

## Research Article

# The Impact of Digital Transformation on Corporate Tax Avoidance: Evidence from China

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Digital transformation plays an important role in reshaping the core competitiveness of enterprises and achieving high-quality development. Based on panel data of Chinese A-share listed companies in Shanghai and Shenzhen from 2009 to 2019, this study examines the impact of digital transformation on corporate internals from the perspective of corporate tax avoidance. It finds that digital transformation significantly inhibits corporate tax avoidance by improving the quality of corporate internal controls; its inhibitory effect on corporate tax avoidance shows significant heterogeneity when firms are in different tax collection intensities and receive different amounts of government subsidies; and the inhibition of corporate tax avoidance significantly improves the efficiency of corporate investment. The research in this study expands the theoretical understanding of digital transformation and corporate tax avoidance and provides relevant insights for the government to promote the deep integration of the digital economy with the real economy.

## 1. Introduction

In recent years, the digital economy has developed rapidly in China. According to the white paper on China's digital economy development and employment (2022) released by the China Communications Research Institute, China's digital economy will reach 45.5 trillion yuan by the end of 2021, accounting for 39.78% of the total GDP, becoming an important focus point for the high-quality development of the national economy. As a microcomponent of the macro economy, enterprises are an important driver of the development and transformation of the macro digital economy. Since 2012, the Chinese government has issued more than 100 special strategic plans and guidelines to guide enterprises in their digital transformation. In response to the country's call, digital transformation is gradually becoming an important strategic direction for enterprises. The digital transformation of enterprises implies the improvement of enterprise data processing capability, which enables enterprises to quickly and accurately obtain data related to production information and make intelligent and optimal

business decisions through the standardized process of “data collection-data analysis-data decision” [1, 2]. In addition, the government's tax administration is being digitally and intelligently upgraded. For example, the use of digital payments, electronic invoices, and other connected devices (e.g., online cash registration systems, etc.) is providing tax administrations with more data and making information about the corporate governance chain more open and transparent, which has an impact on corporate tax planning decisions [3, 4]. Therefore, in the context of the digital economy, it is of great practical importance to study the impact of digital transformation on corporate financial decisions.

Corporate tax avoidance is an important part of corporate financial decisions. For enterprises, the tax burden is an important burden in business management, which also forms an incentive for enterprises to avoid taxes in order to reduce the financial pressure of enterprises. On the one hand, tax avoidance can reduce the tax cost of enterprises and make the operating profit of enterprises reach or exceed the analysts' prediction, forming a “cash flow effect” and increasing the after-tax cash flow of enterprises [5, 6]. On the

other hand, tax avoidance is a potential risk because taxation is a way for the government to participate in the distribution of business results and is the main source of government revenue. Once an enterprise's tax avoidance behavior is detected by the tax authorities, the enterprise is required to pay back taxes and may pay several times the unpaid tax penalty. It can be found that corporate tax avoidance is essentially a game between enterprises and tax authorities [7]. Therefore, corporate tax avoidance has an important impact on government finance, business performance, and the government-enterprise relationship and is a hot topic of concern for the government, enterprises, and academia.

Digital transformation can broaden the width and breadth of information available to enterprises, and management and operators can use the results of information analysis to make decisions in the process of information application [4], which can be seen to have a significant impact on business management decisions. Corporate tax avoidance is actually a trade-off between tax avoidance benefits and tax avoidance costs and has become one of the important decisions in business management. So does digital transformation has an impact on corporate tax avoidance? If so, what are the mechanisms at play? An exploration of these questions will help provide a deeper understanding of how digitalisation empowers corporate governance and also provides empirical evidence for governments to actively promote corporate digital transformation.

## 2. Literature Review

At present, research on the digital transformation of enterprises has been carried out mainly from two aspects: drivers and economic consequences. In terms of drivers, Cai [8] narrated that the governance system of science and technology innovation led by the Communist Party of China is an important external driver of digital transformation based on a new data-driven state system. Qian and He [9] found that the external drivers of digital transformation are reflected in intelligent technology, personalized demand, an online model, and ecological development based on a dynamic capability perspective. It has also been shown that the internal drive of the team, organizational learning capability, and dynamic capability of the company constitute the internal drivers of the digital transformation of the company [10–12]. In terms of economic consequences, Zeng et al. [13] concluded that digital transformation can contribute to the financial performance of firms. Qi et al. [4] found that the higher the degree of digital economy of a firm, the higher the level of corporate governance. Mao-mao et al. [14] demonstrated that digital transformation is a key requisite for firms' innovation performance based on a mixed method of NCA and SEM. Zhang et al. [15] found a negative correlation between the degree of digital transformation in firms and audit pricing. Zhou et al. [16] based on an information processing view that digital transformation can empower firms with data-driven insights and facilitate better decision-making.

In addition, regarding corporate tax avoidance, the existing studies mainly explore it from two perspectives: external influencing factors and internal influencing factors.

From the perspective of external influencing factors, it was firstly proposed by foreign scholars that the strength of tax administration would affect corporate tax avoidance, and the stronger the tax administration, the less corporate tax avoidance [17, 18]. Deng et al. [19] found that government subsidies would inhibit corporate tax avoidance behavior. Xing et al. [20] showed that institutional cross-shareholding can reduce corporate tax avoidance incentives by improving corporate governance and alleviating financing constraints. Chen et al. [21] found that based on geographic economics, the closer the geographic location of the parent and subsidiary within a group, the more tax avoidance by firms. In terms of internal influences, corporate tax avoidance is mainly influenced by executive characteristics, salary standards, and internal controls. Zhao and Wang [22] showed that firms in which the CFO is also a director have significantly lower effective tax rates and more tax avoidance. Liu and Zhao [23] found that for every 100 RMB increase in the monthly minimum wage in a firm's region, the firm's income tax cash outflow through tax avoidance decreases by 2.52%. Li [24] found that the more local CEOs in an enterprise, the lower the degree of tax avoidance and mainly in state-owned enterprises and enterprises in regions with poor economic development.

