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Digital Tax Enforcement and Corporate Abnormal Investment in China

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Abstract:

In recent years, various studies have examined the anomaly of a sudden increase in corporate investment in the fourth quarter and explained the tax planning logic behind this unusual investment phenomenon. However, the literature offers limited analysis of the influencing factors and economic consequences associated with these abnormal investments. Therefore, based on the quasi-natural experiment of the Golden Tax III project, characterized by enhanced digital tax enforcement, this study empirically tests the causal relationship between digital tax enforcement and corporate abnormal investment using a difference-in-differences approach. Benchmark results indicate that digital tax enforcement significantly increases corporate abnormal investments, and that this effect is more pronounced among firms with high tax burdens, severe financing constraints, high capital intensity, and weak cost-shifting ability. The mechanism test suggests that the above findings are attributable to the fact that increased digital tax enforcement makes it more difficult for firms to avoid taxes illegally, thereby increasing the incentive for firms to use abnormal investments to avoid taxes in a compliant manner. Further results show that the implementation of the policy significantly impairs the operating performance of firms, implying that abnormal investments can harm the long-term development of firms while achieving tax avoidance. Overall, this study has important theoretical and practical implications for how the tax reform could be revised to promote the effective investment of firms.

Keywords: Digital tax enforcement; Golden Tax III project; Tax planning; Abnormal investment

JEL Classification: D21; D22; D92; G31

1. Introduction

In recent years, some scholars have examined how taxation affects the distribution of corporate investment expenditures within their investment cycles. For instance, Xu and Zwick (2020) find that within a year-long investment cycle, US firms tend to invest more in the fourth quarter, resulting in a sudden increase in investment during that period. Similarly, Figure 1 displays the quarterly changes in investment expenditure of Chinese listed companies. From 2008 to 2021, the investment expenditures of Chinese listed companies in the fourth quarter were significantly higher than those of the previous three quarters, which is consistent with US firms (Xu and Zwick, 2020). The literature indicates that the sudden increase in investment in the fourth quarter can be attributed to firms engaging in reasonable tax avoidance to reduce their tax expenses (Xu and Zwick, 2020). However, the tax enforcement authority's pervasive utilization of information technologies, such as big data and cloud computing, has notably augmented its capacity to oversee tax-related information. Therefore, an issue worth exploring is whether digital tax enforcement significantly increases the difficulty of illegal tax evasion for firms, forcing them to use abnormal investments for compliant tax avoidance. The literature to date has mainly focused on discussing the tax planning motivations behind abnormal investment behavior, with less analysis of the underlying influencing factors and economic consequences. To fill this gap, we present empirical evidence supporting the influence of digital tax enforcement on firms' abnormal investment behavior and further explore the economic consequences on their overall operating performance.

[Insert Figure 1 here]

Previous studies suggest that firms facing high tax pressures are motivated to reduce their tax expenses by increasing their investments in fixed assets, overseas ventures, and research and development (Belz et al., 2017; Gordon and Hines, 2002; Liu et al., 2020). The

rationale for this is that relevant tax regulations provide various tax policies that can be used for the preferential management of corporate income tax, such as tax-exempt income, preferential tax rates, additional deductions, deduction of taxable income, accelerated depreciation, and tax offset. Therefore, the tax-exempt portion of fixed asset depreciation and R&D investment can be deducted before taxation, to a certain extent forming a "tax shield effect." This implies that firms can utilize the tax shielding effect of investments to reasonably avoid taxes and reduce tax expenses. Scholars are also interested in the economic behavior of firms that use investments to avoid taxes. For instance, Gordon and Hines (2002) indicate that firms invest overseas to transfer their profits when the tax burden in their home country becomes too high. Furthermore, Park (2016) finds that implementing the lowest alternative tax policy in the United States in 1999 increased corporate investment by 15% to 23%.

However, the tax shielding effect of corporate investments theoretically exists in any quarter. Therefore, a natural question is why companies prefer to invest in the fourth quarter, thus creating an abnormal investment phenomenon. Corporate income tax is calculated based on a tax year from January 1 to December 31, according to *Article 53 of the Enterprise Income Tax Law of the People's Republic of China*. Companies must determine their tax expenditures before December 31 of each year to conduct reasonable and legal financial planning, which means that the fourth quarter is the best time for companies to invest for tax planning purposes. Therefore, the dual impact of the "depreciation motive" and "option value motive" will further drive companies' preference for investing in the fourth quarter for tax planning purposes (Xu and Zwick, 2020).

Specifically, with respect to the depreciation motive, when calculating taxable income at the end of the year, companies deduct various taxes that are not subject to tax, tax-exempt income, and allowable pre-deducted taxes from their total revenue. During this process,

expenses incurred from the depreciation and amortization of fixed assets, intangible assets, and other investments can be deducted from the company's taxable income at the end of the year, thereby reducing its actual tax burden. Therefore, investment creates a depreciation incentive for the company in the fourth quarter.

With respect to the option value motive, in the first three quarters, companies can only predict their annual profitability based on their current income and expenditure. However, by the fourth quarter, most of their annual income and expenditure has already been accounted for, making it possible to estimate tax expenses more accurately. Some studies show that uncertainty can increase option value, and companies tend to postpone investments until uncertainty decreases (Bernanke, 1983; Gulen and Ion, 2016). Therefore, under the influence of the option value motive, companies tend to postpone investments when faced with high financial information uncertainty in the first three quarters. However, by the fourth quarter, when they can more accurately assess the income situation of the current year, companies may increase investment to minimize their taxable income. Hence, abnormal investments are driven by a company's tax planning motives and are closely related to the company's tax burden. In other words, companies with a higher tax burden are more motivated to use abnormal investments to avoid tax rationally than those with a lower tax burden (Xu and Zwick, 2020).

It is essential to recognize the significant influence of tax enforcement implemented by tax authorities on both enterprises' tax burden and illegal tax evasion behavior. Recent advancements in information technology, exemplified by the emergence of big data and cloud computing, have ushered in a novel phase in the realm of tax administration, termed "data-driven tax enforcement" (Degl'Innocenti and Rablen, 2020; Pomeranz and Vila-Belda, 2019). This paradigm shift is characterized by the progressive, pervasive digitalization of tax assessment and control mechanisms, which has brought about advances in tax information

supervision technology that have enhanced the regulatory capabilities of tax authorities. These developments are beneficial in strengthening tax enforcement, effectively combating illegal tax evasion, and ultimately ensuring government tax revenue (Casaburi and Troiano, 2016). The digitalization of tax enforcement has increased companies' compliance with tax laws, as the tax authorities now have improved abilities to obtain, identify, and evaluate tax-related information. This has led to an increase in enterprises' actual tax burden. This increased tax burden potentially heightens the impetus for corporations to partake in tax planning. As a result, we argue that because digital tax enforcement has made illegal tax evasion operations more difficult and costly, enterprises are more likely to select compliant abnormal investments for tax planning to achieve reasonable tax avoidance and reduce tax expenditures. In other words, we expect the digitalization of tax enforcement to lead to an increase in the scale of abnormal investments.

China offers an ideal experimental setting in which to investigate the ramifications of digital tax enforcement and corporate abnormal investment. The reason for this is that although it is a fact that Chinese firms have significant abnormal investment behavior, verifying the causal relationship between digital tax enforcement and corporate abnormal investment encounters two significant challenges. First, the digitalization of tax enforcement and corporate abnormal investment may be jointly driven by unobservable macroeconomic conditions, resulting in the omission of important variables that may subsequently bias the estimates. Second, it is challenging to measure the digitalization of tax enforcement directly and there is a lack of adequate proxy variables, leading to potential issues of measurement error. Fortunately, the Golden Tax III project launched in China in 2013 provides a unique opportunity to overcome these challenges. The project serves as an exogenous shock to firms, and has made it difficult for them to influence the government's implementation of macroeconomic policies, thus reducing the likelihood of endogeneity bias in the estimates.

