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The effect of enterprise digital transformation on audit efficiency—Evidence from China

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ABSTRACT

The digital transformation of enterprises is the key to conforming to the trends of the times and realizing reform and innovation. Digital transformation will change the enterprise risk and information environment, and also bring challenges to the audit business. This study takes China's Shanghai and Shenzhen A-share listed companies from 2011 to 2021 as a sample, starting from the perspective of audit delay, and empirically tests the impact of enterprise digital transformation on audit efficiency. The results of the study found that the higher the degree of enterprise digital transformation, the more serious the audit delay and the lower the audit efficiency. Further research found that in non-high-tech enterprises and when audited by non-international "Big 4" and accounting firms without digital expertise, the effect of enterprise digital transformation on reducing audit efficiency is more obvious. This study expands the research field of enterprise digital transformation and auditing and provides empirical evidence for improving auditing efficiency.

1. Introduction

In recent years, the digital economy has developed rapidly and continuously integrated with the real economy, becoming a new driving force for global economic growth. International Data Corporation (IDC) predicts that global investment in digital transformation will grow at a compound rate of 17.1 % per year, with investments expected to reach $2.3 trillion in 2023. According to the survey, as of the end of 2022, the scale of China's digital economy has reached RMB 50.2 trillion, a nominal increase of 11.3 % year-on-year, accounting for 41.5 % of the total GDP.[1] Under the wave of the digital economy, most companies choose to actively influx, and some companies say they "will not transfer", "don't want to transfer" or "don't dare to transfer" because of their weak capabilities, high transformation costs, and long "painful period" of transformation (Liu et al., 2021). Accenture pointed out in the "2022 China Enterprise Digital Transformation Index" that only 17 % of Chinese enterprises have achieved significant results in digital transformation.[2] This indicates that most Chinese enterprises are still in the early stages of digital transformation, and the value brought by the transformation has not yet been fully reflected. Scholars at home and abroad have also done a lot of research on the impact of enterprise digital transformation, but the current research has not reached a consistent conclusion about whether digital transformation brings more positive or negative impacts to enterprises. Some scholars believe that digital transformation improves the accuracy and accessibility of enterprise financial data (Warren Jr et al., 2015), and enhances enterprise performance and value; Some scholars also believe that digital transformation makes enterprise business more complex, increases the uncertainty of enterprise recognition, measurement and reporting (Appelbaum et al., 2017), and brings more risks and challenges. Therefore, exploring how digital transformation will affect enterprises and their stakeholders is crucial to promoting the sustainable and healthy development of the digital economy.

From the perspective of auditing, the role of auditors is to disclose the reliability and fairness of accounting information to all stakeholders. The deepening of the digital transformation of enterprises has also brought a certain impact on the audit environment. In this era of pursuing speed and efficiency, whether auditors can adapt to changes in the environment and audit massive amounts of information more accurately and efficiently is a question worthy of our attention. During the audit

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[1] The data comes from the 2023 "*China Digital Economy Development Report*" white paper of China Academy of Information and Communications Technology. http://www.caict.ac.cn/kxyj/qwfb/bps/.

[2] Accenture. "*2022 China Enterprise Digital Transformation Index*" https://www.accenture.com/cn-zh/insights/strategy/china-digital-transformation-index-2022.

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process, auditors should not only collect enough evidence to satisfy the validity of the audit but also control costs as much as possible. Audit efficiency plays a vital role in the process of enterprises providing timely and reliable financial information to stakeholders. Therefore, this study explores the impact of enterprise digital transformation on audit efficiency to enrich relevant audit research. Existing studies mostly use audit delay as a measure of audit efficiency (Bamber et al., 1993). Audit delay refers to the number of days from the end of the accounting period to the date of the audit report, which can reflect the time spent on auditing and the timeliness of financial reports to a certain extent. It is a rare external variable that can be observed and obtained to measure audit efficiency (Tanyi et al., 2010).

China is in the booming period of the digital economy, and various enterprises are gradually implementing digital transformation, which provides data support for exploring the impact and consequences of enterprise digital transformation. Therefore, this study selects the data of China's listed companies from 2011 to 2021, uses audit delay as the measurement variable of audit efficiency, and empirically tests the impact of enterprises' digital transformation on audit efficiency. Furthermore, this study takes high-tech enterprises as the representatives of enterprises with high digital degrees, and the international "Big 4" and accounting firms with digital expertise as the representatives of high professional competence to analyze and verify their heterogeneous role in the impact of enterprise digital transformation on audit efficiency. The results show that enterprise digital transformation will increase audit delay and reduce audit efficiency, and this effect is more significant in non-high-tech enterprises, non-Big 4 accounting firms, and accounting firms without digital expertise.

The contributions of this study may be as follows. Firstly, it expands the research on the economic consequences of enterprise digital transformation, the existing research on enterprise digital transformation and auditing mainly focuses on the aspects of audit quality, audit fees, and audit risk, while this study explores another economic consequence of enterprise digital transformation on audit efficiency based on the perspective of audit delay. Secondly, it enriches the relevant literature on the factors affecting audit efficiency. In the context of the era of the digital economy, the audit environment will also undergo new changes, and analyzing how the digital transformation of enterprises will affect audit efficiency is of practical significance. Thirdly, this study analyses the mechanism by which the digital transformation of enterprises affects audit efficiency and further examines the heterogeneous effects of high-tech enterprises and accounting firm competence, which provides empirical evidence on how to achieve higher audit efficiency in the future.

The remainder of this study is structured as follows. Section 2 presents a literature review related to digital transformation and auditing. Section 3 presents the research hypotheses through theoretical analysis. Section 4 details the sample data and research methodology. Section 5 reports the empirical results and robustness tests. Section 6 provides further investigations. Section 7 concludes the study.

2. Literature review

2.1. Research on enterprise digital transformation

2.1.1. The concept of enterprise digital transformation

Enterprise digital transformation is the process of bringing about comprehensive changes by utilizing digital technology to deeply integrate with enterprises. Due to the different focuses, different scholars describe the concept of enterprise digital transformation differently, which is mainly divided into four perspectives: product and business (Wu et al., 2021), business model (Akter et al., 2022), organizational structure (Nambisan et al., 2017), and enterprise strategy (Warner and Wäger, 2019) (as shown in Fig. 1). In a summary, enterprise digital