In summary, existing literature on digital transformation has not addressed the perspective of corporate tax avoidance, and studies on the factors influencing corporate tax avoidance have ignored digital transformation as an important corporate strategic decision. Therefore, this study examines the important issue of how digital transformation affects corporate tax avoidance.

## 3. Theoretical Analysis and Hypothesis Development

*3.1. Digital Transformation and Corporate Tax Avoidance.* According to principal-agent theory, information asymmetry and interest friction between managers and shareholders are the main reasons for the formation of corporate principal-agent problems [25]. Digital transformation, on the other hand, is the process of developing digital business models by deploying digital technology [26], which plays an important role in alleviating the principal-agent problem of enterprises. First, in terms of reducing information asymmetry, digital technology can change the way companies collect, store, analyse, and disseminate information [27], thus effectively improving the accuracy, reliability, and timeliness of information [28], standardising production and operation management processes and making corporate information more transparent [29]. As a result, digital transformation enables both managers and shareholders to obtain more reliable information, reducing the cognitive bias caused by the separation of ownership and thus alleviating the information asymmetry problem. Second, in terms of reducing frictions of interest, digital technology can reduce frictions of interest between managers and shareholders, mainly by improving corporate performance. Specifically, digital technology enables companies to intelligently transform and develop their products and services

[30] and efficiently integrate and allocate existing resources [31], thereby improving productivity. In addition, digital technology helps connect with customers [32], optimise products and accurately forecast customer needs, respond to dynamic changes in the market, and increase the efficiency of business operations. Generally speaking, the performance level of a company increases with productivity and operational efficiency. The higher the level of performance, the more rewarding it is for managers, the less they are able to take control and waste resources [29], and the less friction there is between managers and shareholders. The above-mentioned analysis shows that digital transformation can effectively alleviate the principal-agent problem of enterprises. Due to the invisibility and complexity of corporate tax avoidance, when the principal-agent problem between managers and shareholders is reduced, i.e., information asymmetry and interest frictions are reduced, it becomes more difficult for companies to avoid taxes and the incentive to avoid taxes is reduced. The study thus infers that digital transformation can reduce the principal-agent problem and thus reduce corporate tax avoidance. Therefore, the following hypothesis is formulated in this study:

H1: other things being equal, digital transformation has a significant disincentive effect on corporate tax avoidance.

Figure 1 shows the mechanism of the impact of digital transformation on corporate tax avoidance.

**3.2. Digital Transformation, Internal Control Quality, and Corporate Tax Avoidance.** Internal control consists of five elements: the internal environment, information and communication, control activities, risk assessment, and internal oversight. It plays an important role in the process of preventing legal risks, ensuring reliable financial information, and promoting sustainable development in enterprises. The quality of internal control is not only influenced by the importance attached to it by the top management, the resources invested, and the quality of internal control personnel, but it is also related to the advancedness of internal control management tools [33]. Along with the digital transformation of enterprises, digital management tools have started to be widely used in the internal control work of enterprises, and the quality of internal control in enterprises has also changed. The digital transformation has a positive impact on all five elements of internal control. First, according to the previous theoretical logic, digital transformation has improved the ability of companies to process data and the flow of information within the company is smoother. It breaks down traditional organisational boundaries and reduces the information asymmetry between managers and shareholders. This enables a good internal governance environment and enhanced information communication within the company. Second, in terms of control activities, digital transformation promotes the automation of business processes and intelligent management, which can effectively improve the internal management efficiency of enterprises [34]. Finally, the data processing and analysis capabilities brought by digital transformation can improve the accuracy

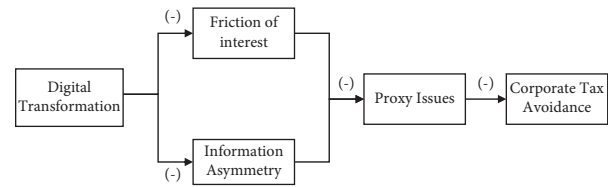


FIGURE 1: Mechanisms of digital transformation on corporate tax avoidance.

and effectiveness of capital allocation decisions, and enterprises can optimise resource allocation and improve productivity while supervising management to regulate their own behavior and reducing decision errors caused by executives' subjective judgment [29]. It can be seen that digital transformation strengthens the daily supervision and improves the risk assessment ability of enterprises. Therefore, the following hypothesis is proposed:

H2a: other things being equal, digital transformation can improve the quality of a company's internal controls:

According to the Internal Control-Integrated Framework issued by the U.S. COSO Committee and the Basic Standard for Enterprise Internal Control in China, the objectives of internal control can be summarised into three categories: improving the efficiency and effectiveness of operations, improving the reliability of internal and external reporting, and complying with relevant laws and regulations. It is easy to see that the higher the quality of internal control, the more attention is paid to the "compliance" of business practices. With the continuous improvement of laws and regulations, the evolution of tax authorities' inspection methods and the improvement of tax collection and management efficiency, although tax avoidance can bring enterprises greater tax savings in the short term, the probability of being discovered by tax regulators increases, and once detected, enterprises will face greater penalties, as well as double losses in profit and reputation. Thus, in the context of the gradual improvement of the tax law system and regulatory system, the higher the quality of internal control, the more companies are willing to take "compliance" as their orientation and can effectively weigh the benefits of tax avoidance, control the level of risk, and mitigate the cost of noncompliance by reducing the degree of tax avoidance [35]. Based on the abovementioned analysis, the following hypotheses are proposed:

H2b: other things being equal, the higher the quality of internal control, the lower the degree of corporate tax avoidance.

In summary, this study argues that digital transformation can reduce corporate tax avoidance by improving the quality of internal controls. Therefore, the following hypotheses are proposed:

H2: other things being equal, the quality of internal control mediates the relationship between the impact of digital transformation and corporate tax avoidance.