Furthermore, the project is based on digital technology, which greatly enhances the tax department's ability to obtain, identify, and evaluate tax-related information, enabling the authorities to effectively crack down on illegal tax evasion (Li et al., 2020). Therefore, the project proves advantageous in identifying the digital regulatory capacity of tax-related information. China thus provides a valuable opportunity to study the digitalization of tax enforcement and corporate abnormal investments by combining the above facts about the characteristics of corporate abnormal investments in China and the launch of the Golden Tax Phase III project in 2013.

Specifically, the Golden Tax III project has made significant contributions to tax information collection, identification, and assessment. First, in terms of tax information collection, the project uses standardized technological platforms to collect and process tax data from across the country. It also addresses the problem of information silos between departments by integrating external information from third parties through a robust information management system. Second, in terms of tax information identification, the project reduces tax authorities' overreliance on invoice vouchers during audits. It conducts deep mining of enterprises' upstream and downstream supply chain data information and utilizes digital technology to comprehensively identify information. Finally, regarding tax information assessment, the project uses complex mathematical models based on big data analysis technology to scientifically evaluate various firm financial indicators. Therefore, it can conduct comprehensive assessments of a company's tax revenue data from previous years and evaluate it in the context of the operating and tax information for the whole industry, effectively identifying companies with a tax burden that deviates from the industry average.

Based on the preceding analysis, we regard the Golden Tax III initiative as a quasi-natural experiment. Our study explores the impact of digital tax enforcement on

corporate abnormal investment using Chinese listed companies from 2008 to 2021. Because the Golden Tax III project was launched nationwide on a city-by-city and year-by-year basis, we use a staggered difference-in-differences (DID) model design to examine its effects. Moreover, following the measurement standard proposed by Xu and Zwick (2020), we use the ratio of investment expenditures in the fourth quarter to the average investment expenditures in the previous three quarters to represent abnormal investments. The results show that digital tax enforcement significantly increases companies' abnormal investments, which is consistent with our expectations. We conduct several additional tests, such as the parallel trend test, heterogeneity treatment effect test, placebo test, sensitivity test, and exclusion of alternative explanations test, to support our arguments.

After verifying the positive causal association between digital tax enforcement and abnormal investment, we further examine its underlying mechanism. First, to confirm that the abnormal investment behavior of Chinese companies is indeed driven by tax planning motives, we investigate the impact of the size of their taxable base on such behavior. In theory, if the purpose of abnormal investment is to minimize tax expenditures, then the larger the company's taxable base, the higher we would expect its abnormal investment to be. Accordingly, this study describes the corporate tax base in terms of whether the firm has positive earnings before interest and taxes (*Taxable*), and the ratio of earnings before interest and taxes to total assets (*Taxable1*). We find that the larger the taxable base of an enterprise, the more severe its abnormal investment behavior, thereby confirming the tax planning motives behind the abnormal investment behavior of enterprises.[1] Second, we further investigate the influence of digital tax enforcement on companies' non-compliant tax evasion. To this end, we use the difference between pre-tax accounting income (total profits) and taxable income (income tax expense divided by the income tax rate at the end of the period)

[1] We use whether the firm has a positive income before depreciation and amortization (*Ebitda*), and the ratio of income before depreciation and amortization to total assets (*Ebitda1*) as robustness indicators and obtain similar conclusions.

divided by total assets to measure the degree of tax evasion (*Evasion1*). The results show that the digitalization of tax enforcement significantly reduces the non-compliance tax evasion behavior of companies.[2] In summary, the digitalization of tax enforcement reduces non-compliance tax evasion behavior, which induces companies to use abnormal investments for reasonable tax planning to minimize tax expenditures. Therefore, we empirically verify our proposed impact mechanism.

Although we validate that the digitalization of tax enforcement reduces firms' illegal tax evasion, thereby forcing them to intensify abnormal investments to achieve reasonable tax avoidance, this impact may exhibit heterogeneity in a cross-sectional analysis. Therefore, we conduct several cross-sectional tests from the perspectives of the tax burden, financing constraints, capital intensity, and cost-shifting ability. First, firms with a higher tax burden have a stronger motivation to partake in tax planning through reasonable tax evasion. Second, as the digitalization of tax enforcement substantially augments the actual tax burden of firms, their motivation to transfer this tax burden pressure through abnormal investments will be stronger when they face additional financing constraints. Third, firms characterized by lower levels of capital intensity exhibit a greater dependence on labor inputs than firms with higher levels of capital intensity, which tend to rely more on capital investments. Thus, firms with high capital intensity are more likely to use abnormal investments for tax planning than firms with low capital intensity. Fourth, although the digitalization of tax enforcement increases the tax burden of firms, if firms have strong cost-shifting abilities, their engagement in reasonable tax evasion through abnormal investments will correspondingly decrease. Based on the above analysis, we find that the impact of digital tax enforcement on corporate abnormal investments is amplified in firms characterized by high tax burdens, high financing constraints, high capital intensity, and high cost-shifting abilities.

[2] We also use the residuals obtained from the regression of *Evasion1* on total profits (*Evasion2*) as an indicator of the robustness of tax evasion and obtain similar conclusions.

Finally, we further evaluate the response of overall corporate performance to tax enforcement digitalization, represented by the Golden Tax III project. Specifically, we use three measures, namely return on equity (*ROE*), the growth rate of profit (*Growth*), and Tobin's Q, to characterize the overall corporate performance. Our findings indicate that tax enforcement digitalization significantly reduces overall corporate performance. Indeed, previous research also suggests that a surge in investment during a particular period can harm the operational efficiency of firms (Sakellaris, 2004). Thus, based on the premise that the digitalization of tax enforcement increases abnormal investments by companies, we find that overall corporate performance tends to deteriorate.

The potential marginal contributions of this study are as follows. First, Hall and Jorgenson (1967) emphasize that taxation constitutes a significant determinant of corporate capital investment costs, thus rendering its incorporation into the theoretical framework of corporate investment essential. Building upon this foundation, a multitude of scholars have extensively examined how tax policies influence corporate investment behavior (Chirinko et al., 1999; Fan and Liu, 2020; Guceri and Albinowski, 2021; Hassett and Metcalf, 1999; Liu and Mao, 2019; Yagan, 2015; Zwick and Mahon, 2017). Nevertheless, these investigations predominantly focus on dissecting the impact of different taxation policies on the overall scale of corporate investment and various categories of investment, while paying less attention to the intra-investment cycle structural adjustments of corporate capital expenditures. Consequently, this study enriches the literature on microeconomic consequences in the realm of taxation policies, thus contributing to a comprehensive understanding of the formative logic underpinning corporate investment behaviors.

Second, as a significant taxation reform, the Golden Tax III project has received substantial attention from the academic community since its inception. There are a plethora of studies exploring the influence of the project on corporate behaviors, encompassing tax

avoidance strategies (Li et al., 2020) and earnings information (Zhao, 2023). Notably, one strand of research is concerned with the impact of the project on firms' investment efficiency (Zhang et al., 2023). In contrast, our study examines the influence of the Golden Tax III project's implementation on the temporal distribution of corporate investments across quarters, thereby confirming the tax avoidance function of firms' abnormal investments. Therefore, our findings not only enable a holistic assessment of the policy consequences stemming from the implementation of the Golden Tax III initiative but also supplement investigations into the determinants of corporate abnormal investments.

