Stakeholders in the external market, such as creditors, shareholders, and regulators, should make a more objective and positive assessment of companies that have implemented the digital technology transformation.

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References

- Baron, R.M., & Kenny, D.A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, 51(6), 1173–1182. <https://doi.org/10.1037/0022-3514.51.6.1173>
- Brynjolfsson, E., Hui, X., & Liu, M. (2019). Does machine translation affect international trade? Evidence from a large digital platform. *Management Science*, 65(12), 5449–5460. <https://doi.org/10.1287/mnsc.2019.3388>

- Cahill, D., Baur, D.G., & Liu, Z.F. (2020). I am a blockchain too: How does the market respond to companies' interest in blockchain? *Journal of Banking & Finance*, 113(C), 105740. <https://doi.org/10.1016/j.jbankfin.2020.105740>
- Chen, H., Chen, J.G., Lobo, L., & Wang, Y. (2011). Effects of audit quality on earnings management and cost of equity capital: Evidence from China. *Contemporary Accounting Research*, 28(3), 892–925. <https://doi.org/10.1111/j.1911-3846.2011.01088.x>
- Cheng, S.F., De Franco, G., & Jiang, H. (2019). Riding the blockchain mania: Public firms' speculative 8-K disclosures. *Management Science*, 65(12), 5901–5913. <https://doi.org/10.1287/mnsc.2019.3357>
- Cheng, C.S.A., Wang, J., & Wei, S.X. (2015). State ownership and earnings management around initial public offerings: Evidence from China. *Journal of International Accounting Research*, 14(2), 89–116. <https://doi.org/10.2308/jiar-51193>
- Chen, T., Haford, J., & Lin, C. (2015). Do analysts matter for governance? Evidence from natural experiments. *Journal Financial Economics*, 115(2), 383–410. <https://doi.org/10.1016/j.jfineco.2014.10.002>
- Chen, Y.B., Lin, C., & Chen, X.L. (2019). Artificial intelligence, aging and economic growth. *Economic Research Journal*, 127(1), 47–63. (In Chinese). <https://doi.org/10.1007/s00712-018-0623-3>
- Chen, W., & Srinivasan, S. (2020). *Going digital: Implications for firm value and performance* [Unpublished manuscript]. Harvard Business School.
- Chen, D.M., Wang, L.Z., & Chen, A.N. (2020). Digitalization and strategic management theory: Review, challenges and prospects. *Management World*, 5, 220–236. (In Chinese). <https://doi.org/10.3969/j.issn.1002-5502.2020.05.016>
- Chen, J., & Xu, H.J. (2019). How does enterprise rent-seeking affect earnings management. *China Industrial Economics*, 12, 171–188. (In Chinese). <https://doi.org/10.19581/j.cnki.ciejournal.2019.12.010>
- Chen, G.Q., Zeng, D.J., Wei, Q., & Zhang, M.Y. (2020). Transitions of decision-making paradigms and enabled innovations in the context of big data. *Management World*, 2, 95–105. (In Chinese). <https://doi.org/10.3969/j.issn.1002-5502.2020.02.009>
- Chod, J., Trichakis, N., & Tsoukalas, G. (2020). On the financing benefits of supply chain transparency and blockchain adoption. *Management Science*, 66(10), 4378–4396. <https://doi.org/10.1287/mnsc.2019.3434>
- Dechow, P.M., & Dichev, I.D. (2002). The quality of accruals and earnings: The role of accrual estimation errors. *The Accounting Review*, 77(Suppl), 35–59. <https://doi.org/10.2308/accr.2002.77.s-1.35>
- Dechow, P.M., Ge, W., Larson, C.R., & Sloan, R.G. (2011). Predicting material accounting misstatements. *Contemporary Accounting Research*, 28(1), 17–82. <https://doi.org/10.1111/j.1911-3846.2010.01041.x>
- Dechow, P.M., Sloan, R.G., & Sweeney, A.P. (1995). Detecting earnings management. *The Accounting Review*, 70(2), 193–225. <http://links.jstor.org/sici?sici=0001-4826%28199504%2970%3A2%3C193%3ADEM%3E2.0.CO%3B2-Y>
- De Franco, G., Kothari, S.P., & Verdi, R.S. (2011). The benefits of financial statement comparability. *Journal of Accounting Research*, 49(4), 895–931. <https://doi.org/10.1111/j.1475-679X.2011.00415.x>
- Dong, W., & Chen, H.W. (2011). Internal control, accruals quality and earnings response empirical evidence of Chinese A-share listed companies in 2009. *Audit Research*, 4, 68–78. (In Chinese). <https://sjyz.chinajournal.net.cn/WKC/WebPublication/paperDigest.aspx?paperID=2918E55C-C659-4337-85A1-693EDF883C1C>