**3.3. Moderating Role of Tax Administration.** Tax administration is an external monitoring mechanism adopted by the government for enterprises, which can effectively restrain their aggressive tax avoidance behaviors [36]. Since tax authorities in different regions have certain discretionary powers, it leads to some differences in the intensity of tax administration in different regions of China [37]. The stronger the tax administration in a company's region, the greater the risk and cost of noncompliance associated with tax avoidance, which can reinforce the "compliance" orientation of the company and thus restrain the opportunistic behavior of management in tax avoidance [38]. Following the abovementioned analysis, the higher the quality of internal controls, the greater the awareness of "compliance" and it is easy to conclude that this awareness of "compliance" is further enhanced in companies located in areas with strong tax administration. In general, the digital transformation can improve the quality of internal control to inhibit tax avoidance, and this inhibiting effect is more obvious in the regions with high tax administration intensity. Based on the abovementioned analysis, the following hypotheses are proposed:

H3: other things being equal, the disincentive effect of digital transformation on corporate tax avoidance is more pronounced in areas with high tax collection intensity.

**3.4. Moderating Role of Government Subsidies.** Government subsidies are important allocation resources held by the government, which play an important role in adjusting industrial structure, improving the quality of economic development, implementing industrial policies, and affecting the growth and development of various industries. China is currently in a stage of economic transition, and the government plays an important role in both macroeconomic operation and microenterprise economic activities. Based on the exchange theory, there is reciprocity between the government and enterprises at this stage, which is manifested by the government providing enterprises with public service products and other related resources as well as tax breaks and other preferential policies, while enterprises pay more taxes to the government by generating more operating profits [39]. Government subsidies can alleviate financing constraints, improve liquidity, and send positive signals to the market to gather more resources [40, 41], and the government can mitigate the loss of benefits due to corporate tax avoidance. Although tax avoidance will increase corporate profits in the short term, in the long run, it will promote short-sighted behavior and damage corporate credibility with the government, which is detrimental to long-term development [19]. It is easy to see that corporate tax avoidance is short-sighted and opportunistic behavior, which is against the economic law of mutual benefit and

win-win situation. Taken together, companies that receive more government subsidies due to sustainability considerations and the concept of mutual benefit and win-win situation have more incentives for their managers to reduce the degree of tax avoidance by transforming into digital. Therefore, this study proposes the following hypothesis:

H4: other things being equal, the disincentive effect of digital transformation on corporate tax avoidance is more pronounced among firms that receive more government subsidies.

Figure 2 shows the theoretical model of this study.

## 4. Study Design

**4.1. Sample Selection and Data Sources.** This study selects A-share listed companies as the research object, and the time interval of the sample is 2009–2019. In order to make the research results more robust, the data are processed as follows: exclude the enterprises treated by ST and PT; exclude the enterprises belonging to the financial category; exclude the enterprises with an effective tax rate less than 0 and greater than 1; exclude the enterprises with income tax expense, current taxable income, and profit before tax less than 0; exclude the enterprises with an asset and liability ratio greater than 1 and less than 0; and exclude the enterprises with missing data on relevant variables. After data screening, the panel data consisting of 14,312 observation samples were finally obtained. The nominal tax rate is obtained from the WIND database, the company financial data are obtained from the IFind database, and all other data are obtained from the CSMAR database. In addition, to avoid the effects of extreme values, all continuous variables were winsorized up and down by 1% and 99% when processing the data.

### 4.2. Variable Settings

**4.2.1. Dependent Variable.** Our dependent variable is the degree of corporate tax avoidance, and referring to the existing literature, this study uses the tax accounting difference (BTD) proposed by Manzon and Plesko [42] to measure the degree of corporate tax avoidance. The BTD is the difference between the pretax profit and the taxable income of an enterprise, and the larger the difference, the greater the degree of tax avoidance of the enterprise. It is calculated as follows:  $BTD = (\text{total profit before tax for the period} - \text{taxable income for the period}) / \text{total assets at the end of the previous period}$ , where taxable income for the period =  $(\text{current income tax expense} - \text{current deferred income tax expense}) / \text{nominal income tax rate}$ . As can be seen from the calculation method, compared to the effective tax rate (ETR), this indicator further takes into account the possibility of tax avoidance by enterprises using deferred tax items, which is more suitable for the income tax system of Chinese enterprises with multiple tax rates.

In addition, in order to better present the regression results, this study multiplies BTD by 100 to obtain the proxy variable for the degree of corporate tax avoidance in this study.

**4.2.2. Independent Variable.** The independent variable is the degree of digital transformation (DT) of the firm. Following María Luz Martín et al. [43] and Fei et al. [44], we use the number of words related to “digital transformation” that appear in the annual financial statements of the listed firms to measure the firms. Since this variable has a significantly right skewed distribution, the natural logarithm of the number of word frequencies plus one is used as a measure in this study.

**4.2.3. Mediating Variables.** The mediating variable is internal control quality (ICQ). Regarding the measurement of internal control quality, the DIB internal control index developed by Shenzhen DIB was used to measure the quality of internal control in enterprises with reference to Tang [45]. This index is a quantitative index of internal control of Chinese listed companies based on five elements of corporate internal control, namely, internal environment, risk assessment, control activities, information and communication, and internal supervision. In addition, Shenzhen Diebold is a professional and authoritative internal control information database provider in China, and this internal control index has been highly favored by many scholars. In this study, the obtained internal control index is divided by 100 as a proxy variable for the quality of internal control.

**4.2.4. Moderating Variables.** The moderating variables are tax administration intensity (TE) and government subsidies (Sub).