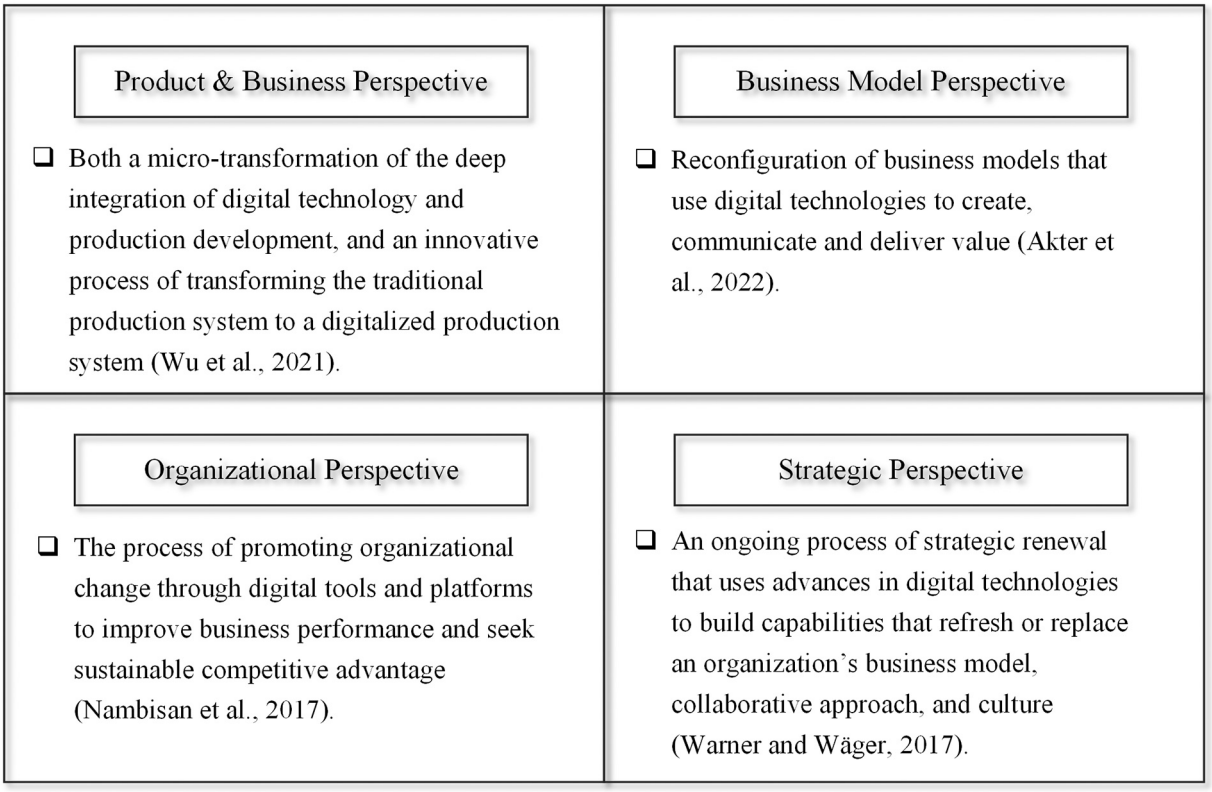

Fig. 1. Different perspectives on enterprise digital transformation definitions.

transformation can be defined as the process of using digital technology to improve product production and business processes, promote organizational change, and create new business models to enhance enterprise value and form core competitiveness under the premise of conforming to the strategic development plan of the enterprise.

2.1.2. Impact of enterprise digital transformation

The promotion of digital management and transformation of enterprises requires capital investment and time accumulation and requires enterprises to make correct digital transformation path choices based on their scale, advantages, and industry attributes (Liu et al., 2021). Different people have different views on the impact of digitalization on enterprises.

On the one hand, the digital transformation of enterprises has a positive impact on enterprises. The rise of digital technologies has provided new opportunities for entrepreneurs to realize innovations (Nambisan et al., 2019). Digital transformation can improve the performance of new product development by affecting the innovation capability of enterprises (Chi et al., 2020) and enhancing enterprise value (Dai et al., 2023). Specifically, digital transformation has a positive impact on enterprise profitability, internal control quality, return on investment, and sales growth, and can promote enterprise service transformation (Zhao, 2021) and effectively improve enterprise performance. Studies have shown that companies can use machine learning and a large amount of detailed financial information to predict future earnings more effectively (Chen et al., 2022), and "robot analysts" can also provide investors with better portfolio advice than "human analysts" (Coleman et al., 2022). Some people also believe that with the continuous strengthening of the digitalization of enterprises, the probability of making mistakes will also be reduced, thereby improving the operating efficiency of enterprises. At the same time, it is also very important to allow customers to participate in the production of enterprises. Only by exerting efforts from the demand side can it be beneficial to maximize the value of enterprises in the digital economy (Qi and Xiao, 2020).

On the other hand, digital transformation also brings some new challenges to enterprises. The study found that there is a nonlinear relationship between enterprise digital investment and efficiency, which shows a downward trend in the early stage, rises after the inflection point, and presents an inverted "U"-shaped relationship (Liu et al., 2021). This shows that it is often difficult in the early stage of digital transformation for enterprises. Digital transformation not only increases business complexity caused by digital technology but also requires managers to think and reorganize the entire business of the organization, which will lead to organizational changes and generate new business models (Piccinini et al., 2015). At the same time, the accounting profession needs to be vigilant about the development and use of digital technology, so that technology can be correctly and effectively applied to enterprise organization management (Moll and Yigitbasioglu, 2019). The rise of the digital economy has intensified market competition. If enterprises want to gain a foothold in the new wave, they must make correct strategic choices and form their own stronger core competitive advantages to follow the trend of the digital economy.

2.2. Influencing factors of auditing efficiency

Audit efficiency refers to the time required to complete a given audit workload (Zeng et al., 2018), which is mostly measured by audit delay, and its influencing factors can be divided into enterprise internal factors and enterprise external factors.

Internal factors. Internal factors affecting audit delay mainly include enterprise performance, internal control quality, enterprise size, financial risk, internal audit, and so on. When an enterprise discloses good news or an enterprise with better performance discloses, the date is often earlier, that is, the audit delay is shorter (Wu et al., 2006). Most scholars have found that the higher the quality of internal control, the smaller the audit delay and the higher the audit efficiency (Li et al., 2015; Munsif et al., 2012). With high-quality internal controls, auditors can shorten audit time by avoiding excessive substantive procedures. Larger firms generally have better internal control status and thus reduce audit delays (Bonsón-Ponte et al., 2008). Some scholars have also focused on family businesses and found that equity incentives in listed companies will reduce audit delays (Ghosh and Tang, 2015; Li et al., 2021). When the controlling shareholder implements an equity pledge, the audit risk will increase. To reduce the risk, auditors often choose to increase audit investment, thereby increasing audit delay (Ren and Zhang, 2018). The outsourced internal audit function (IAF) provider also has an impact on audit efficiency, and the audit efficiency is significantly improved when the IAF provider comes from a Big4 audit firm (Baatwah et al., 2019). Internal audit assistance can improve audit efficiency by saving audit costs (Abbott et al., 2012). In addition, a research survey found that, under the assurance of the audit quality level of the enterprise sample, the comparability of financial statements is negatively correlated with the audit time (Kang et al., 2015). Murthy et al. (2023) found that client accounting system homogeneity (i.e., a large number of clients using related accounting systems) was directly related to audit efficiency.

External factors. First, at the level of accounting firms, enterprise midterm audits (Li et al., 2016) will reduce audit delay, and the structure and functions of the audit team also affect audit quality and audit efficiency to a certain extent (Cameran et al., 2018). Audit teams led by women tend to be more productive when faced with more complex tasks (Bustos-Contell et al., 2022). Risk assessment plays an important role in audit work. The accuracy of auditors in risk assessment not only affects the quality of financial reports but also affects audit effectiveness and efficiency. Second, effective information communication can improve audit efficiency. Zheng et al. (2022) pointed out that effective communication between predecessors and predecessors can improve audit efficiency. Usually, in the same product market, audit partner sharing enables knowledge dissemination among different audit operations, which can improve audit efficiency (Kang et al., 2022). Third, external environmental factors such as the media, systems, and emergencies will also have an impact on audit efficiency. In this information age, the media plays an important role as a link between listed companies and stakeholders. Some studies have pointed out that negative media evaluations positively affect audit pricing, but have no significant relationship with audit delays, indicating that auditors avoid the risks of more negative evaluations by charging risk premiums, rather than increasing audit investment (Liu et al., 2017). In terms of systems, the improvement of the delisting system can improve the internal control level of enterprises and reduce audit risks, thereby reducing audit delays (Yu et al., 2019). In addition, the occurrence of unexpected events often increases audit delays. For example, the distance issue brought about by the COVID-19 outbreak has generally increased audit delays for listed companies (Caligiuri et al., 2020).