- Doupnik, T.S., & Tsakumis, G.T. (2004). A critical review of tests of Gray's theory of cultural relevance and suggestions for future research. *Journal of Accounting Literature*, 23, 1–48. https://scholar.google.com/scholar_lookup?hl=zh-CN&volume=23&publication_year=2004&pages=1-48&author=T.+S.+Doupnik&author=G.+T.+Tsakumis&title=A+Critical+Review+of+Tests+of+Gray%27s+Theory+of+Cultural+Relevance+and+Suggestions+for+Future+Research#d=gs_qabs&t=1669636297736&u=%23p%3D-bxs3VqPkwEJ
- Du, X. (2015). Does Confucianism reduce minority shareholder expropriation? Evidence from China. *Journal of Business Ethics*, 132(4), 661–716. <https://doi.org/10.1007/s10551-014-2325-2>

- Durnev, A., Morck, R., & Zarowin, Y.P. (2003). Does greater firm-specific return variation mean more or less informed stock pricing? *Journal of Accounting Research*, 41(5), 797–836. <https://doi.org/10.1046/j.1475-679X.2003.00124.x>
- Fan, J.P.H., & Wong, T.J. (2002). Corporate ownership structure and the informativeness of accounting earnings in East Asia. *Journal of Accounting and Economics*, 33(3), 401–425. [https://doi.org/10.1016/S0165-4101\(02\)00047-2](https://doi.org/10.1016/S0165-4101(02)00047-2)
- Gong, Q., Ban, M.Y., & Zhang, Y.L. (2021). Blockchain, enterprise digitalization and supply chain finance innovation. *Management World*, (2), 22–34. (In Chinese). <https://doi.org/10.3969/j.issn.1002-5502.2021.02.004>
- Gu, F.L., & Shen, H.H. (2019). Review of the academic meeting held by accounting society of China. *Accounting Research*, 10, 93–94. (In Chinese). <https://doi.org/10.3969/j.issn.1003-2886.2019.10.014>
- Hong, Y., Huseynov, F., & Zhang, W. (2014). Earnings management and analyst following: A simultaneous equations analysis. *Financial Management*, 43(2), 355–390. <https://doi.org/10.1111/fima.12043>
- Huang, Y.P., & Huang, Z. (2018). The development of digital finance in China: Present and future. *China Economic Quarterly*, 4, 1489–1502. (In Chinese).
- Huang, Q.H., Yu, Y.Z., & Zhang, S.L. (2019). Internet development and productivity growth in manufacturing industry: Internal mechanism and China experiences. *China Industrial Economics*, 8, 5–23. (In Chinese). <https://doi.org/10.19581/j.cnki.ciejournal.2019.08.001>
- Hutton, A.P., Marcus, A.J., & Tehrani, H. (2009). Opaque financial report, R², and crash risk. *Journal of Financial Economics*, 94(1), 67–86. <https://doi.org/10.1016/j.jfineco.2008.10.003>
- Jame, S.A., Rebel, A.C., & Lin, J.W. (2000). Agency costs and ownership structure. *Journal of Finance*, 55(1), 81–106. <https://doi.org/10.1111/0022-1082.00201>
- Jensen, M.C., & Meckling, W.H. (1976). Theory of the firm: Managerial behavior, agency cost and ownership structure. *Journal of Financial Economics*, 3(4), 5–50. [https://doi.org/10.1016/0304-405X\(76\)90026-X](https://doi.org/10.1016/0304-405X(76)90026-X)
- Jiang, G., Lee, C.M.C., & Yue, H. (2010). Tunneling through intercorporate loans: The China experience. *Journal of Financial Economics*, 98(1), 1–20. <https://doi.org/10.1016/j.jfineco.2010.05.002>
- Jin, L., & Myers, C.S. (2006). R² around the world: New theory and new tests. *Journal of Financial Economics*, 79(2), 257–292. <https://doi.org/10.1016/j.jfineco.2004.11.003>
- Jones, K., Krishnan, G.V., & Melendrez, K.D. (2008). Do models of discretionary accruals detect actual cases of fraudulent and restated earnings? An empirical analysis. *Contemporary Accounting Research*, 25(2), 499–531. <https://doi.org/10.1506/car.25.2.8>
- Kothari, S., Leone, A., & Wasley, C. (2005). Performance matched discretionary accrual measures. *Journal of Accounting and Economics*, 39(1), 163–197. <https://doi.org/10.1016/j.jacc.2004.11.002>
- La Porta, R., Lopez-de-Silanes, F., Shleifer, A., & Vishny, R.W. (1998). Law and finance. *Journal of Political Economy*, 106(6), 1113–1155. <https://doi.org/10.1086/250042>
- Lee, E., Walker, M., & Zeng, C. (2014). Do Chinese government subsidies affect firm value? *Accounting, Organization and Society*, 39(3), 149–169. <https://doi.org/10.1016/j.aos.2014.02.002>