Third, this study effectively bridges the corporate investment and earnings management literatures. There are many studies of the influence of factors such as managerial incentives (Armstrong et al., 2015; Desai and Dharmapala, 2006), family firms (Chen et al., 2010), and institutional ownership (Colombo et al., 2018; Huseynov et al., 2017) on firms' tax avoidance motivations, thereby dissecting their implications for corporate earnings management behavior. This paper posits that the phenomenon of a significant upsurge in corporate investment expenditure during the fourth quarter not only serves to moderate firms' year-end earnings but also facilitates the attainment of the "tax shield" value attributed to investment depreciation, thus fundamentally characterizing abnormal investment as a form of earnings management strategy. Moreover, the digitalization of tax administration is poised to reinforce firms' incentives to use this earnings management strategy, thereby enriching and complementing the realm of earnings management research.

The rest of this paper is organized as follows. Section 2 describes the institutional background. Section 3 illustrates the identification strategy, including the econometric specification, data, and variable definitions. Section 4 reports the empirical results, including the baseline results and robustness tests. Section 5 presents the mechanism tests, heterogeneous effects, and further discussion. Section 6 concludes the paper.

2. Institutional background

Leveraging digital information technology to enhance the accessibility and oversight of tax-associated information is a significant endeavor aimed at fostering the advancement of China's tax enforcement framework. Referred to as the Golden Tax Project, the China Tax Administration Information System encapsulates a meticulously crafted contemporary system that integrates tangible Chinese tax administration practices with advanced technological instruments. Over more than 20 years of construction and gradual improvement, China's Golden Tax System has gone through three stages: Golden Tax Phase I, Golden Tax Phase II, and Golden Tax Phase III.

Specifically, the State Administration of Taxation initiated the inaugural phase of the Golden Tax I project in 1994 to strategically advance the VAT cross-checking system. Nevertheless, owing to the sluggish pace of data input and the high prevalence of errors linked to manual invoice data entry, the Phase I initiative ended after a 2-year trial period. Subsequently, the State Administration of Taxation introduced the second phase of the project in 1998. This phase heralded the automated aggregation of invoice data and comprehensive oversight encompassing invoicing, certification, and auditing workflows. Consequently, the Golden Tax II project accomplished the integration of the VAT cross-checking system and the invoice co-checking system within a network framework, thereby markedly enhancing the efficiency of VAT tax compilation and administration. Nevertheless, confronted with the escalating volume of tax-associated information and the mounting intricacy of tax collection and management domains, the adaptability of the Golden Tax II project to the requirements of contemporary tax enforcement became increasingly tenuous. Thus, in response, the State Administration of Taxation took the initiative to introduce the Golden Tax III project.

In contrast to the preceding two projects, the third project has provided a considerable

impetus to the advancement of tax enforcement through heightened integration of information technology and enhanced operational efficiency. This concerted effort has culminated in a qualitative leap in the potency of tax enforcement capabilities (Li et al., 2020; Zhang et al., 2023; Zhao, 2023). The project has orchestrated the establishment of a technical foundation, encompassing network infrastructure and foundational software designed to uniformly process national tax-related data in adherence to standardized and consistent criteria, thereby ensuring the comprehensive inclusion of all tax categories. Since the implementation of this technical groundwork, the project has progressively enabled centralized data and information processing across both the State Administration of Taxation and provincial branches, facilitating a consolidated approach to the management of nationwide data. Moreover, the scope of the initiative spans all tax classifications and operational procedures, bolstered by a networked interaction with relevant entities, thus markedly enhancing tax bureaus' capacity to comprehensively access tax-centric information and overcome impediments to operational workflows. Notably, the initiative has undergone business restructuring, optimization, and standardization, thereby forging a principal tax management business system alongside four distinct application software systems encompassing administrative management, external information handling, and decision support functions. In summary, the Golden Tax III initiative has proficiently enhanced the tax enforcement capabilities of taxation agencies through the adept utilization of technologies such as big data and cloud computing, while promoting the digital elevation of China's tax collection and administrative domains.

Since its initiation in 2013, the Golden Tax III project has undergone a phased progression from initial local piloting to comprehensive adoption on a national scale. The inaugural phase took place in 2013 in Chongqing, Shandong, and Shanxi provinces. In 2014, the project was expanded across Henan, Inner Mongolia, and Guangdong provinces, with the

exception of Shenzhen city. Building on this momentum, in 2015, the State Administration of Taxation expanded this initiative to 14 additional provinces, including Hunan, Anhui, Sichuan, and Jilin, among others.. By 2016, the system had been inaugurated throughout all provinces and territories within China, with the exceptions of Hong Kong, Macau, and Taiwan. This feat marked the attainment of a nationwide diffusion and implementation of digitalized tax enforcement under the Golden Tax III framework. The successive advancement of the endeavor across diverse geographical realms has consistently elevated the level of digitalization within tax enforcement procedures. The dynamic nature of this institutional evolution engenders a valuable quasi-natural experimental setting, conducive to probing the ramifications of tax enforcement digitalization on corporate abnormal investments.

3. Data, variables, and strategy

3.1. Data

To assess the influence of the Golden Tax III project on the abnormal investment conduct exhibited by firms, we use a sample of Chinese listed companies from 2008 to 2021. The initial phase of the Golden Tax III experimental scheme was inaugurated in 2013, while the third phase commenced in 2016, so the chosen timeframe ensures an ample number of observations both preceding and following the advent of the policy disruptions.

The primary dataset is derived from the CSMAR database. The initial sample underwent the following refinement steps: (1) exclusion of financial entities (inclusive of banks, securities firms, and insurance enterprises), (2) exclusion of ST-category firms within the designated timespan, (3) exclusion of insolvent entities, and (4) exclusion of firms exhibiting negative abnormal investment values. All of the continuous variables are Winsorized at the 1st and 99th percentiles to prevent the undue influence of outliers on the estimations.

3.2. Variable definitions

3.2.1. Corporate abnormal investment

The dependent variable in this study is firms' abnormal investments (*Inv4*). Specifically, following Xu and Zwick (2020), we use the ratio of investment expenditures in the fourth quarter to the average investment expenditures in the previous three quarters to measure corporate abnormal investment. Corporate investment expenditure refers to the total paid by companies for the acquisition of fixed assets, intangible assets, and other long-term assets. The specific calculation method is shown in Equation (1):

$$Inv4 = \frac{InvQ4}{\left[\frac{InvQ1+InvQ2+InvQ3}{3}\right]}, \quad (1)$$

where *InvQ1*, *InvQ2*, *InvQ3*, and *InvQ4* denote the corporate investment expenditures from the first quarter to the fourth quarter, respectively.

3.2.2. Digitalization of tax enforcement

We measure the digitalization of tax enforcement (*Tax3*) by whether the corporate location is in a Golden Tax III pilot province. Specifically, for a pilot region, *Tax3* equals 0 before implementing the pilot project and 1 after implementing the project. For example, Jilin province started implementing the pilot project in 2015, so the *Tax3* of a company located in Jilin province is equal to 0 before 2015 and equal to 1 in 2015 and after. Consistent with the literature (Li et al., 2020; Zhang et al., 2023), in the areas where the pilot project was implemented in the second half of the year, we consider the start of the pilot to be in the next year.

3.2.3. Control variables

Following the literature (Xu and Zwick, 2020), we select the following control variables: firm investment expenditures (*Inv*), firm size (*Size*), profitability (*Roa*), investment opportunities (*Tobin*), asset-liability ratio (*Lev*), cash holdings (*Cash*), equity concentration (*Top1*), and the ratio of independent directors (*Ind*). The variables are defined in Table 1.