2.3. Impact of digital transformation on external audit

Existing research on the impact of digital transformation of enterprises on external auditing mainly focuses on the aspects of audit quality, audit fees, and audit risks. In addition, the digital transformation of accounting firms also exists and has a certain impact on external auditing.

2.3.1. Impact of enterprise digital transformation on external audit

First, in terms of digitalization and audit quality research, Zhai and Li (2022) adopted a multi-time point double difference model. After

empirical research, they found that the digital transformation of enterprises can improve information transparency and reduce enterprise risks, thereby improving audit quality. Rahman and Ziru's (2022) empirical study similarly found that the more digitized a firm is the higher the quality of audits, in addition to the fact that audit quality is higher if the accounting firm is more sophisticated in terms of IT expertise.

Second, in terms of enterprise digital transformation and audit fees, some studies found that the higher the degree of enterprise digital transformation, the lower the audit fees (Zhang et al., 2021), while the other part of the studies got the opposite conclusion, which is justified by the fact that enterprise informatization construction or digital transformation raises the audit costs and audit risks (Wu et al., 2022; Zhong et al., 2022). Third, in terms of enterprise digital transformation and audit risk, Ling et al. (2022) and Zou et al. (2022) both found that enterprise digital transformation can help reduce audit risk from the aspects of optimizing enterprise internal control and improving the quality of information disclosure.

2.3.2. *Impact of accounting firm digital transformation on external audit*

With the development and application of digital technologies, the concept of auditing, auditor-client relationship, audit firm structure, procedures, and the audit profession may change, but new technologies will not replace auditors in a short time (Tiberius and Hirth, 2019). Through a case study of accounting firms, it is found that digital empowerment of accounting firms promotes the intelligentization of audit work processes in terms of big data mining technology, the application of intelligent annual report analysis systems, and the construction of electronic confirmation centers, thereby reducing audit risks (Xu et al., 2022). The higher the degree of information construction of accounting firms, the higher the audit efficiency (Zeng et al., 2018). Digital transformation will help IT audit to play its role more actively, thereby promoting better development of the organization (Aditya et al., 2018). Through interviews with audit partners and empirical research, Fedyk et al. (2022) found that the investment and use of artificial intelligence technology by accounting firms will improve audit quality and audit efficiency, but the improvement of audit efficiency may take many years to take effect.

Existing studies have mainly found that enterprise digital transformation can improve audit quality and reduce audit risks, but there are still controversies on the impact of enterprise digital transformation on audit fees. In addition, no study has clarified the mechanism and effect of enterprise digital transformation on external audit efficiency. Based on the research of existing scholars, this study constructs the theoretical mechanism and model of enterprise digital transformation affecting the external auditing efficiency from the aspects of information transparency (Warren Jr et al., 2015; Yang et al., 2020; Appelbaum et al., 2017), enterprise risk (Nambisan et al., 2019; Han et al., 2023; Chen and Srinivasan, 2023), and auditing methods and procedures (Brown-Liburd et al., 2015; Salijeni et al., 2021; Manita et al., 2020).

3. Research hypothesis

Big data, blockchain, artificial intelligence, and cloud computing are commonly used technologies by enterprises in digital transformation (Moll and Yigitbasioglu, 2019; Akter et al., 2022). Combining the application of these digital technologies, this study analyzes the mechanism of the impact of enterprise digital transformation on audit efficiency based on the audit workload and work difficulty.

Positive effect. Enterprise digital transformation may improve information transparency, reduce enterprise risks, and help auditors strengthen the reliability and intelligence of audit procedures, thus reducing the audit workload and work difficulty, and improving audit efficiency (See Fig. 2).

First, enterprise digital transformation can enhance information availability and diversity of data forms, improve enterprise information transparency, and promote audit efficiency. Enterprise digital transformation can improve information availability. Mature IT system layout is the foundation of enterprise digital transformation, and the application of IT systems (e.g., ERP) makes it easier for enterprises to obtain the information they need, which is conducive to strengthening the transfer of information and communication within and outside the enterprise (Bloom et al., 2014). The application of emerging technologies in the digital transformation process can enhance the breadth, reliability, and connectivity of data. Specifically, big data technology can provide enterprises with semi-structured data and unstructured data in addition to structured data, such as text, images, video, and audio, etc., which can effectively supplement traditional structured financial information and provide information users with more comprehensive data information (Warren Jr et al., 2015; Yang et al., 2020). The decentralized and immutable characteristics of blockchain can improve the transparency and auditability of transaction information (Yang et al., 2020; Akter et al., 2022). Cloud computing can provide data storage and processing services, integrate various information platforms within enterprises, and extend data to suppliers and customers to realize data integration of the whole industry chain and break information barriers (Moll and Yigitbasioglu, 2019). The above will improve the transparency of enterprise information, reduce the difficulty of auditors to obtain information, and improve audit efficiency.

Second, enterprise digital transformation helps enterprises reduce strategic, operational and fraud risks, thereby reducing audit risks and promoting audit efficiency. The digital transformation of enterprises is in line with the irreversible development trend of the digital economy and is favorable to enhancing the innovation capability of enterprises (Nambisan et al., 2019) so that they can maintain their competitive advantages and reduce strategic risks in the future. Appropriate investment in information and management technologies by enterprises through digital transformation facilitates the identification, assessment, and treatment of risks (Brennan et al., 2019), enhances internal control monitoring techniques, and reduces the likelihood of major deficiencies (Masli et al., 2010). For example, technologies such as big data, cloud computing, and artificial intelligence can provide a large amount of data information on specific objectives or behaviors, and by intelligently analyzing this information, abnormal risk points can be effectively identified (Han et al., 2023). All of this helps to improve the effectiveness of internal control of enterprises and reduce operational risks. Blockchain technology can increase the transparency and credibility of financial information, and AI's robotic process automation (RPA) can replace repetitive and highly standardized operations and reduce the scope for human manipulation, all of which can help improve the quality of financial reporting and reduce the risk of financial fraud (Wang and Han, 2023). Low enterprise risk usually means that the auditor is exposed to a lower risk of material misstatement and therefore does not need to increase the audit investment to reduce the audit risk, which to some extent reduces the auditor's workload and work difficulty (Bell et al., 2001) and improves the audit efficiency.

Third, the digital transformation of enterprises helps external auditors to enhance the reliability and intelligence of the audit process. In recent years, auditors have been experimenting with the application of intelligent audit tools. For example, big data analytics (BDA) tools help enable extensive data acquisition and processing (Salijeni et al., 2021), and data interfaces facilitate real-time auditing (Manita et al., 2020). Increased digitization of enterprises can provide auditors with multi-format and all-encompassing data (Warren Jr et al., 2015), enhancing the convenience and comprehensiveness of auditors' access to data, and providing auditors with the possibility of implementing more reliable and intelligent auditing tools. Intelligent and reliable audit procedures will improve audit efficiency by freeing auditors from simple and highly repetitive tasks to more critical procedures.

Therefore, the following hypothesis is proposed:

Hypothesis 1a. Enterprise digital transformation positively affects audit efficiency.