For the measurement of tax administration intensity, we refer to Chigome and Robinson [46] and Mertens [47] and start with the following model to estimate the expected tax revenue in each region:

$$\frac{T_{i,t}}{GDP_{i,t}} = \alpha_0 + \alpha_1 \frac{IND1_{i,t}}{GDP_{i,t}} + \alpha_2 \frac{IND2_{i,t}}{GDP_{i,t}} + \alpha_3 \frac{OPEN_{i,t}}{GDP_{i,t}} + \varepsilon_{i,t}. \quad (1)$$

In equation (1),  $T_{i,t}/GDP_{i,t}$  denotes the ratio of local tax revenue to GDP in the province  $i$  in year  $t$ , respectively,  $IND1_{i,t}$  and  $IND2_{i,t}$  are the output values of primary and secondary industries, and  $OPEN_{i,t}$  is the total import and export of each province. The model is used to predict the

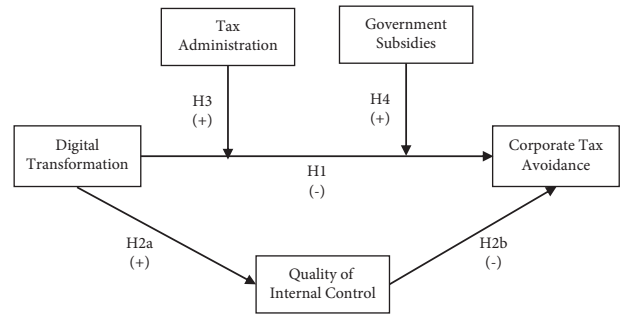


FIGURE 2: Theoretical analysis model.

expected tax administration capacity  $T_{i,t}/GDP_{i,t-EST}$  for the province  $i$  in year  $t$ . Then, the TE of tax administration intensity is the ratio of actual tax  $T_{i,t}/GDP_{i,t}$  to the corresponding expected tax  $T_{i,t}/GDP_{i,t-EST}$ , whereas the larger the TE, the greater the tax collection intensity.

For the measurement of government subsidies, we refer to Deng et al. [19] and take the logarithm of the government subsidies obtained after deducting all the tax incentives returned from the firms’ annual reports and use the value obtained as an indicator of the level of government subsidies.

**4.2.5. Control Variables.** Referring to the existing studies [16, 48], we include a series of control variables that may affect the extent of corporate tax avoidance. These control variables include total year-end assets (Size), gearing ratio (Lev), total assets’ net profit margin (ROA), equity concentration (TOP1), institutional ownership (Inst), equity checks and balances (Balance1), nature of equity (SOE), tangible assets ratio (FA), intangible assets ratio (IA), marketability index (MTK), and whether it is a Big 4 (Big4). In addition, we consider year and industry fixed effects to control for potential heterogeneity at these levels. Finally, the symbols and definitions of the main variables used in this study are detailed in Table 1.

**4.3. Model Setting.** Referring to Wang et al. [49] and Zhou et al. [16], the following multidimensional fixed effects linear model is applied to explore the impact of digital transformation on corporate tax avoidance:

$$BTD_{i,t} = \beta_0 + \beta_1 DT_{i,t} + \sum_k \beta_k Controls_{k,i,t} + industry_{fe} + year_{fe} + \varepsilon_{i,t}, \quad (2)$$

where the subscripts  $i$  and  $t$  represent different firms and years, respectively, Controls denote control variables, industry\_fe and year\_fe represent industry fixed effects and year fixed effects, respectively, and  $\varepsilon_{i,t}$  denotes random error terms. The regression results are concerned with the coefficient of  $\beta_1$ . If the coefficient is significantly positive, it means that digital transformation can promote firms to

embark on more tax avoidance behaviors, and if it is significantly negative, it means that it has the opposite conclusion.

In order to verify the mediating role of internal control quality, this study adopts a mediating effect model by referring to Zhonglin and Baojuan [50]. Specifically, the following model is set on the basis of (1):

TABLE 1: Main variable symbols and definitions.

Variables	Symbols	Description
Degree of tax avoidance	BTD	Tax and accounting differences
Degree of digital transformation	DT	The frequency of digital transformation words in the annual report plus one takes the natural logarithm
Quality of internal control	ICQ	DIB internal control index developed by Shenzhen DIB
Tax administration	TE	Reference 4.2.4 calculations relating to the intensity of tax administration
Government subsidies	Sub	The breakdown of nonoperating income is net of the natural log of government grants for all refunds of tax incentives that policy grants
Total assets	Size	Natural logarithm of total assets
Gearing ratio	Lev	Total liabilities/total assets
Return on assets	ROA	Net profit/total assets
Shareholding concentration	Top1	Number of shares held by the largest shareholder/total number of shares
Institutional shareholding ratio	Inst	Total number of shares held by institutional investors/outstanding share capital
Degree of shareholding checks and balances	Balance1	The percentage of shares held by the second largest shareholder divided by the percentage of shares held by the first largest shareholder
Nature of shareholding	SOE	Whether state-owned enterprises
Tangible assets ratio	FA	Tangible assets/total assets
Intangible assets ratio	IA	Intangible assets/total assets
Marketability index	MTK	Referring to the regional marketization index constructed by Fan Gang and Wang Xiaolu
Whether the four major	Big4	1 if the company is audited by the big 4 (PwC, Deloitte, KPMG, and Ernst & Young), 0 otherwise

$$ICQ_{i,t} = \gamma_1 DT_{i,t} + \sum_k \gamma_k \text{Controls}_{k,i,t} + \text{industry}_{fe} + \text{year}_{fe} + \varepsilon_{i,t}, \quad (3)$$

$$BTD_{i,t} = \delta_0 + \delta_1 ICQ_{i,t} + \sum_k \delta_k \text{Controls}_{k,i,t} + \text{industry}_{fe} + \text{year}_{fe} + \varepsilon_{i,t}, \quad (4)$$

$$BTD_{i,t} = \eta_0 + \eta_1 ICQ_{i,t} + \eta_2 DT_{i,t} + \sum_k \eta_k \text{Controls}_{k,i,t} + \text{industry}_{fe} + \text{year}_{fe} + \varepsilon_{i,t}. \quad (5)$$

In models (3)–(5), the variables are defined in the same way as in model (2). Equation (4) is a regression model without DT but with the mediating variable ICQ; equation (5) includes both DT and ICQ. If both  $\delta_1$  and  $\eta_1$  are significant, it indicates that internal control quality (ICQ) has a partial mediating role.