- Li, T., Li, Q., & Chen, C.X. (2020). The effect of data management ability on firm productivity—new evidence from China employer-employee survey. *China Industrial Economics*, 6, 174–192. (In Chinese). <https://doi.org/10.19581/j.cnki.ciejournal.2020.06.010>
- Liu, Y.C., Sun, J.S., Jiang, Y.C., Chen, X.Y., & Liu, C.L. (2020). 4C model: Value discovery in big data. *Management World*, 2, 129–138. (In Chinese). <https://doi.org/10.19744/j.cnki.11-1235/f.2020.0026>
- Lu, T., & Dang, Y. (2014). Corporate governance and innovation: Differences among industry categories. *Economic Research Journal*, 6, 115–128. (In Chinese). <https://kns-cnki-net-s.fzu.edu.cn/KCMS/detail/detail.aspx?dbname=cjfd2014&filename=jyj201406009&dbcode=cjfq>
- McKinsey & Company. (2017). How does China's digital economy lead the new global trend. *Research Report*.

- Pan, H.B., & Yu, M.G. (2014). Intra-group transactions, executive compensation, and capital allocation efficiency. *Accounting Research*, 10, 20–27. (In Chinese). <https://kns-cnki-net-s.fzu.edu.cn/KCMS/detail/detail.aspx?dbname=cjfd2014&filename=kjyj201410003&dbcode=cjfq>
- Qi, B.L., Tian, G.L., & Li, L.C. (2010). Internal control deficiencies of listed companies and quality of financial information. *Journal of Management Science*, 4, 38–47. (In Chinese). <https://kns-cnki-net-s.fzu.edu.cn/KCMS/detail/detail.aspx?dbname=cjfd2010&filename=jcjj201004005&dbcode=cjfq>
- Qi, I.D., & Xiao, X. (2020). Transformation of enterprise management in the era of digital economy. *Management World*, 6, 135–152. (In Chinese). <https://doi.org/10.19744/j.cnki.11-1235/f.2020.0091>
- Richardson, S.A., Sloan, R.G., Soliman, M.T., & Tuna, I. (2005). Accrual reliability, earnings persistence and stock prices. *Journal of Accounting and Economics*, 39(3), 437–485. <https://doi.org/10.1016/j.jacceco.2005.04.005>
- Roll, R. (1988). R^2 . *The Journal of Finance*, 43(7), 541–566. <https://doi.org/10.1111/j.1540-6261.1988.tb04591.x>
- Roychowdhury, S. (2006). Earnings management through real activities manipulation. *Journal of Accounting and Economics*, 42(3), 335–370. <https://doi.org/10.1016/j.jacceco.2006.01.002>
- Shen, G.B., & Yuan, Z.Y. (2020). The effect of enterprise internetization on the innovation and export of Chinese enterprises. *Economic Research Journal*, 1, 33–48. (In Chinese). <https://kns-cnki-net-s.fzu.edu.cn/KCMS/detail/detail.aspx?dbname=cjfd2020&filename=jijj202001004&dbcode=cjfq>
- Shleifer, A., & Vishny, R.W. (1986). Large shareholders and corporate control. *Journal of Political Economy*, 94(3), 461–488. <https://doi.org/10.1086/261385>
- Sobel, M.E. (1982). Asymptotic confidence intervals of indirect effects in structural equation models. *Sociological Methodology*, 13, 290–312. <https://doi.org/10.2307/270723>
- Sun, X.B., Qian, Y., Zhang, M.C., & Li, J.Z. (2019). A study on the implementation mechanism of enterprise supply chain agility driven by big data. *Management World*, 9, 133–151. (In Chinese). <https://doi.org/10.19744/j.cnki.11-1235/f.2019.0123>
- Tang, X.S., Jiang, X.Y., & Lei, X. (2019). Financial statement comparability and executive compensation contracting efficiency. *Accounting Research*, 1, 37–44. (In Chinese). <https://doi.org/10.3969/j.issn.1003-2886.2019.01.006>
- Tong, Y., & Wang, H.C. (2007). Related party transactions, benefits of control and earnings quality. *Accounting Research*, 4, 75–82. (In Chinese). <https://kns-cnki-net-s.fzu.edu.cn/KCMS/detail/detail.aspx?dbname=cjfd2007&filename=kjyj200704010&dbcode=cjfq>
- Wang, J., Peng, B., Xiong, Y.R., Zhang, P., & Zhang, J. (2015). The effectiveness of internal control and financial information quality—introduction of western internal control research and prospect under the institutional background of China (I). *Accounting Research*, 6, 87–95. (In Chinese). <https://kns-cnki-net-s.fzu.edu.cn/KCMS/detail/detail.aspx?dbname=cjfd2015&filename=kjyj201506012&dbcode=cjfq>
- Watts, R., & Zimmerman, J. (1986). *Positive accounting theory*. prentice Hall.