[Insert Table 1 here]

3.3. Model setting

As mentioned in the institutional background, the Golden Tax III project is characterized by batch piloting and gradual extension, which allows us to construct a DID model from the dimensions of region and time. Therefore, we use the DID method to assess the impact of tax enforcement digitalization on corporate abnormal investment. Referring to previous studies (Li et al., 2020; Zhang et al., 2023), we construct the following staggered DID model:

$$Inv4_{pit} = \alpha_0 + \alpha_1 Tax3_{pit} + \sum_j \beta_j X_{pit} + \mu_t + \delta_i + \epsilon_{pit}, \quad (2)$$

where *p*, *i*, and *t* refer to province, firm, and year, respectively. *Inv4* represents corporate abnormal investment. *Tax3* is a proxy variable to characterize digital tax enforcement by measuring the implementation of the Golden Tax III project. X denotes a set of control variables: firm investment expenditures (*Inv*), firm size (*Size*), profitability (*Roa*), investment opportunities (*Tobin*), asset-liability ratio (*Lev*), cash holdings (*Cash*), equity concentration (*Top1*), and the ratio of independent directors (*Ind*). μ_t and δ_i stand for year and firm fixed effects, respectively. To exclude the effects of heteroskedasticity and serial correlation on the parameter estimates, we cluster the standard errors of the estimated coefficients at the firm level. Based on the earlier theoretical analysis, we expect α_1 to be significantly larger than 0, indicating that the digitalization of tax enforcement exacerbates abnormal corporate investment.

3.4. Descriptive statistics

Table 2 displays the descriptive statistical distribution of the core variables. The sample mean for corporate abnormal investment (*Inv4*) is 2.4171, implying that the average investment expenditure of Chinese real firms in the fourth quarter is more than twice that of the previous three quarters. This shows the objective fact that abnormal investment behavior is prevalent among Chinese firms. In addition, the average *Tax3* is 0.5342, and the standard deviation is 0.4988. This shows that the variable *Tax3* has a large degree of variability, which

provides a sound foundation for the parameter estimation in this study. Finally, there are no outliers in the statistical distributions of the control variables such as firm size (*Size*) and profitability (*Roa*), indicating that the Winsorization of the variables is effective.

[Insert Table 2 here]

4. Empirical results

4.1. Baseline results

A regression based on Model (2) is used to test the impact of the Golden Tax III project on corporate abnormal investment. The findings from the baseline regression analysis are presented in Table 3. Column (1) presents the computed coefficient pertaining to *Tax3*, which is determined to be 0.1376. Notably, this coefficient exhibits a statistically significant positive association at the 1% level, in the absence of any control variables. This indicates that the digitalization of tax enforcement exacerbates abnormal corporate investment behavior, which is consistent with our theoretical expectations. In the regression results in columns (2) to (4), we gradually add control variables such as investment expenditure (*Inv*) and firm size (*Size*) to eliminate the impact of inherent differences between firms on the estimation results. We find that the estimated coefficient for the core explanatory variable (*Tax3*) remains significant and positive, which supports the initial conclusion.

Further, we attempt to explain the economic implications of the estimated coefficients. Taking column (4) as an example, the estimated coefficient of the core explanatory variable (*Tax3*) is 0.1968, which means that the ratio of investment expenditure in the fourth quarter to the average value of investment expenditure in the previous three quarters increases by 19.68% after implementing the Golden Tax Phase III project. This indicates that the digitalization of tax enforcement makes it more difficult for firms to evade taxes, which strengthens their motivation to use investment expenditures for tax planning and eventually leads to an

increase in abnormal investment behavior.

[Insert Table 3 here]

4.2. Robustness tests

To ascertain the robustness of the above findings, we first explore the dynamic effect of tax enforcement digitalization on abnormal investments using a parallel trend test. We correct for the heterogeneity treatment effect of the staggered DID model using the approach of Sun and Abraham (2021). Second, we conduct a placebo test to exclude the effect of other incidental factors on the regression results. Third, we conduct sensitivity tests by changing the sample and time window. Finally, we exclude other possible explanations based on abnormal sales in the fourth quarter, abnormal stock returns in the fourth quarter, CEO turnover, and CEO gender.

4.2.1. Parallel trend test

Notably, the baseline regression results are valid only if the assumption of parallel trends is satisfied. In other words, the abnormal investment behavior of firms in the experimental and control groups needs to exhibit a common trend before the policy implementation. To verify the parallel trend test, the following intertemporal dynamic model is constructed using the event study method to test the dynamic effect of digital tax enforcement on abnormal investments:

$$Inv4_{pit} = \alpha_0 + \sum_{n=-4,n\neq-1}^{4} \theta_n Tax3_{it}^{n} + \sum_j \beta_j X_{pit} + \mu_t + \delta_i + \epsilon_{pit}, \quad (3)$$

where D_{ct}^{n} is a dummy variable for the Golden Tax Phase III project and n represents the relative year of reform: $\mathrm{n} = 0$ indicates the current reform year, $\mathrm{n} < 0$ indicates the pre-reform year, and $\mathrm{n} > 0$ indicates the post-reform year. Assuming that $\mathrm{P_c}$ represents the project implementation year, $\mathrm{D_{ct}^{n}}$ is defined as $\mathrm{D_{ct}^{n}} = 1$ when $\mathrm{t} - \mathrm{P_c} = \mathrm{n}(-4 < \mathrm{n} < 4)$, otherwise $\mathrm{D_{ct}^{n}} = 0$. For example, $\mathrm{D_{ct}^{4}} = 1$ when $\mathrm{t} - \mathrm{P_c} \leq -4$, otherwise $\mathrm{D_{ct}^{-4}} = 0$; $\mathrm{D_{ct}^{4}} = 1$ when $\mathrm{t} - \mathrm{P_c} \geq 4$, otherwise $\mathrm{D_{ct}^{4}} = 0$. As the year preceding the project implementation (n =

-1) is set as the baseline period y, it is not included in Model (3).

We focus our attention on the magnitude and statistical significance of θ_n, which visually portrays the dynamic changes in corporate abnormal investment before and after implementing the Golden Tax III project. Figure 2 plots the estimated coefficients of θ_n and the confidence intervals at the 90% level. It can be seen that the magnitude of parameter θ_n is approximately 0 and fails to meet the 10% significance threshold prior to the execution of the project. This indicates that the abnormal investment of firms in the experimental and control groups did not change significantly before the reform, thus passing the parallel trend test.

Subsequent to the execution of the Golden Tax III project, the coefficient of θ_n is positive and statistically significant at the 10% level. This outcome substantiates the conspicuous divergence in abnormal investments between the experimental and control groups. Specifically, the influence of tax enforcement digitalization on the augmentation of abnormal investment is prominently manifested from the inaugural year of the reform's implementation and extends its influence throughout the ensuing years. In a holistic assessment, the outcomes derived from the analysis of dynamic effects provide robust corroboration to the preceding research conclusions.

[Insert Figure 2 here]

4.2.2. Heterogeneous treatment effect

It has been noted in previous studies that the staggered DID identification framework suffers from heterogeneous treatment effects (Callaway and Sant'Anna, 2021; De Chaisemartin and d'Haultfoeuille, 2020; Sun and Abraham, 2021). That is, the same policy produces different effects in different periods, leading to biased model estimates. Therefore, following Sun and Abraham (2021), we use the cohort-specific average treatment effects to correct for potential estimation bias. Specifically, we first divide firms into different treatment

groups G according to the time of the policy shock and divide the time T according to the year. Thus, we can obtain (G, T) based on group and time. Subsequently, we calculate the corresponding average treatment effect (ATT) for each grouping (G, T). Finally, we weight the average of ATT (G, T) to obtain the final estimate of the policy effect.