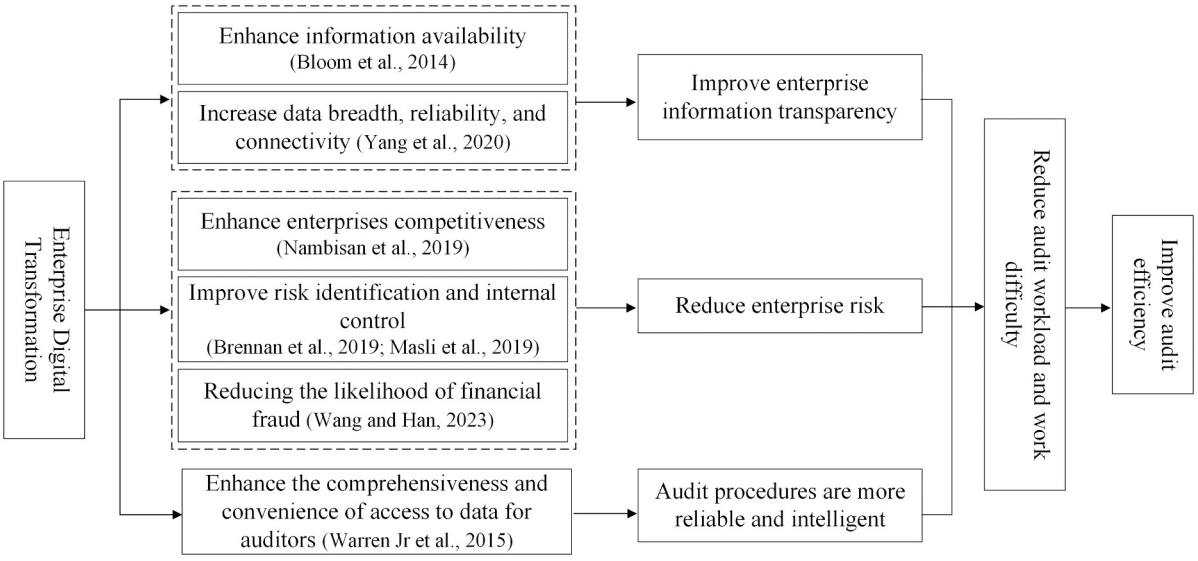

Fig. 2. The mechanism of enterprise digital transformation to improve audit efficiency.

Negative effect. Enterprise digital transformation may reduce information transparency, increase enterprise risks, and make the auditor's work more difficult, thus increasing audit workload and work difficulty and reducing audit efficiency (See Fig. 3).

First, enterprise digital transformation increases the complexity of systems, reduces information transparency, and leads to a decrease in audit efficiency. The digital transformation of enterprises needs to undergo organizational and strategic changes (Piccinini et al., 2015), which will increase the complexity of the enterprise's business and bring about larger personnel changes, resulting in an unstable information environment within the enterprise. Traditional recognition, measurement, and reporting may not be able to adapt to existing digitalized finances (Appelbaum et al., 2017). For example, whether and how newly generated data resources can be recognized, measured, and disclosed cannot be answered by traditional accounting standards for the time being. The use of data analytics also lacks specialized regulatory guidance (Austin et al., 2021). These bring new challenges to the work of accountants and affect the timeliness and reliability of accounting information. In addition, the underlying architectural features of blockchain technology are difficult to verify clearly, and the quality of data used to train models in artificial intelligence may be biased, etc. (Munoko et al., 2020), and all these ethical issues reduce the transparency of enterprise information, requiring auditors to spend more time and effort to collect more adequate and appropriate audit evidence, which reduces the efficiency of auditing.

Second, the digital transformation of enterprises has its strategic risks, and the digital transformation process increases the risk of operational uncertainty, as well as the increased risk of enterprises using high-tech means to commit fraud, which will increase audit risks and lead to a decrease in audit efficiency. In terms of strategic risk, enterprise digital transformation involves a full range of changes in technology, resources, human resources, and systems, which is inherently risky and uncertain. In addition, the current environment is complex and volatile, market competition, business environment, and customer demand have the possibility of drastic changes within a short period (Yang et al., 2020), if the enterprise fails to make the right strategic choices in the digital transformation, it will face a high strategic risk. Blockbuster and Kodak are typical examples of companies that have been eliminated by the times because they failed to make timely business model changes. In terms of operational risks, some enterprises blindly pursue digital transformation without considering their own positioning and development strategies, resulting in a lack of synergy between the original enterprise system and the application of advanced technologies, and a lack of adaptation of employees to new business processes (Chen and Srinivasan, 2023). For example, incompatible IT infrastructures and data architectures may hinder storing, analyzing, and obtaining effective information from data sets (Akter et al., 2022). In addition, there are security risks associated with digital technologies, the more complex the system the more unstable and vulnerable it is to operational failures, and individuals and organizations are also at risk of data leakage and privacy invasion in the use of information (Han et al., 2023). These will be the hidden dangers that will affect the normal operation of the enterprise. In terms of the risk of financial fraud, the development and introduction of digital technologies, investment in technical staff, and the creation of new markets in the process of digital transformation of enterprises cost a lot of money (Chen and Srinivasan, 2023). Most traditional enterprises have become more competitive in the market. In the face of increased enterprise crises, the possibility of fraud has increased (Zhong et al., 2022). At the same time, the high degree of digitization also provides the possibility for enterprises to adopt more covert fraud methods and increase their fluke of escaping regulation. For example, Wirecard took advantage of the large volume and difficult verification of its payment agent business to exaggerate its income by fabricating payment transactions. Although blockchain and artificial intelligence reduce the possibility of data tampering and manipulation, this may only be for low and mid-level enterprise employees. If the potential gains are large enough, managers can rewrite transaction data in the blockchain by capturing >51 % of the computing power (Han et al., 2023). High enterprise risk usually represents a higher risk of material misstatement, and to control the audit risk at a manageable level, the auditor will choose to increase the substantive procedures or expand the sample size to reduce the inspection risk, which undoubtedly increases the auditor's workload and work difficulty (Bell et al., 2001) and reduces the audit efficiency.

Third, when accounting firms' digitalization construction lags behind that of enterprises, it is more difficult to interface with the business of digitally transformed enterprises. The digitalization construction of some accounting firms lags behind that of enterprises (Barr-Pulliam et al., 2022), especially small and medium-sized accounting firms. In this case, enterprises' complex business systems and huge data make it difficult for auditors to obtain high-quality and standardized data, exposing auditors to challenges such as information overload, data relevance, and fuzzy identification (Brown-Liburd et al., 2015). In addition, the diversity and covert nature of fraudulent means make it more difficult for auditors to detect. Digital transformation makes the data of enterprises tend to be "paperless", compared with paper information, electronic data are more likely to be altered, and the use of big data technology fraud increases the difficulty of the auditor to identify and judge the reliability of audit evidence (Appelbaum et al., 2017). For example, Luckin Coffee in the new retail model, through the "pick-up code jump number" to inflate sales of fraudulent tactics was not detected by the auditors in time. Muddy Waters Research mobilized 92 full-time and 1418 part-time employees to collect 25,843 receipts from 2213 stores and 11,260 h of store traffic monitoring, and issued an 89-page short-selling report, which finally brought the Luckin Coffee financial fraud to the surface. The report was issued by a short-selling organization. Traditional auditing is unable to invest as much manpower, material resources, and time as short-selling organizations to monitor audited units, and requires improvements in auditing methods and procedures if it is to effectively perform its oversight function. In short, after the digital transformation of the enterprise, the auditor will face many thorny issues, which will increase the difficulty of the auditor to interface with the business of the enterprise and require the auditor to invest more time and energy, thus reducing the audit efficiency.

Therefore, the following hypothesis is proposed:

Hypothesis 1b. Enterprise digital transformation negatively affects audit efficiency.

4. Research methods

4.1. Data and sample

This study adopts China's A-share listed companies in Shanghai and Shenzhen from 2011 to 2021 as the initial research samples. To make the research results more robust, the data were processed as follows: (1) Companies in ST state were excluded; (2) Excluding listed companies in the financial industry; (3) Eliminate companies with missing data of relevant variables. In addition, to minimize the influence of outliers on the research results, both ends of continuous variables were reduced by 1 %. Finally, a total of 30,941 observations are obtained. In this study, a fixed effects unbalanced panel data model is used for statistical analysis using Stata 17.0. The enterprise digital transformation variables in the robustness test were compiled by the authors using text mining techniques, and the financial and enterprise characteristics data involved in this study were obtained from the CSMAR database.