Further, to verify the moderating effects of tax administration and government subsidies, we introduce tax administration (TE) and government subsidies (Sub) on the basis of model (2) to construct the following model (where  $M$  represents TE and Sub):

$$BTD_{i,t} = \lambda_0 + \lambda_1 DT_{i,t} + \lambda_2 M_{i,t} + \lambda_3 DT_{i,t} \times M + \sum_k \lambda_k \text{Controls}_{k,i,t} + \text{industry}_{fe} + \text{year}_{fe} + \varepsilon_{i,t}. \quad (6)$$

We determine the moderating role of tax administration (TE) and government subsidies (Sub) in the influential relationship between digital transformation and corporate tax avoidance based on the significance and sign of regression coefficients  $\lambda_1$  and  $\lambda_3$ .

## 5. Empirical Results and Analysis

*5.1. Descriptive Statistics and Correlation Analysis.* Table 2 reports the descriptive statistics of the overall sample. The mean value of BTD is  $-0.407$ , which is basically consistent with the study of Zhang and Dong et al. [51], indicating that the Chinese tax law strictly regulates the taxable

income of enterprises, resulting in the taxable income of enterprises being greater than their pretax accounting profits. The minimum and maximum values of BTD are  $-8.47$  and  $15.099$ , indicating the degree of tax avoidance among enterprises. The mean value of DT is  $1.057$ , and the standard deviation is  $1.281$ , indicating that the degree of digital transformation of enterprises is still at a relatively low level in general and that there are large differences among individuals. The mean value of ICQ is  $6.803$ , the mean value of TE is  $1.016$ , and the mean value of Sub is  $0.041$ . The performance of the control variables is generally consistent with the results of the existing literature and will not be repeated.

TABLE 2: Descriptive statistics.

Variables	Observations	Average value	Standard deviation	Minimum value	Maximum value
BTD	14312	-0.407	2.015	-8.47	15.099
DT	14312	1.057	1.281	0	6.098
ICQ	14312	6.803	0.924	0	9.856
TE	14312	1.016	0.193	0.499	1.581
Sub	14312	0.041	0.082	0	3.022
Size	14312	22.223	1.333	17.806	28.509
Lev	14312	0.415	0.199	0.008	0.986
Roa	14311	0.06	0.045	-0.401	0.517
Top1	14312	0.361	0.15	0.035	0.894
Inst	14312	0.407	0.24	0	1.568
Balance1	14311	0.344	0.286	0.001	1
SOE	14312	0.375	0.484	0	1
FA	14312	0.925	0.096	0.076	1
IA	14312	0.049	0.066	0	0.924
MTK	14312	8.132	1.809	-0.3	11.11
Big4	14312	0.069	0.254	0	1

Table 3 shows the correlations between the variables, with significant but small correlations between most of them. It can be found that there is a negative correlation between BTD and DT, which is a preliminary proof that digital transformation can inhibit the degree of corporate tax avoidance, and the hypothesis H1 of this study is initially tested.

## 5.2. Analysis of Regression Results

**5.2.1. Main Regression Analysis.** Table 4 reports the regression results on the effect of digital transformation on corporate tax avoidance. Columns (1) and (2) both show the regression results controlling for industry fixed effects and year fixed effects. Column (1) presents the regression results without adding control variables, and it can be found that the coefficient of DT is significantly negative at the 1% level, indicating that digital transformation has a significant inhibitory effect on corporate tax avoidance. Column (2) shows the regression results after adding the control variables, and the coefficient of DT is still significantly negative at the 1% level, indicating that the inhibitory effect of digital transformation on corporate tax avoidance is still significantly negative after accounting for the endogeneity caused by omitted variables. Therefore, the abovementioned regression results indicate support for the main hypothesis H1 of this study.

**5.2.2. Mediating Analysis.** Table 5 presents the results of the analysis with the quality of internal control as a mediating variable. Column (1) presents the regression results of model (3), and it can be found that the regression coefficient of DT is 0.029 and is significantly positive at the 1% level, indicating that digital transformation significantly improves the quality of internal control of the firm and that hypothesis H2a is proved. Column (2) shows the regression results of model (4), which indicates the regression results of the effect of internal control quality on corporate tax avoidance in the absence of digital transformation, and the coefficient of ICQ

is significantly negative at the 1% level, which can indicate that hypothesis H2b is valid. In addition, column (3) shows the regression results obtained by including both digital transformation and internal control in the regression model, and the results show that the coefficient of ICQ is still significantly negative at the 1% level, indicating that the inhibitory effect of digital transformation on corporate tax avoidance is partially achieved by the quality of corporate internal control in its mediating role. In summary, the mediating role of internal control quality proposed in H2 is valid.

**5.2.3. Moderating Analysis.** In order to further explore the relationship between digital transformation and corporate tax avoidance, this study examines the moderating role of external regulators, i.e., tax administration and government subsidies. This study tests whether tax administration and government subsidies have a moderating role between digital transformation and corporate tax avoidance based on model (6). Table 6 reports the results of the moderating effect analysis. According to the regression results reported in column (1), it can be found that the coefficients of the key interaction term  $DT \times TE$  are all significantly positive at the 5% level. This result indicates that the inhibitory effect of digital transformation on corporate tax avoidance behavior is more prominent among firms within regions with strong tax administration, and hypothesis H3 is verified. The regression results in column (2) show that the coefficient of the key interaction term  $DT \times SUB$  is significantly positive at the 5% level, which can indicate that the inhibitory effect of digital transformation on corporate tax avoidance is more pronounced among firms that receive more government subsidies, and hypothesis H4 is verified.

## 6. Robustness Tests

**6.1. Instrumental Variable Analysis.** The empirical study in this study may have an endogeneity problem caused by reverse causality, i.e., the higher the degree of tax avoidance,

TABLE 3: Correlation analysis.