Figure 3 plots the corrected estimated coefficients of the core independent variables and the confidence intervals at the 90% level. The results show that the revised estimated coefficients remain non-significant before the implementation of the project, which again confirms the common trend hypothesis. Furthermore, compared with Figure 2, the revised estimated coefficients of the core explanatory variables are larger after the implementation of the project and still satisfy the significance test at the 10% level. In summary, after overcoming the heterogeneity treatment effect on the estimation results, the findings of this study still hold.

[Insert Figure 3 here]

4.2.3. Placebo test

To exclude the confounding effect of other unobservable factors on the baseline findings, we construct spurious experimental groups to conduct a placebo test, following Chetty et al. (2009) and Ferrara et al. (2012). Specifically, we first generate a dummy experimental group by randomly assigning each city in the sample interval as having either implemented or not implemented the Golden Tax III project, thus constructing a spurious core independent variable *Tax3_F*. Second, combining the above-mentioned control variables, we regress the variable *Tax3_F* on corporate abnormal investment.

Theoretically, the spurious independent variable should have no relationship with corporate abnormal investment, meaning that the regression coefficients should not be significantly different from 0. Figure 4 plots the kernel density functions and their corresponding p-values for the estimated coefficients obtained from 1,000 placebo tests. It is

clear that the majority of the p-values of the sampled estimated coefficients are distributed around 0. That is, the dummy treatment effect constructed in this study does not exist. Overall, these counterfactual results indirectly suggest that the baseline regression results are caused by implementing the Golden Tax III project rather than other factors.

[Insert Figure 4 here]

4.2.4. Sensitivity test

To ensure that the preceding conclusions are robust, we conduct a series of sensitivity tests, including changing the sample, changing the time window, and adjusting the model settings.

First, to test whether replacing the research sample affects the estimation results, we perform the following three tests. (1) The manufacturing industry is the main body of the real economy, and its production and operation activities cannot be separated from the input of fixed assets and intangible assets. At the same time, manufacturing firms make up the majority of the sample. Therefore, we use only the manufacturing sample for parameter re-estimation, and the results are shown in column (1) of Table 4. (2) The investment behavior of firms changes in a highly uncertain economic environment, and the outbreak of the international financial crisis in 2008 brought a significant shock to firms worldwide (Kim and Kung, 2017). Therefore, we change the time window to 2009–2021, and the regression results are presented in column (2) of Table 4. (3) To make the study sample more comparable in terms of time series, we transform the sample data from an unbalanced panel to a balanced panel. The regression results are presented in column (3) of Table 4.

Second, the corporate governance variables in the control variables of Model (2) include only a few. Therefore, to test whether the selection of control variables affects the baseline results, we include three more corporate governance variables in the baseline model: the combination of two offices (*Dual*), represented by whether the chairman and CEO are the

same person; board size (*Board*), represented by the number of board members; and management expense ratio (*Fee*), represented by the ratio of management expenses to total assets. The regression results are shown in column (4) of Table 4.

Finally, various industries follow different development cycles, and such time-varying characteristics may create bias in the baseline results. Therefore, we further incorporate industry–year interaction fixed effects in the baseline model, and the results are shown in column (5) of Table 4.

The estimation results for all columns in Table 4 reveal that the estimated coefficient of the core independent variable (*Tax3*) remains significant and negative when the study sample is changed or the model settings are adjusted, which is consistent with the baseline results.

[Insert Table 4 here]

4.2.5. Excluding other possible explanations

The preceding section discusses how the digitalization of tax enforcement exacerbates abnormal investment by strengthening the motivation for corporate tax planning. However, other potential factors could interfere with our findings, such as abnormal sales in the fourth quarter or turnover in corporate executives. Therefore, this section attempts to exclude the effects caused by other possible disturbances.

First, we exclude the impact of corporate abnormal sales in the fourth quarter. The principle for companies making investments is that they must have sufficient capital reserves. Therefore, if firms have higher sales in the fourth quarter, they will have the capacity to increase their investments in the fourth quarter. To exclude this potential interference, we use the same measure as abnormal investment to gauge abnormal sales (*S4*), which is the ratio of sales revenue in the fourth quarter to the average sales revenue in the previous three quarters. We include *S4* as a control variable in the baseline regression model and present the results in column (1) of Table 5.

Second, we exclude the effect of abnormal stock returns in the fourth quarter. Suppose investors are more willing to invest in the fourth quarter and contribute to higher corporate stock returns. This will drive the propensity of corporate decision-makers to increase investment spending in this quarter. Therefore, we use the ratio of stock returns in the fourth quarter to the average stock returns in the previous three quarters to measure corporate abnormal stock returns (*E4*). We include *E4* as a control variable in the baseline regression model and present the results in column (2) of Table 5.

Third, we exclude the effect of CEO turnover. In general, newly appointed CEOs tend to be more cautious in their investment decisions and spend less on investments than more established CEOs (Xie, 2015). However, they usually make investment judgments based on the financial budget at the end of the accounting period, leading to more investments in the fourth quarter. Therefore, we set a dummy variable *Tounovr*, which equals 1 if the corporate CEO changed in the current year and 0 otherwise. We include *Tounovr* as a control variable in the baseline model for regression, and the results are shown in column (3) of Table 5.

Fourth, we exclude the effect of CEO gender. Previous studies show that female CEOs exhibit more obvious risk-averse characteristics than male CEOs (Faccio et al., 2016). Thus, female CEOs typically make more cautious investment decisions in the first three quarters but choose to invest more at the end of the year. Therefore, we set a dummy variable *Ceosex*, which equals 1 if the CEO is female and 0 otherwise. We include *Ceosex* in the baseline model for regression, and the results are shown in column (4) of Table 5.

Fifth, we exclude the effect of CEO age. Older CEOs are generally more cautious about investment decisions than younger CEOs (Serfling, 2014). In other words, older CEOs might strictly control corporate investment expenditures in the first three quarters. However, they are forced to invest more in the fourth quarter to meet the annual investment budget, thus creating an abnormal investment phenomenon. Therefore, to exclude this alternative

explanation, we identify the median age of CEOs in the sample firms and use it as a grouping criterion to set a dummy variable *Ceoage*. *Ceoage* is equal to 1 if the CEO is older than the median and 0 otherwise. We include *Ceoage* in the baseline model for regression, and the results are shown in column (5) of Table 5.

Combining the regression results in all columns of Table 5, we find that the estimated coefficients of the core independent variable (*Tax3*) are significant and positive and consistently pass the significance test at the 1% level. These results indicate that the baseline results of this study remain robust after excluding other possible explanations.

[Insert Table 5 here]

5. Further analysis

5.1. Mechanism analysis

5.1.1. Corporate tax base

Based on our previous theoretical analysis, we posit that digital tax enforcement elevates the intricacy of the actions associated with evading taxes and the tax burden. The increased tax burden makes firms more inclined to use the tax shielding value of abnormal investments to reduce their tax expenditures. However, the validity of this analytical logic is based on the assumption that corporate abnormal investment behavior is indeed driven by tax planning motives. Although Xu and Zwick (2020) find that U.S. firms experience a surge in investment spending anomalies at the end of the year to minimize their tax expenditure, it is unclear whether this empirical evidence also applies to Chinese firms. In other words, to prove the validity of the logical analysis of this study, we first need to demonstrate the tax planning logic behind the abnormal investment behavior of firms.