4.2. Measurement

Audit delay (AUDELAY). Referring to Abbott et al. (2012) and Bamber et al. (1993), this study used audit delay, that is, the calendar days from the balance sheet date to the issue of the audit report, to measure audit efficiency.

Enterprise digital transformation (DCG). In this study, word frequency related to digital transformation in annual reports is used to measure the degree of enterprise digital transformation (Wu et al., 2021; Chen and Srinivasan, 2023). Specifically, Enterprise Digital Transformation (*DCG*) = ln (word frequency + 1). In existing research on enterprise digital transformation, some scholars use the proportion of intangible assets related to digital transformation to measure the degree of digital transformation (Zhang et al., 2021). The method chosen by more scholars is the word frequency related to digital transformation in the annual report (Wu et al., 2021). The annual report is a summary of the

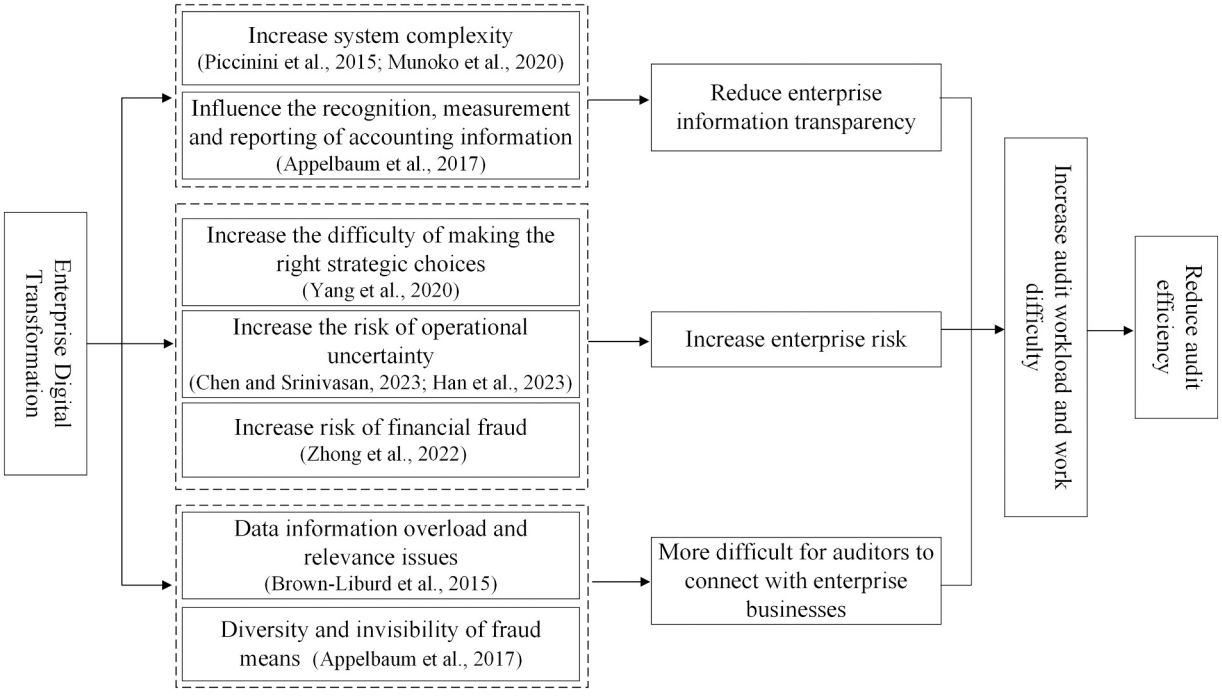

Fig. 3. The mechanism of enterprise digital transformation to reduce audit efficiency.

Table 1
Variables and their definitions.

Type	Name	Symbol	Definition
Dependent variable	Audit delay	*AUDELAY*	Calendar days from the balance sheet date to the audit report date
Independent variable	Enterprise digital transformation	*DCG*	Add 1 to the frequency of words related to digital transformation in the annual report, and the natural logarithm is taken.
Control variables	Bankruptcy risk	*ZScore*	Enterprise risk warning Z value
	Enterprise scale	*Size*	The natural log of the firm's total assets at the end of the period
	Financial leverage	*LEV*	Total liabilities/total assets
	The proportion of independent directors	*DLDS*	The proportion of independent directors to the total number of directors
	Ownership concentration	*First*	The shareholding ratio of the largest shareholder of the enterprise
	Business complexity	*RECINV*	(year-end accounts receivable + inventory)/year-end total assets
	Return on assets	*ROA*	Net profit/total assets of the enterprise
	Loss or not	*Loss*	If the net profit of the year is negative, it is 1, otherwise, it is 0
	integration of two roles	*Daul*	If the chairman is also the general manager, it is 1, otherwise, it is 0
	Audit opinion	*MAR*	If the standard unqualified opinion is issued, it is 1, otherwise, it is 0
	accounting firm size	*BIG4*	If the audit unit of the current year is the international Big 4, it is 1; otherwise, it is 0

business status of the enterprise, and the information disclosed can reflect the degree of digital transformation of the enterprise to some extent. We obtained word frequency from the CSMAR database. The principle is to first construct a list of keywords from five aspects: artificial intelligence, cloud computing, blockchain technology, big data technology, and digital technology application (see Appendix A for details), and then use crawler technology to obtain the digital transformation word frequency from the annual reports of enterprises.

Control variables. Referring to the previous studies (Zhang et al., 2021; Zhai and Li, 2022), this study selected the following variables as control variables: bankruptcy risk (*ZScore*), enterprise size (*Size*), financial leverage (*LEV*), the proportion of independent directors (*DLDS*), shareholding concentration (*First*), business complexity (*RECINV*), return on assets (*ROA*), whether there is a Loss (*Loss*), integration of two roles (*Daul*), audit opinion (*MAR*), accounting firm size (*BIG4*). The details are shown in Table 1.

4.3. Modeling

To test the relationship between enterprise digital transformation and audit efficiency, this study refers to relevant literature (Zhou et al., 2022) and constructs the following model:

$$AUDELAY = \beta_0 + \beta_1 DCG + \beta_2 controls + Firm + Ind + Year + \varepsilon \quad (1)$$

In Formula (1), the explained variable is audit delay (*AUDELAY*), which is used to measure audit efficiency, the core explanatory variable is enterprise digital transformation degree (*DCG*), controls are the control variable group, the *Firm* represents the enterprise, *Ind* is the industry dummy variable, *Year* is the year dummy variable, and ε is the random disturbance term. To make the regression results more reliable, this study controls the firm individual fixed effect, industry fixed effect, and year fixed effect, and clustered at the firm level.

Table 2
Descriptive statistical results of variables.

Variable	N	Mean	p50	sd	min	max
AUDELAY	30,941	97.97	104	18.04	40	119
DCG	30,941	1.324	1.099	1.374	0	5.024
ZScore	30,941	4.980	3.167	5.815	−0.274	37.27
Size	30,941	22.15	21.96	1.295	19.76	26.16
LEV	30,941	0.419	0.408	0.211	0.051	0.931
DLDS	30,941	0.376	0.364	0.053	0.333	0.571
First	30,941	0.346	0.324	0.147	0.094	0.748
RECINV	30,941	0.264	0.246	0.161	0.009	0.730
ROA	30,941	0.037	0.039	0.066	−0.298	0.197
Loss	30,941	0.105	0	0.306	0	1
Daul	30,941	0.295	0	0.456	0	1
MAR	30,941	0.966	1	0.181	0	1
BIG4	30,941	0.058	0	0.233	0	1

5. Results

5.1. Descriptive statistics

Table 2 shows the descriptive statistics of the main variables. As can be seen from the data in the table, the minimum *AUDELAY* value is 40, the maximum value is 119, and the average value is 97.97, indicating that different enterprises have different audit delays, and most of them have low audit efficiency. Enterprise digital transformation (*DCG*) shows that there is a large gap in the degree of digital transformation among enterprises. The mean size of an accounting firm (*BIG4*) is 0.058, indicating that about 5.8 % of listed companies during the sample study period are audited by international "Big 4" accounting firms. Details of descriptive statistics for other variables are shown in Table 2.