	BTD	DT	ICQ	TE	Sub	Size	Lev	Roa
BTD	1							
DT	-0.021***	1						
ICQ	-0.024***	-0.02	1					
TE	-0.026***	-0.040***	0.039***	1				
Sub	-0.041***	-0.083***	0.113***	0.210***	1			
Size	0.064***	0.061***	0.210***	0.056***	0.090***	1		
Lev	-0.035***	-0.043***	0.109***	0.041***	0.082***	0.568***	1	
Roa	0.068***	0.023***	0.176***	-0.029***	-0.019	-0.113***	-0.374***	1
Top1	0.022***	-0.098***	0.105***	0.070***	0.029***	0.188***	0.089***	0.077***
Inst	0.062***	-0.019	0.153***	0.083***	0.072***	0.446***	0.245***	0.087***
Balance1	-0.012	0.079***	-0.048***	-0.072***	-0.027***	-0.071***	-0.128***	0.047***
SOE	0.055***	-0.151***	0.103***	0.131***	0.095***	0.358***	0.312***	-0.160***
FA	0.019	-0.155***	0.066***	0.038***	0.022***	-0.004	0.099***	-0.008
IA	-0.008	-0.066***	-0.026***	-0.034***	0.027***	0.025***	-0.023***	-0.001
MTK	0.022***	0.237***	-0.006	0.005	-0.111***	0.017	-0.088***	0.043***
Big4	0.063***	-0.019	0.149***	0.076***	0.047***	0.398***	0.143***	0.011
	Top1	Inst	Balance1	SOE	FA	IA	MTK	Big4
Top1	1							
Inst	0.327***	1						
Balance1	-0.599***	-0.115	1					
SOE	0.218***	0.375***	-0.228***	1				
FA	0.117***	0.028***	-0.104***	0.104***	1			
IA	0.026***	0.051***	0.010	0.071***	-0.649***	1		
MTK	-0.003	-0.034***	0.074***	-0.193***	-0.049***	-0.078***	1	
Big4	0.156***	0.241***	0.020	0.166***	-0.022***	0.071***	0.050***	1

the more cash flow firms hold, which may have an impact on firms' decisions to undertake digital transformation. To alleviate this problem, this study selects the number of urban Internet broadband access subscribers (DT\_Internal) and the average degree of digital transformation of other firms located in the same province and belonging to the same industry (DT\_Ind) as instrumental variables based on Zhou et al. [16] and Zhao et al. [52]. The same economic environment allows firms in the same province to enjoy similar digital infrastructure and digital economy development policies. In addition, firms in the same industry may have similar business characteristics and development strategies, which may lead to convergence in the digital transformation of firms. Therefore, the degree of digital transformation of enterprises is closely related to the digitalization process in the province and the degree of digital transformation of other enterprises in the same industry, and this result satisfies the correlation condition of the instrumental variable. Meanwhile, the extent of enterprises' tax avoidance is unlikely to be influenced by the overall digitalization process of enterprises in their region and the digital transformation of other enterprises, which ensures the endogeneity of the instrumental variables. Based on the abovementioned analysis, the instrumental variables in this study meet the selected criteria.

Drawing on the methodology of Jin and Wu [53], this study uses a two-stage approach for instrumental variable analysis. In the first stage, digital transformation (DT) is regressed as the dependent variable on the instrumental variables DT\_Internal and DT\_Ind and all control variables. In the second stage, we replace the degree of digital transformation (DT) in the full model with the arithmetic

mean of the fitted values of the first stage model. The estimation results are reported in Table 7, where the results of the first stage show that both instrumental variables are significantly positively associated with digital transformation, and the results of the second stage show that the coefficient of DT is significantly negative at the 1% level. This result further validates hypothesis H1. In addition, the results of the plausibility test related to the instrumental variables reported in the second stage further indicate that the instrumental variables were selected in accordance with the selected criteria.

**6.2. Self-Selected Problem.** Furthermore, to eliminate the bias caused by the sample self-selection problem, the propensity score matching method (PSM) is used to deal with this problem in this study. First, samples with a degree of digital transformation (DT) higher than the median are put into the experimental group (DT\_D = 1), and other samples are put into the control group (DT\_D = 0). Then, we set gearing ratio (Lev), top shareholder's ownership (Top1), institutional ownership (Inst), equity checks and balances (Balance1), nature of ownership (SOE), intangible asset ratio (IA), and whether there are four big ones (Big4) as characteristic variables and estimate the probability of each sample being selected into the experimental group by using the logit model. The 1 : 1 nearest neighbor matching method was used to match the samples selected for the experimental group with the corresponding control group samples. After matching, the standardized deviations of the control variables were all reduced and the *t*-test results indicated that there was no systematic difference between the two groups. Then, the reobtained samples were regressed again. Column (1) of Table 8 reports the regression results for the new



TABLE 4: Regression results of the impact of digital transformation on corporate tax avoidance.

Variables	(1) BTD	(2) BTD
DT	-0.074*** (0.015)	-0.085*** (0.015)
Size		0.128*** (0.018)
Lev		-0.883*** (0.115)
Roa		2.890*** (0.429)
Top1		-0.428*** (0.146)
Inst		0.174** (0.081)
Balance1		-0.223*** (0.072)
Soe		0.088** (0.040)
FA		0.422* (0.253)
IA		-0.483 (0.433)
Market		0.022** (0.010)
Big4		0.229*** (0.069)
Constant	-0.342*** (0.022)	-3.422*** (0.470)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Observations	14,312	14,312
R <sup>2</sup> (within)	0.281	0.448

Note: standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , and \*  $p < 0.1$ . The same is given as in the following table.

TABLE 5: Digital transformation, quality of internal controls, and corporate tax avoidance.

Variables	(1) ICQ	(2) BTD	(3) BTD
DT	0.029*** (0.006)		-0.081*** (0.015)
ICQ		-0.141*** (0.022)	-0.137*** (0.022)
Constant	2.323*** (0.182)		-3.105*** (0.472)
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Observations	14,312	14,312	14,312
R <sup>2</sup> (within)	0.687	0.456	0.474

samples, and the coefficient of DT is significantly negative at the 1% level, further supporting hypothesis H1.