Specifically, we explore the influence of the tax base on abnormal investments. Theoretically, if firms make abnormal investments with the aim of minimizing tax

expenditures, a larger tax base size will lead to more abnormal investments. Based on this logic, we construct two indicators to measure the size of the corporate tax base. The first indicator is *Taxable*, which equals 1 if the corporate EBIT is positive and 0 otherwise. The second indicator is *Taxable1*, which equals the ratio of EBIT to total corporate assets. We use whether the firm has a positive EBITDA (*Ebitda*) and the ratio of EBITDA to total corporate assets (*Ebitda1*) as robustness indicators. Table 6 reports the regression results on the impact of the size of the tax base on corporate abnormal investment. We find that the estimated coefficients of corporate tax base proxy variables are significantly positive regardless of the measurement. Overall, Table 6 fully demonstrates that the larger the corporate tax base, the more severe the abnormal investment behavior, thus confirming the corporate tax planning motive.

[Insert Table 6 here]

5.1.2. Corporate tax evasion

Second, we examine the influence of digital tax enforcement on corporate tax evasion. We argue that digital tax enforcement combats corporate tax evasion (Li et al., 2020) and forces firms to use abnormal investments for sound tax planning. To test this mechanism, we follow the approach of Liu et al. (2022) and use *Evasion1* to measure the degree of corporate tax evasion. Specifically, *Evasion1* is equal to the difference between pre-tax accounting earnings (total profits) and taxable earnings (end-of-period income tax expense divided by income tax rate) divided by total assets. A larger *Evasion1* value implies more severe tax evasion by the firm. In addition, we use the residual (*Evasion2*) obtained from the regression of *Evasion1* on total profits to measure the extent of corporate tax evasion. Because the residual term removes the part of *Evasion1* explained by surplus management, this generates a more accurate measure of corporate tax evasion.

Table 7 reports the results of digital tax enforcement on corporate tax evasion. We find

that when the dependent variable is *Evasion1*, the estimated coefficients of *Tax3* are all negative and consistently pass the significance test at the 1% level. Similarly, when the dependent variable is *Evasion2*, the estimated coefficients of *Tax3* are all negative and significant. These results fully suggest that the digitalization of tax enforcement significantly reduces corporate noncompliant tax evasion, thus providing empirical evidence for the core argument of this study.

[Insert Table 7 here]

5.2. Cross-sectional analysis

Although the baseline results provide empirical evidence that the digitalization of tax enforcement exacerbates corporate abnormal investment behavior, it ignores its heterogeneous manifestations among different types of firms. Accordingly, we further explore the relationship between tax enforcement digitalization and corporate abnormal investment from the perspectives of the corporate tax burden, financing constraint, factor intensity, and cost-shifting ability.

5.2.1. Tax burden

Generally, firms with higher tax burdens have stronger motivations for tax planning, such as reasonable tax avoidance. However, our research shows that the Golden Tax III project makes it more difficult for companies to engage in illegal tax evasion, leading to an increase in their actual tax burden. Under this circumstance, firms are forced to use abnormal investments for reasonable tax avoidance. Therefore, we expect that the digitalization of tax enforcement promotes abnormal investment more significantly in firms with a higher tax burden.

To verify the above assumptions, we construct *Taxburden1*[3] and *Taxburden2*[4] indicators to measure the corporate tax burden, following the approach of Liu et al. (2022). First, we

[3] *Taxburden1* = Income tax expense/Total profit.
[4] *Taxburden2* = (Income tax expense - Deferred income tax)/Total profit.

identify the median of *Taxburden1* and *Taxburden2*, and then categorize the samples above the median as firms with a higher tax burden and the rest of the samples as firms with a lower tax burden. Finally, we estimate subgroup regressions based on the median tax burden, and the results are shown in Table 8.

The findings presented in Table 8 illustrate that the estimated coefficient of *Tax3* is positive and strongly significant for firms with a substantial tax burden. Conversely, this coefficient does not demonstrate statistically significant outcomes at the 10% threshold in firms shouldering a lesser tax burden. Furthermore, the magnitude of the *Tax3* coefficient is notably greater for firms subject to a higher tax burden. Collectively, these outcomes provide compelling indications that the enhancing effect of digital tax enforcement on abnormal investment is prominent in firms confronted by a significant tax burden.

[Insert Table 8 here]

5.2.2. Financing constraint

Our mechanism tests show that the Golden Tax III project effectively strengthens the taxation department's ability to discover and transmit corporate financial information, thus significantly pushing up the actual tax burden of firms. Therefore, firms are more motivated to transfer their tax burden through abnormal investments under the dual pressure of financing constraints and tax expenditures. In other words, we expect that the promotion effect of the Golden Tax III project on abnormal investment is more obvious in firms with severe financing constraints.

Based on these foundations, we apply two distinct methodologies to assess corporate financing constraints. First, Chinese state-owned enterprises, in comparison to their non-state-owned counterparts, typically benefit from greater government support and preferential policies due to their pivotal role in ensuring the stable development of the national economy (Liu et al., 2021; Opie et al., 2019). Consequently, we categorize our

sample firms into non-state-owned and state-owned enterprises, with the latter enjoying a privileged status. Simultaneously, non-state-owned enterprises are designated as representing the high financing constraint cohort, while state-owned enterprises are classified as indicative of the low financing constraint cohort. Second, we calculate the SA index[5] (Hadlock and Pierce, 2010; Shi et al., 2023) as a gauge for measuring corporate financing constraints and subsequently determine the median value of the SA index. Using this SA median, we partition the sample firms into groups representing high and low financing constraint segments. Ultimately, our analytical approach entails conducting grouped regression analyses based on these financing constraints.

The results presented in Table 9 reveal that the computed coefficient associated with *Tax3* is positive and significant only for firms subject to substantial financing constraints. In contrast, the coefficient is not statistically significant at the 10% threshold for firms facing lower financing constraints. In sum, these findings imply that the enhanced connection between tax enforcement digitalization and abnormal investment is more prominent among firms confronted by elevated financing constraints.

[Insert Table 9 here]

5.2.3. Factor intensity

High capital-intensive firms rely more on capital investment in their production and operation activities than low capital-intensive firms. As a result, the abnormal investment activities of high capital-intensive firms deviate from the investment plans of low capital-intensity firms, resulting in higher investment costs. It can be inferred that low capital-intensity firms are less inclined to use abnormal investments for tax planning purposes. In other words, we expect that the facilitation effect of tax enforcement digitalization on corporate abnormal investment is more pronounced among firms with higher capital intensity.

[5] $\mathrm{SA} = -0.737 \times \mathrm{Size} + 0.043 \times \mathrm{Size}^2 - 0.040 \times \mathrm{Age}$. The larger the SA index, the more severe the financing constraints.

We classify the capital intensity of the sample firms in terms of firm and industry dimensions. First, we use the natural logarithm of corporate net fixed assets divided by the number of employees to measure corporate capital intensity (Chen et al., 2022). We then classify firms above the median as high capital-intensive firms and the rest as low capital-intensive firms. Second, we use the industry mean of corporate capital intensity to measure industry capital intensity and classify industries above the median as high capital-intensive industries, and the rest as low capital-intensive industries. We perform a grouped regression and the results are shown in Table 10.

The results presented in Table 10 show that the coefficient of *Tax3* is positive and strongly significant only for firms characterized by a high degree of capital intensity. The coefficient is not statistically significant at the 10% level for firms with lower levels of capital intensity. Furthermore, the coefficient of *Tax3* is of a greater magnitude for the high capital intensity subgroup than for the low capital intensity subgroup. On the whole, these findings suggest that the impact of tax enforcement digitalization on the augmentation of abnormal investment is more pronounced among firms with high capital intensity.