Table 3
Digital transformation and audit efficiency.

Variables	(1)	(2)	(3)
	AUDELAY	*AUDELAY*	*AUDELAY*
DCG	3.841***	1.253***	0.361**
	(0.148)	(0.153)	(0.154)
ZScore		−0.136***	−0.120***
		(0.036)	(0.036)
Size		7.004***	4.441***
		(0.307)	(0.334)
LEV		−7.451***	−5.061***
		(1.426)	(1.345)
DLDS		5.447*	0.691
		(3.155)	(3.090)
First		−11.543***	−3.410
		(2.208)	(2.135)
RECINV		2.711	2.909*
		(1.719)	(1.562)
ROA		−31.877***	−25.915***
		(2.769)	(2.692)
Loss		2.998***	2.873***
		(0.451)	(0.443)
Daul		−0.550	−0.275
		(0.378)	(0.357)
MAR		−8.159***	−6.937***
		(0.748)	(0.733)
BIG4		−1.789	−1.733
		(1.177)	(1.072)
Firm FE	Yes	Yes	Yes
Ind FE	No	No	Yes
Year FE	No	No	Yes
_cons	92.884***	−44.740***	7.362
	(0.196)	(6.997)	(8.156)
N	30,941	30,941	30,941
r2_a	0.039	0.127	0.162

Note: Firm-level clustered robust standard errors in parentheses; ***p < 0.01, **p < 0.05, *p < 0.1.

5.2. Multivariate analysis

The benchmark regression results of this study are shown in Table 3. Among them, column (1) is the preliminary regression of digital transformation (*DCG*) to audit delay (*AUDELAY*), with a coefficient of 3.841, which is positively significant at the 1 % level. Column (2) shows the regression result after adding control variables. Although the regression coefficient of digital transformation (*DCG*) on audit delay (*AUDELAY*) is partly absorbed by control variables, the regression result is still significant at the 1 % level. Column (3) shows the regression results after further controlling the year and industry, which are still positive and significant at the 1 % level. This indicates that the higher the degree of enterprise digital transformation, the more serious the audit delay, and the lower the audit efficiency. Hypothesis H1b is preliminarily verified and H1a is not.

5.3. Endogeneity test

5.3.1. Propensity score matching

To alleviate the endogeneity problems caused by sample selection bias, this study uses propensity score matching (PSM) to test. Taking the median of digital transformation (*DCG*) as the boundary, the samples are divided into two groups. If the sample is larger than the median, the value is 1, as the experimental group; otherwise, the value is 0, as the control group. The specific matching method is 1:1 nearest neighbor matching within the caliper without putting back, the caliper range is 0.05, and all control variables are selected as matching covariables. The matching results meet the balance hypothesis. Finally, the matched samples are regression, and the results are shown in column (1) of Table 4. The regression coefficient of enterprise digital transformation (*DCG*) to the explained variable (*AUDELAY*) is 0.491, which is significantly positive at the 1 % level, further verifying hypothesis H1b in this study.

Table 4
Endogeneity test.

Variables	PSM	*IV=DCG_Ind*	*IV=DCG_Pro_Ind*
	(1)	(2)	(3)
	AUDELAY	*AUDELAY*	*AUDELAY*
DCG	0.491***		
	(0.176)		
IV		1.212*	0.912**
		(0.668)	(0.399)
ZScore	−0.080**	−0.127***	−0.146***
	(0.041)	(0.032)	(0.039)
Size	4.738***	4.173***	4.536***
	(0.391)	(0.334)	(0.360)
LEV	−5.195***	−5.296***	−7.123***
	(1.524)	(1.196)	(1.451)
DLDS	1.964	−0.079	1.812
	(3.514)	(2.876)	(3.465)
First	−5.440**	−3.675**	−6.550***
	(2.520)	(1.851)	(2.225)
RECINV	3.181*	3.441**	3.374**
	(1.768)	(1.372)	(1.603)
ROA	−26.540***	−26.047***	−27.331***
	(2.960)	(2.586)	(3.079)
Loss	3.030***	2.955***	2.906***
	(0.495)	(0.430)	(0.517)
Daul	−0.222	−0.350	−0.029
	(0.404)	(0.329)	(0.391)
MAR	−6.640***	−6.853***	−6.878***
	(0.782)	(0.650)	(0.800)
BIG4	−3.129***	−2.025**	−1.933*
	(1.209)	(0.819)	(1.018)
Firm FE	yes	yes	yes
Ind FE	yes	no	no
Year FE	yes	yes	yes
_cons	−1.890		
	(9.206)		
Kleibergen-Paap rk LM statistic		583.146***	1371.077***
Kleibergen-Paap Wald rk F statistic		769.217 [16.38]	3060.269 [16.38]
N	22,678	29,659	21,213
r2_a	0.168	0.031	0.004

Note: Firm-level clustered robust standard errors in parentheses; ***p < 0.01, **p < 0.05, *p < 0.1; the critical value at the 10 % level of weak identification test in square brackets.

5.3.2. Instrumental variable

To mitigate the endogeneity problem caused by omitted variables and with reference to the existing literature (Zhai and Li, 2022; Zhou et al., 2022), we chose the average *DCG* of the other firms belonging to the same industry in the same year and the average *DCG* of the other firms located in the same province and belonging to the same industry in the same year as the instrumental variables (*IV*), denoted by *DIG_Ind* and *DIG_Pro_Ind*, respectively. The regression results are shown in columns (2) and (3) of Table 4. The Kleibergen-Paap rk LM statistic is significant at the 1 % level, which indicates that there is no "instrumental variable unidentifiable" problem. The Kleibergen-Paap Wald rk F statistic is much higher than the critical value of 16.38, which indicates that there is no weak instrumental variable problem. The regression coefficients of enterprise digital transformation (*DCG*) on audit delay (*AUDELAY*) in both cases are 1.212 and 0.912, which are significant at the 10 % and 5 % levels, respectively, confirming the robustness of the empirical results of this study.

5.4. Robustness tests

5.4.1. Substitution of variables

To avoid the problems associated with the single selection of variables, we substitute independent and dependent variables separately.

Substitute independent variable. We replaced the independent variable with indicators constructed from our collection of word frequency. Specifically, we use Python to mine the annual reports of listed companies to obtain word frequency with the digital transformation keywords constructed by Wu et al. (2021). First, we still choose the total number of word frequency plus 1 to take the natural logarithm as a measure of the degree of enterprise digital transformation, denoted as *DCG1*. Second, drawing on Zhou et al. (2022), we treated each project indicator of enterprise digital transformation as a binary variable, and if the word frequency of each project is >0, the value is 1 and 0 if otherwise. Then sum the score of each project, denoted as *DCG2*. The regression results are shown in column (1) column (2) and of Table 5, which are still positive and significant at the 1 % level. Hence, H1b is also supported.