6.3. *Alternative Measure of the Key Variable.* In terms of measuring digital transformation, we have adopted a new approach to measuring the frequency of words related to

TABLE 6: Regression results for moderating effects.

Variables	(1) BTD	(2) BTD
DT	-0.084*** (0.016)	-0.083*** (0.016)
TE	-0.093 (0.088)	
DT × TE	0.097** (0.067)	
Sub		-0.004 (0.003)
DT × Sub		0.003** (0.002)
Constant	-3.317*** (0.478)	-3.471*** (0.471)
Control variables	YES	YES
Year FE	YES	YES
Industry FE	YES	YES
Observations	14,312	14,312
R <sup>2</sup> (within)	0.48	0.48

TABLE 7: Instrumental variable method test.

Variables	First stage (1) DT	Second stage (2) BTD
DT		-0.234** (0.116)
DT_Internal	0.0001*** (0.0065)	
DT_Ind	0.661*** (0.042)	
Control variables	YES	YES
Year FE	YES	YES
Industry FE	YES	YES
Kleibergen-Paap rk LM statistic		252.514 [0.000]
Kleibergen-Paap rk Wald F statistic		129.719 [19.93]
Value of Hansen J p		0.709
Observations	14312	14312
R <sup>2</sup> (within)	0.379	0.413

The [] value is the  $P$  value, and the [] value is the critical value at the 10% level of the Stock–Yogo weak identification test.

“digital transformation” in the annual financial statements that we have obtained, i.e., if a category of words related to digital technology appears, the degree of digital transformation (DT) is increased by 1, otherwise it remains unchanged. According to this treatment, a DT value of 5 means that the company has adopted all digital technologies and represents the highest level of digital transformation, while a DT value of 0 represents the lowest level of digital transformation. For the measurement of corporate tax avoidance, our second measure builds on the first one, the abnormal tax club discrepancy (DDBTD) proposed by Desai and Dharmapala [54]. Based on the new key variables DT and DDBTD, we reran the regression and the regression results are shown in column (2) of Table 8, where we can find that the coefficient of DT is significantly negative at the 1% level. This result also proves the robustness of hypothesis H1.

TABLE 8: Robustness tests.

Variables	(1) BTB	(2) DDBTD	(3) BTB	(4) BTB	(5) BTB	(6) BTB	(7) BTB
DT	-0.104*** (0.021)	-0.084*** (0.017)	-0.077*** (0.016)	-0.116*** (0.019)	-0.094*** (0.019)	-0.094*** (0.015)	-0.091*** (0.014)
Constant	-3.758*** (0.649)	-2.618*** (0.509)	-3.153*** (0.502)	-3.938*** (0.592)	-4.627*** (0.528)	-3.372*** (0.470)	-3.339*** (0.470)
Year FE	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES
Observations	7,545	14312	11,476	9,181	11,949	14,310	14,253
R <sup>2</sup> (within)	0.492	0.420	0.476	0.543	0.470	0.454	0.452

*6.4. Using Subsamples.* To assess the robustness of the research results, the original sample selection process is modified in this study. First, the sample year interval is narrowed to 2012–2019 to obtain subsample A. The reasons for doing so are based on two main points: first, the financial crisis that erupted in 2008 caused abnormal fluctuations in the operating income and profits of listed companies, and this effect continued until 2011; second, by 2012, more than 85% of companies had not yet implemented digital transformation, which may have led to biased estimates. Second, the subsample B is obtained by excluding those firms from the original sample that have never implemented digital transformation and have a sample size of less than 5. Finally, the sample C is obtained by excluding high-tech firms because they have a higher foundation and likelihood of digital transformation, and the modified subsample is regressed using model (1). The regression results are reported in columns (3)–(5) of Table 8, and it can be found that the coefficients of DT are all significantly negative at the 1% level, which further supports hypothesis H1.

*6.5. Extended Observation Window.* Considering the possible time lag of the impact of digital transformation [55], this study lags the core explanatory variable (DT) by one and two periods, respectively, and then regresses it again according to model (1). Columns (6–7) of Table 8 report the regression results with one and two lags, and it can be found that the coefficient of DT is also significantly negative at the 1% level. This further corroborates the robustness of hypothesis H1.

## 7. Further Analysis

This study focuses on the impact of digital transformation on companies by reducing corporate tax avoidance from the perspective of investment efficiency.

A large number of existing studies have found that information asymmetry and interest frictions between

corporate management and shareholders are important factors that affect investment efficiency [56]. Information asymmetry makes management suffer from adverse selection and moral hazard problems; interest frictions are manifested by the inconsistent interests between management and shareholders, which in turn leads to the deviation of the firm's investment decisions from the goal of maximizing corporate value. It is easy to find that both information asymmetry and interest frictions will reduce the efficiency of corporate investment. Based on the agency view of tax avoidance, tax avoidance not only increases the degree of information misalignment but also makes the incentives within the firm ineffective, thus increasing the interest frictions between managers and shareholders [57]. From this, we conjecture that, assuming that other things are equal, the higher the degree of corporate tax avoidance, the more severe the principal-agent problem and the less efficient the firm's investment. Meanwhile, digital transformation can alleviate the information asymmetry between enterprises and the outside world, as well as reduce the agency costs of enterprises [58], enabling enterprises to not only obtain more information useful for investment decisions but also improve corporate governance [29], which in turn improves their investment efficiency. Based on the abovementioned analysis, the inhibitory effect of corporate digital transformation on corporate tax avoidance may further enhance the investment efficiency of firms. In this study, we analyse this issue, and for the measurement of corporate investment efficiency, we refer to the study of Richardson [59] and use the residuals of the OLS regression model to measure the investment efficiency of firms. Specifically, as shown in the regression model (7), Invest is the investment expenditure, Cash is the cash holding level, Return is the absolute value of the regression residuals, and Grow is the growth of the firm, which is measured using both the annual growth rate of the operating income and Tobin's Q. The remaining variables are consistent with the control variables in model (2).