[Insert Table 10 here]

5.2.4. Cost-shifting ability

Tax expenses are essential accounting items for companies. Although it is difficult for firms to entirely shift the tax burden caused by the digitalization of tax enforcement, they can transfer some of the tax burden to costs. For example, studies find that firms can transfer costs such as taxes and social security contributions, to employees, consumers, or customers (Nielsen and Smyth, 2008). Thus, firms with strong cost-shifting capabilities may have fewer abnormal investment activities. In other words, we expect the promotion effect of the Golden Tax III project on abnormal investment to be smaller among firms with strong cost-shifting abilities.

According to previous studies (Chava et al., 2023; Liu et al., 2022), firms in competitive industries and those in the western provinces of China have lower cost-shifting abilities. Based on this, we measure the cost-shifting ability of firms. First, we calculate the Herfindahl index based on the primary operation revenue of firms as a measure of industry competitiveness and classify the group above the median (less competitive) as firms with strong cost-shifting abilities and the rest as those with weak cost-shifting ability. Second, we classify firms in the eastern provinces of China as firms with strong cost-shifting abilities and those in the central and western provinces as firms with weak cost-shifting abilities. Subsequently, we perform a grouped regression and the results are shown in Table 11.

It can be observed that the estimated coefficient of *Tax3* is positive and significant only among firms with weak cost-shifting ability; it does not satisfy the significance test at the 10% level among firms with strong cost-shifting abilities. Additionally, the coefficient of *Tax3* is larger in firms with weaker cost-shifting abilities than those with stronger cost-shifting abilities. Overall, these results suggest that the enhancing effect of digital tax enforcement on abnormal investment is more pronounced among firms with weaker cost-shifting ability.

[Insert Table 11 here]

5.3. Economic consequences analysis

We have demonstrated that the digitalization of tax enforcement can exacerbate abnormal investment by increasing the tax burden on firms. Moreover, this effect is heterogeneous depending on the tax burden, financing constraints, factor intensity, and cost-shifting ability. Nevertheless, it remains unclear whether firms' decisions to engage in abnormal investment in response to the upgraded digital tax enforcement have implications for their overall operational circumstances. Therefore, in our next analysis we examine the economic consequences associated with firms' operational conditions.

In theory, firms are expected to scientifically and rationally formulate investment plans

within the current fiscal year by expanding effective investments to maximize corporate returns. However, in the context of the Golden Tax Phase III project, firms engage in abnormal investment to reasonably avoid taxes. As a result, the original corporate investment plan is disrupted, which does not help to improve the firms' future profitability and the realization of its value. Based on this, we believe that abnormal investments made in the context of the digitalization of tax enforcement may worsen the overall operating conditions of firms.

To validate this conjecture, we follow the methodology of Serfling (2016) and capture the overall operational conditions of enterprises from three dimensions: return on equity (*ROE*), profit growth (*Growth*), and firm value (*Tobin's Q*).[6] As presented in Table 12, the estimated coefficients of the core explanatory variable, *Tax3*, are negative and significant at least at the 10% level. These results substantiate that the digitalization of tax enforcement significantly diminishes firms' operational performance and firm value, thereby worsening their overall operational conditions. In fact, previous research also indicates that a surge in investment during a particular period can impede firms' operational efficiency (Sakellaris, 2004). Thus, under the premise that the digitalization of tax enforcement exacerbates abnormal investment by firms, their overall operational conditions are prone to deteriorate.

[Insert Table 12 here]

6. Conclusion

Our examination of the quarterly data from non-financial listed companies in China provides evidence that corporate fixed asset investments are more concentrated in the fourth quarter, implying the presence of abnormal investment behavior. Nevertheless, the literature predominantly focuses on the tax planning motives behind such abnormal investment

[6] Firm value is measured using Tobin's Q, which is the sum of the market value of the stock and the book value of the debt divided by the total assets of the firm.

behaviors, with limited analysis of the underlying influencing factors and economic consequences. Consequently, leveraging the quasi-natural experiment of the Golden Tax III project, this study utilizes data from Chinese A-share listed companies from 2008 to 2021 to systematically investigate the influence of digital tax enforcement on corporate abnormal investment. The findings of this study reveal a significant increase in abnormal investment following the implementation of digital tax enforcement. This conclusion remains robust even after conducting various tests for dynamic effects, placebo tests, sensitivity analyses, and controlling for alternative explanatory variables. The mechanism test indicates that the baseline conclusion can be attributed to the substantial reduction in corporate tax evasion due to digital tax enforcement, which reinforces the incentive for corporations to engage in abnormal investment as a means of legitimate tax avoidance. Furthermore, considering the manifestation of these effects under different contextual conditions, a series of heterogeneity analyses are conducted. The results of our study indicate that the increasing effect of digital tax enforcement on corporate abnormal investment is more pronounced in firms characterized by high tax burdens, severe financing constraints, high capital intensity, and weak cost-shifting abilities. Finally, in assessing the economic consequences, we find that the tax burden introduced by digital tax enforcement adversely affects overall firm performance, leading to declines in net asset profitability, profit growth rate, and firm value.

Based on our findings, we propose a series of policy recommendations. First, while the application of information technology in the realm of tax enforcement facilitates the broadening of the corporate tax base, it also elevates the effective tax rate for enterprises, compelling them to escalate their abnormal investments for tax planning purposes. Hence, in the process of upgrading the digitized tax enforcement system, it is incumbent upon the government to counter this with appropriate tax reduction and fee alleviation policies, thus fostering the sustained long-term development of firms. Second, our research findings reveal

that the positive impact of digital tax enforcement on abnormal corporate investments is more pronounced among firms constrained by financing limitations. This implies that firms facing stronger financing constraints are more susceptible to the influence of higher tax burdens. In light of this, while intensifying the advancement of digital tax enforcement, the government should also enhance its support for corporate financing. Third, this study confirms that firms resorting to abnormal investments for tax evasion purposes compromise their long-term developmental capabilities. Hence, from an enterprise-centric perspective, it is imperative for firms to judiciously design their operational structures and refrain from indiscriminate reliance on abnormal investments to alleviate tax-related pressures. In other words, firms should undertake appropriate adjustments to their operational methods and capital structures based on their individual circumstances, thus enhancing their operational proficiency.

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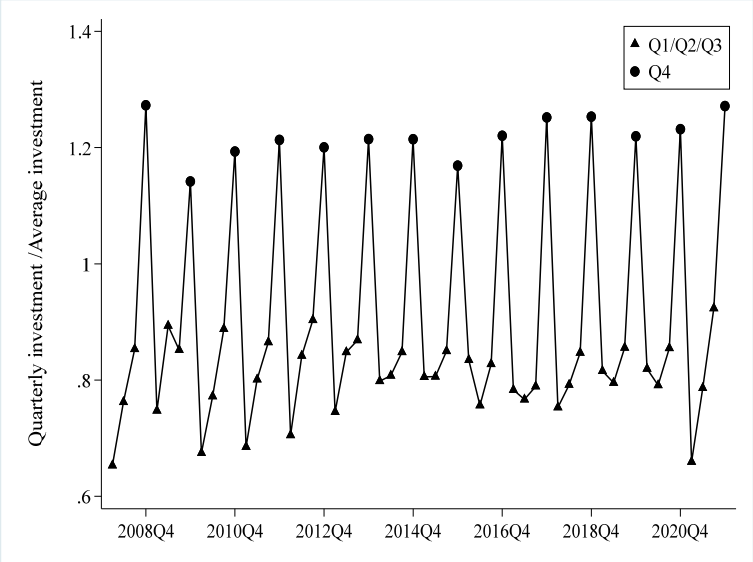

Fig. 1. Abnormal investment phenomenon in Chinese listed companies

Note: Figure 1 illustrates the quarterly variations in investment expenditure of Chinese listed companies from 2008 to 2021. The data are derived from the quarterly corporate investment records available in the CSMAR database.