Substitute dependent variable. Audit cost is a function of transaction cost and production factors, and the reduction of cost and workload can reflect the effectiveness of the audit (Baatwah et al., 2019). Therefore, this study selects audit fee as the replacement variable of *ADELAY*, and the regression results are shown in column (3) of Table 5. It also verifies that the improvement of the degree of digital transformation will increase the audit costs, that is, reduce the audit efficiency, which reflects the robustness of the regression results.

5.4.2. Sub-sample

Excluding the sample during the COVID-19 epidemic. Considering the many difficulties faced in conducting audits during the New Crown epidemic, which have a significant impact on audit efficiency, the paper re-estimates by excluding the 2020 and 2021 samples. The regression results shown in column (4) of Table 5 test hypothesis H1b.

Select samples with good-quality of accounting information disclosure. Strategic disclosure of information related to digital transformation in annual reports can affect the accuracy of digital text metrics. To reduce the interference of this situation on the empirical results, this study selects the samples of "excellent" and "good" accounting information disclosure quality in the CSMAR database for re-estimation. The results

Table 5
Robustness test.

Variables	*Substitute independent variable*		*Substitute dependent variable*	*Sub-sample*	
	(1)	(2)	(3)	(4)	(5)
	AUDELAY	AUDELAY	ADFEE	AUDELAY	AUDELAY
DCG			0.013***	0.423**	0.316*
			(0.003)	(0.187)	(0.191)
DCG1	0.456***				
	(0.174)				
DCG2		0.346***			
		(0.119)			
ZScore	−0.117***	−0.117***	−0.000	−0.153***	−0.100**
	(0.036)	(0.036)	(0.001)	(0.043)	(0.044)
Size	4.431***	4.453***	0.328***	5.067***	4.156***
	(0.344)	(0.343)	(0.009)	(0.399)	(0.478)
LEV	−5.449***	−5.473***	0.067**	−6.230***	−2.256
	(1.388)	(1.387)	(0.031)	(1.642)	(1.863)
DLDS	−0.597	−0.629	−0.093	1.797	3.514
	(3.140)	(3.143)	(0.067)	(3.721)	(4.244)
First	−3.757*	−3.858*	−0.044	−3.978	−2.758
	(2.171)	(2.165)	(0.054)	(2.490)	(2.920)
RECINV	3.288**	3.323**	−0.021	4.023**	5.251**
	(1.600)	(1.599)	(0.034)	(1.928)	(2.169)
ROA	−27.807***	−27.816***	−0.229***	−26.211***	−35.534***
	(2.789)	(2.791)	(0.050)	(3.475)	(3.849)
Loss	2.758***	2.765***	0.024***	3.444***	1.316**
	(0.446)	(0.447)	(0.007)	(0.560)	(0.582)
Daul	−0.201	−0.200	0.005	−0.700	−0.533
	(0.365)	(0.365)	(0.007)	(0.434)	(0.450)
MAR	−6.265***	−6.267***	−0.102***	−6.645***	−8.289***
	(0.766)	(0.766)	(0.013)	(0.894)	(2.047)
BIG4	−1.641	−1.628	0.290***	0.392	−0.920
	(1.104)	(1.104)	(0.036)	(1.228)	(1.501)
Firm FE	yes	yes	yes	yes	yes
Ind FE	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes
_cons	5.925	7.562	6.470***	−5.062	12.406
	(5.739)	(8.330)	(0.229)	(10.742)	(11.125)
N	29,877	29,877	30,624	23,234	20,090
r2_a	0.159	0.159	0.626	0.157	0.151

Note: Firm-level clustered robust standard errors in parentheses; ***p < 0.01, **p < 0.05, *p < 0.1.

are shown in column (5) of Table 5, which once again confirms the robustness of the results.

6. Additional analysis

In this part, this study analyzes what factors may affect the effect of digital transformation on audit efficiency. The following are the analysis results from the high-tech enterprises and competency of accounting firms. Among them, the competency of accounting firms is measured from two perspectives: international "Big 4" and digital expertise.

6.1. The influence of high-tech enterprises

Due to the particularity of the industry in which high-tech enterprises are located, the degree of digitization is far higher than that of other industries. Therefore, we believe that when exploring the impact of enterprise digital transformation on audit efficiency, whether high-tech enterprises are high-tech enterprises may lead to great differences in results. Referring to the classification of the core industries of the digital economy in the *Statistical Classification of Digital Economy and Its Core Industries (2021)* issued by the National Bureau of Statistics, and compared with the *Guidance on Industry Classification of Listed Companies (Revised in 2012)*, We consider information transmission, software and information technology services (I), scientific research and technology services (M), and computer, communications and other electronic equipment manufacturing (C39) in manufacturing as digital industries. Enterprises in this sector are considered high-tech (*Htech = 1*) and have a high degree of digitalization, while the rest are non-high-tech (*Htech = 0*). As shown in columns (1) and (2) of Table 6, the results of the group test indicate that the effect of enterprise digital transformation on reducing audit efficiency is more significant in non-high-tech enterprises. This may be due to the high degree of digitalization of high-tech enterprises can more effectively integrate digital technologies into the transformation process of enterprises, avoid bringing huge changes to the internal environment and business models of enterprises, and thus weaken the negative effect of enterprises' digital transformation on audit efficiency.

6.2. The influence of accounting firm competence

6.2.1. International "Big 4"

The international "Big 4", as the benchmark of the industry, has higher standards and stronger professionalism in the selection and training of auditors, so the professional competence of auditors from the "Big 4" is also stronger (Eshleman and Guo, 2014; Che et al., 2020). Professional auditors can significantly improve audit efficiency (Brazel and Agoglia, 2007). In addition, large accounting firms are more likely to invest heavily in the development of applied analytics tools such as AI, like the "Big 4" who implemented Big Data Analytics (BDA) as early as 2015 (Salijeni et al., 2021; Munoko et al., 2020). Currently, PwC's Halo and GL.ai, Ernst & Young's Helix and Canvas, Deloitte's Omnia, and KPMG's Clara are all intelligent auditing tools based on big data, AI, and other technologies, which can effectively help auditors deal with and respond to a large amount of data information and complex operations of enterprises. Compared with the "Big 4", small and medium-sized accounting firms are at a disadvantage in terms of talent, capital,

Table 6
Further analysis.

Variables	High-tech enterprise		International "Big 4"		Accounting firm digital expertise	
	(1)	(2)	(3)	(4)	(5)	(6)
	Htech = 1	Htech = 0	BIG4 = 1	BIG4 = 0	Digital_exp = 1	Digital_exp = 0
DCG	0.093	0.370**	0.217	0.358**	0.293	0.471**
	(0.366)	(0.169)	(0.417)	(0.161)	(0.251)	(0.201)
ZScore	−0.077	−0.121***	0.179*	−0.122***	−0.162***	−0.069
	(0.070)	(0.041)	(0.103)	(0.037)	(0.058)	(0.046)
Size	4.968***	4.324***	1.491	4.593***	5.546***	4.520***
	(0.806)	(0.376)	(1.314)	(0.343)	(0.635)	(0.418)
LEV	−10.137***	−3.833***	3.870	−5.321***	−8.151***	−3.663**
	(3.438)	(1.457)	(5.027)	(1.389)	(2.277)	(1.756)
DLDS	5.966	−0.315	−1.680	0.305	−2.875	4.225
	(6.989)	(3.450)	(6.363)	(3.271)	(5.677)	(3.768)
First	−6.136	−4.007*	−6.470	−3.253	−2.553	−3.532
	(6.827)	(2.288)	(7.804)	(2.235)	(3.714)	(2.839)
RECINV	4.670	2.923*	−10.163**	3.557**	3.544	0.877
	(3.891)	(1.735)	(4.726)	(1.591)	(2.717)	(2.011)
ROA	−20.315***	−27.152***	−18.360*	−26.357***	−33.662***	−21.135***
	(5.507)	(3.109)	(10.576)	(2.776)	(4.521)	(3.387)
Loss	3.797***	2.664***	1.517	2.872***	2.361***	3.144***
	(0.973)	(0.495)	(1.314)	(0.458)	(0.785)	(0.562)
Daul	−0.857	−0.060	0.038	−0.255	−0.349	0.072
	(0.782)	(0.400)	(1.243)	(0.365)	(0.617)	(0.453)
MAR	−7.329***	−7.006***	−8.005**	−6.921***	−5.705***	−7.531***
	(1.751)	(0.808)	(3.526)	(0.746)	(1.366)	(0.903)
BIG4	−2.955	−1.506				−2.239*
	(1.863)	(1.191)				(1.314)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Ind FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
_cons	−17.718	8.408	55.603*	4.437	−17.459	7.125
	(18.409)	(8.389)	(29.842)	(8.372)	(15.000)	(10.210)
N	5261	25,680	1783	29,158	11,143	19,798
r2_a	0.163	0.155	0.154	0.164	0.151	0.154