$$\begin{aligned} \text{Invest}_{i,t} = & \theta_0 + \theta_1 \text{Grow}_{i,t-1} + \theta_2 \text{Lev}_{i,t-1} + \theta_3 \text{Cash}_{i,t-1} + \theta_4 \text{Age}_{i,t-1} + \theta_5 \text{Size}_{i,t-1} \\ & + \theta_6 \text{Return}_{i,t-1} + \theta_7 \text{Invest}_{i,t-1} + \text{Industry}_{fe} + \text{Year}_{fe} + \varepsilon_{i,t}. \end{aligned} \quad (7)$$

The absolute values of the regression residuals, namely, investment efficiency  $Effic1$  and  $Effic2$ , are obtained according to model (7), respectively. The obtained investment efficiency is regressed separately, and the regression results are shown in columns (1) and (2) of Table 9, where it can be found that the coefficients of the interaction term  $DT \times BTD$  are significantly positive, indicating that digital transformation can weaken the damage of corporate tax avoidance on corporate investment efficiency. In general, digital transformation can significantly improve corporate investment efficiency by inhibiting corporate tax avoidance.

## 8. Implications and Limitations

**8.1. Implications.** There are several theoretical implications and practical value for this research study. First, in the context of the rapid development of China's digital economy, the study of the impact of digital transformation on corporate financial decisions is extended from the perspective of corporate tax avoidance. It verifies that digital transformation can improve the efficiency of corporate investment by reducing corporate tax avoidance, providing empirical evidence for the government to vigorously promote digital transformation in enterprises. Second, the mechanism of digital transformation affecting corporate tax avoidance is examined from the perspective of internal control, providing empirical evidence for insight into the logical relationship between the two. Third, a heterogeneity analysis was conducted from the perspective of tax collection intensity and government subsidies, providing empirical evidence for the government to improve tax collection and rationalise the allocation of market resources.

**8.2. Limitations.** Inevitably, there are certain limitations to the research in this study, which also provide scope for future research. First, the findings of this study are somewhat deficient in terms of generalisability. This is because our research sample focuses on Chinese listed companies, but there are many unlisted companies in China. Whether the causal relationships derived in this study are equally applicable to this group of firms remains to be further tested. Our future research can further test whether the findings of this study are also applicable to unlisted companies in China to verify the generalisability of our findings in a developing country such as China. Second, the findings of this study are more applicable to similar developing countries than to all countries, as the institutional backgrounds and economic environments of different countries vary significantly. Further, future research could conduct comparative studies in emerging economies and developed countries to examine the applicability of our research model in different development contexts. Third, in terms of the mechanisms of digital transformation's impact on corporate tax avoidance, this study only examines the path of the quality of corporate internal controls, but the impact of digital transformation is multifaceted, such as corporate governance and innovation capabilities, and other different paths of influence may exist. Our future research will also explore this issue in order to

TABLE 9: Digital transformation, corporate tax avoidance, and corporate investment efficiency.

Variables	(1)	(2)
	$Effic1$	$Effic2$
DT	0.222*** (0.085)	0.156** (0.067)
BTD	-0.058 (0.036)	-0.060** (0.029)
BTD $\times$ DT	0.030** (0.026)	0.023** (0.020)
Constant	3.517*** (3.660)	3.331*** (2.952)
Control variables	YES	YES
Year FE	YES	YES
Industry FE	YES	YES
Observations	14312	14312
$R^2$ (within)	0.206	0.234

enrich the impact mechanisms involved. Fourth, as the legitimacy of corporate tax avoidance is currently difficult to clearly quantify and define empirically, the study in this paper draws heavily on the approach of Hanlon and Heitzman [60] and makes no distinction between reasonable and nonreasonable tax avoidance. Our future research will exclude the reasonable part of tax avoidance to make the findings of this study more robust.

## 9. Conclusion and Insights

This study examines the impact of digital transformation on corporate tax avoidance using a multidimensional fixed-effects linear model with a sample of A-share listed companies in Shanghai and Shenzhen from 2009 to 2019. The findings show that digital transformation can significantly inhibit corporate tax avoidance under the framework of principal-agent theory. Among them, mechanism analysis shows that digital transformation can reduce corporate tax avoidance by improving the quality of corporate internal controls; heterogeneity analysis shows that the inhibitory effect of digital transformation on corporate tax avoidance is more pronounced for firms located within regions with high tax administration intensity and for firms receiving more government subsidies. In addition, digital transformation can significantly improve firms' investment efficiency by inhibiting corporate tax avoidance. The research in this study deepens and expands the theoretical understanding of digital transformation and corporate tax avoidance and provides a reference for the government to help companies carry out digital transformation.

Based on the abovementioned empirical results, we can obtain the following insights:

First of all, on the one hand, the government should support enterprises to carry out digital transformation, which can not only reduce the extent of corporate tax avoidance, thus reducing the government's financial losses, but also enable enterprises to improve investment efficiency with the help of digital technology; on the other hand, enterprises should focus on the positive impact of digital transformation on enterprise investment efficiency, promote

the in-depth application of digital technology in enterprise investment decision-making, form a digital governance system, and make investment decisions that are scientific, standardised, and precise.

Second, enterprises should pay attention to the positive effect of digital transformation on the quality of internal control, improve the “compliance” oriented internal quality construction, reduce the risk of violating tax regulations due to tax avoidance, and effectively ensure the interests of shareholders.

Finally, tax authorities should strengthen the importance of tax administration, use digital technology to create a dynamic information disclosure platform and supervision platform interconnected with enterprises’ internal information systems, realise the digitization of tax collection and administration, and indirectly increase the cost of corporate tax avoidance by management in a way that improves the level of tax collection and enforcement. Enterprises should also actively cooperate with the tax collection and administration work of taxation departments and provide timely information and feedback on inspections. The shareholders of enterprises should incorporate corporate tax avoidance activities into the internal control system to effectively stop the self-interested behavior of management and better perform the supervision function.

## Data Availability

Data used to support the findings of this study are available from the corresponding author upon reasonable request.

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

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