- Wen, Z.L., & Ye, B.J. (2014). Analyses of mediating effects: The development of methods and models. *Advances in Psychological Science*, 22(5), 731–745. (In Chinese). <https://doi.org/10.3724/SP.J.1042.2014.00731>
- Wen, Z.L., Zhang, L., Hou, J.T., & Liu, H.Y. (2004). Mediation effect test procedure and its application. *Acta Psychologica Sinica*, 5, 614–620. (In Chinese). <https://doi.org/10.3724/SP.J.1042.2014.00731>
- Wu, L., Hitt, L., & Lou, B. (2020). Data analytics, innovation, and firm productivity. *Management Science*, 66(5), 2017–2039. <https://doi.org/10.1287/mnsc.2018.3281>
- Xie, X.Y., Zuo, Y.H., & Hu, Q.J. (2021). Human resources management in the digital era: A human-technology interaction lens. *Management World*, 1, 200–216. (In Chinese). <https://doi.org/10.19744/j.cnki.11-1235/f.2021.0013>
- Xu, C.Y., & Liu, R.Z. (2014). Can accounting comparability reduce earnings management? *Accounting Research*, 7, 50–57. (In Chinese). <https://kns-cnki-net-s.fzu.edu.cn/KCMS/detail/detail.aspx?dbname=cjfd2014&filename=kjyj201407007&dbcode=cjfq>
- Xu, P., & Xu, X.Y. (2020). Change logic and analysis framework of enterprise management in the era of artificial intelligence. *Management World*, 1, 122–129. (In Chinese). <https://doi.org/10.19744/j.cnki.11-1235/f.2020.0010>

- Yang, D.M., & Bi, J.Q. (2019). "Internet plus", entrepreneurs' external investment and corporate valuation. *China Industrial Economics*, 6, 136–153. (In Chinese). <https://doi.org/10.19581/j.cnki.ciejournal.2019.06.008>
- Yang, D.M., & Liu, Y.W. (2018). Why can internet plus increase performance. *China Industrial Economy*, 5, 80–98. (In Chinese). <https://doi.org/10.19581/j.cnki.ciejournal.2018.05.005>
- Yermack, D. (2017). Corporate governance and blockchains. *Review of Finance*, 21(1), 7–31. <https://doi.org/10.1093/rof/rfw074>
- Yuan, C., Xiao, S.S., & Geng, C.X. (2021). Digital transformation and division of labor between enterprises: Vertical specialization or vertical integration. *China Industrial Economics*, 9, 137–155. (In Chinese). <https://doi.org/10.19581/j.cnki.ciejournal.2021.09.007>
- Zeng, X.Y., & Xu, X.N. (2020). Review of the academic meeting held by accounting society of China. *Accounting Research*, 2, 191–193. (In Chinese). <https://doi.org/10.3969/j.issn.1003-2886.2020.02.015>
- Zhang, X., Yang, T., Wang, C., & Wan, G.H. (2020). Digital finance and household consumption: Theory and evidence from China. *Management World*, 11, 48–63. (In Chinese). <https://doi.org/10.19744/j.cnki.11-1235/f.2020.0168>
- Zhao, C., Chen, S.H., & Cao, W. (2020). "Internet plus" Information disclosure: Substantive statement or strategic manipulation——Evidence based on the risk of stock price crash. *China Industrial Economics*, 3, 174–192. (In Chinese). <https://doi.org/10.19581/j.cnki.ciejournal.2020.03.020>
- Zhou, C.S., & Chen, J. (2006). Controlling shareholder's embezzlement of listed company's funds and earning management. *Finance and Trade Research*, 3, 128–135. (In Chinese). <https://doi.org/10.19337/j.cnki.34-1093/f.2006.03.022>
- Zhu, C. (2019). Big data as a governance mechanism. *The Review of Financial Studies*, 32(5), 2021–2061. <https://doi.org/10.1093/rfs/hhy081>