Note: Firm-level clustered robust standard errors in parentheses; ***p < 0.01, **p < 0.05, *p < 0.1.

and industry insight. Based on this, we conduct group regression tests using international "Big 4" (*BIG4 = 1*) and non-international "Big 4" (*BIG4 = 0*) as representatives of accounting firms with strong and weak competencies, respectively.

From the regression results in columns (3) and (4) of Table 6, it is clear that the effect of the enterprise digital transformation in reducing audit efficiency is only realized when audits are conducted by non-international "Big 4" firms. The reason for this result may be that auditors with strong professional competence and accounting firms with a high degree of digital construction can effectively deal with the complex situation of enterprises undergoing digital transformation, thus alleviating the effect of enterprises' digital transformation reducing audit efficiency. This result corroborates with existing research that digitization increases the gap between large and small and medium-sized accounting firms, with larger firms tending to be better able to take advantage of the benefits offered by digital technologies (Lugli and Bertacchini, 2023).

6.2.2. *Accounting firm digital expertise*

To further explore the role of accounting firm competency in the impact of enterprise digital transformation on audit efficiency, this study draws on measures of auditor industry expertise (Fung et al., 2012; Bills et al., 2015) and refers to Rahman and Ziru's (2022) study to construct an indicator of accounting firm digital expertise (*Digital_exp*). It reflects the accounting firm's accumulated knowledge and experience in digitalization. The calculation formula is as follows:

$$Digital\_exp_i = \sum_{j=1}^{J} ADFEE_{ij} \Big/ \sum_{i=1}^{I}\sum_{j=1}^{J} ADFEE_{ij} \quad (2)$$

In the formula, the numerator represents the sum of audit fees of all clients of accounting firm i in the digital industry, the denominator represents the sum of audit fees of all accounting firms in the digital industry, and $Digital\_exp_i$ is the market share of accounting firm i in the digital industry. We treat the top three accounting firms in terms of market share in each year as having digital expertise, i.e., *Digital_exp = 1*, otherwise *Digital_exp = 0*. Columns (5) and (6) of Table 6 report the results of the grouped regressions. The regression results are no longer significant when accounting firms have digital expertise, while the coefficient is 0.471, which is significantly positive at the 5 % level when accounting firms do not have digital expertise. This suggests that the digital expertise of accounting firms can mitigate the negative impact of enterprise digital transformation on audit efficiency.

7. Conclusions

This study takes audit delay as a measurement variable of audit efficiency and takes A-share listed companies in Shanghai and Shenzhen from 2011 to 2021 as samples to study the impact of enterprise digital transformation on audit efficiency. The results show that enterprise digital transformation will aggravate audit delay and reduce audit efficiency. On the one hand, it may be that most enterprises in China are still in the primary stage of digital transformation, and the challenges they meet in the process of transformation have not been overcome promptly. On the other hand, the digital competence of accounting firms may not be enough. Faced with the challenges of new technology and data complexity brought by the digital transformation of enterprises, auditors cannot complete the audit work efficiently and orderly. This study also further analyzes the moderating effect of accounting firm competence and high-tech enterprises in the study of digital transformation on audit efficiency. The research results show that when the transformation enterprises are non-high-tech enterprises and the audit units are "non-Big 4" and "accounting firms without digital expertise", the effect of enterprise digital transformation on reducing audit efficiency is more

obvious. This also shows that the mature degree of digital transformation of enterprises and the high competence of accounting firms can alleviate the negative effects of digital transformation of enterprises on audit efficiency.

Limitations of this study include: First, digital transformation began to be widely mentioned around 2015, and most enterprises in China are currently in the initial stage of digital transformation. It cannot be ruled out that the empirical results of this study are the product of a specific period in this stage, and the long-term effects of digital transformation need more research to further explore and verify. Second, this study investigated the impact of digital transformation of enterprises on auditing efficiency with comprehensive indicators constructed by text mining methods, and future research could explore the impact of different digital technologies on enterprises and auditing behaviors.

Emerging technologies bring opportunities as well as challenges, and this study identifies the adverse impacts of enterprise digital transformation on auditing work, bringing some insights into how to improve auditing efficiency in the context of enterprise digital transformation. First, accounting firms should strengthen the cultivation of digital competence, including promoting the digital transformation of accounting firms themselves, etc., to better undertake and respond to the business of enterprises and achieve higher audit quality and efficiency. Second, with regard to the recognition of data assets, the quality and safety of data and information, and the "black box" of digital technology, the relevant departments should clarify the standards of use and formulate codes of conduct as soon as possible.

Declaration of generative AI in scientific writing

None.

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CRediT authorship contribution statement

Aolin Leng: Methodology, Supervision, Writing – review & editing. **Yue Zhang:** Data curation, Methodology, Visualization, Writing – original draft.

Declaration of competing interest

The authors declare no conflict of interest.

Data availability

Data will be made available on request.

Appendix A

Taking the specific keywords related to digital transformation proposed by Wu et al. (2020) as the standard, the crawler technology is adopted to eliminate the negative expressions of "no", "no" and other negative words before the keywords, and the full-text search is conducted in the management discussion and analysis section of the annual financial report or annual report of listed companies.

Negative words: no, don't, not yet, nothing, no need, irrelevant.

Table A.1
Keywords of digital transformation.

Index classification	Index name
Artificial intelligence technology	Artificial intelligence, business intelligence, image understanding, investment decision support systems, intelligent data analysis, intelligent robots, machine learning, deep learning, semantic search, biometric technology, facial recognition, speech recognition, identity verification, autonomous driving, natural language processing
Blockchain technology	Cryptocurrency, smart contracts, distributed computing, decentralization, bitcoin, consortium blockchain, differential privacy technology, consensus mechanism
Cloud computing technology	In-memory computing, cloud computing, stream computing, graph computing, internet of things, multi-party secure computing, neuromorphic computing, green computing, cognitive computing, converged architecture, billion-level concurrency, exabyte-level storage, cyber-physical systems
Big data technology	Big data, data mining, text mining, data visualization, heterogeneous data, credit reporting, augmented reality, mixed reality, virtual reality
Digital technology applications	Mobile internet, industrial internet, mobile interconnection, internet healthcare, e-commerce, mobile payment, third-party payment, NFC payment, B2B, B2C, C2B, C2C, O2O, internet payment platform, smart wearables, smart agriculture, intelligent transportation, smart healthcare, intelligent customer service, smart home, robot advisor, smart tourism, intelligent environmental protection, smart grid, smart energy, intelligent marketing, digital marketing, unmanned retail, internet finance, digital finance, fintech, financial technology, quantitative finance, open banking

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