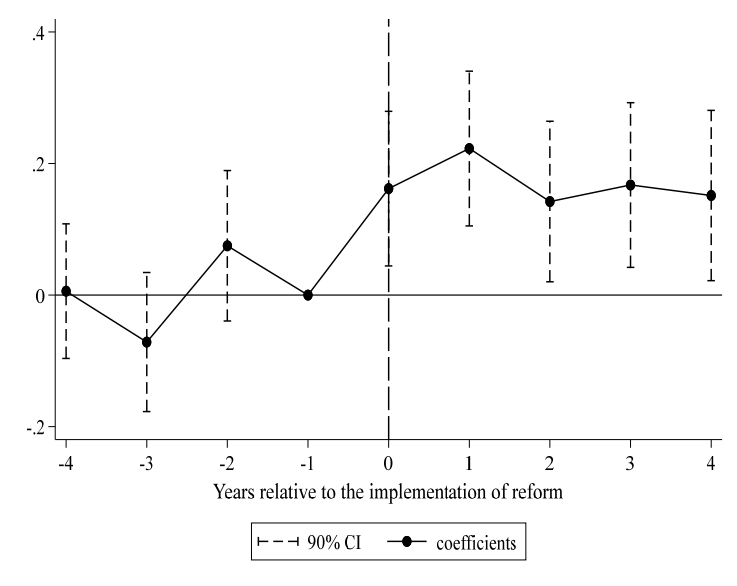

Fig. 2. Dynamic effect tests

Note: The figure compares the differences in abnormal investment among firms involved and not involved in the reform before and after the implementation of the Golden Tax III project to test for parallel trends.

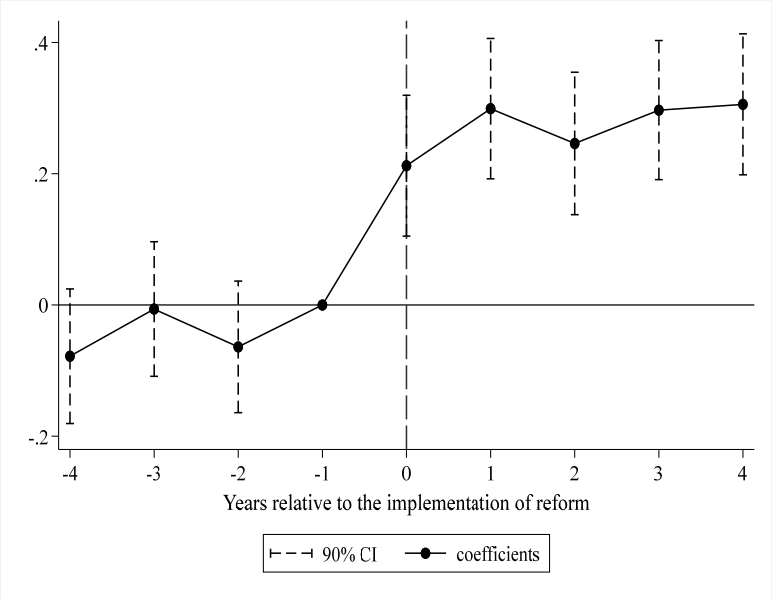

Fig. 3. Corrected dynamic effect tests

Note: The figure displays the parallel trend test with cohort–period averaging treatment effects to correct for potential estimation bias based on Figure 1.

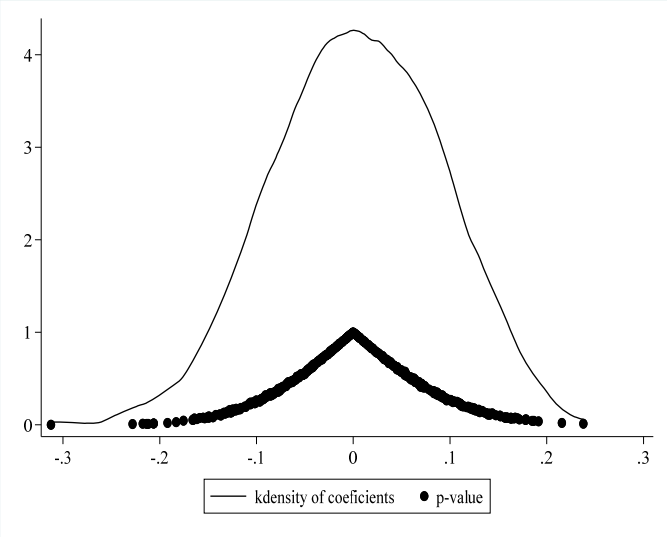

Fig. 4. Placebo tests

Note: The figure shows the result of a randomized placebo test and displays the coefficient distribution on the spurious policy variable *Tax*3_F generated by 1,000 random samples.

Table 1. Definition of variables

This table provides precise definitions of the fundamental variables.

Variable	Explanation	Definition
Inv4	Abnormal investments	The ratio of investment expenditures in the fourth quarter to the average investment expenditures in the previous three quarters
Tax3	Digital tax enforcement	Dummy variable equal to 1 if the province where the firm is located was selected as a pilot province for the Golden Tax III initiative in the current year and the following years, and 0 otherwise
Inv	Firm investment expenditure	Total cash paid for the acquisition of fixed assets, intangible assets, and other long-term assets divided by total assets
Size	Firm size	The natural logarithm of total assets
Roa	Profitability	The ratio of net profit to total assets
Tobin	Investment opportunity	The ratio of the sum of the stock market value and the book value of debt to the book value of total assets
Lev	Assets-liabilities ratio	The ratio of total debt to total assets
Cah	Cash holdings	The ratio of monetary funds to total assets
Top1	Equity concentration	The ratio of the shareholding of the largest shareholder
Ind	Independent directors	The ratio of the number of independent directors to the total number of board of directors

Table 2. Descriptive statistics

This table presents the descriptive statistics for the fundamental variables.

Variables	N	Mean	Std. Dev.	P5	p25	Median	p75	p95
Inv4	33,058	2.4171	2.7308	0.2213	0.8103	1.4511	2.6852	11.3506
Tax3	33,058	0.5342	0.4988	0.0000	0.0000	1.0000	1.0000	1.0000
Inv	32,043	0.0544	0.0473	0.0021	0.0169	0.0405	0.0790	0.1705
Size	33,058	22.0613	1.1976	20.2495	21.1336	21.9105	22.8456	24.5529
Roa	32,043	0.0340	0.7180	-0.0692	0.0137	0.0369	0.0670	0.1269
Tobin	31,289	1.9514	0.9924	0.9865	1.2366	1.6056	2.3081	4.6560
Lev	32,043	0.4334	0.2058	0.1048	0.2634	0.4269	0.5957	0.8029
Cash	33,058	0.1933	0.1318	0.0374	0.0948	0.1557	0.2593	0.5038
Top1	32,044	34.7257	15.1309	13.4400	22.9900	32.5650	45.0000	62.1900
Ind	31,963	0.3712	0.0446	0.3333	0.3333	0.3333	0.4286	0.4615

Table 3. Main results

This table presents the findings derived from the foundational regression analyses. *Tax3* denotes the proxy variable for the Golden Tax III policy to indicate the digitalization of tax enforcement. *Inv4* denotes the proxy variable for abnormal investment by firms. Standard errors clustered at the firm level are in parentheses. *, **, and *** represent the 10%, 5%, and 1% significance levels, respectively. (In the table below, the presentation format of significance levels and the meaning of the numbers in parentheses are the same as in Table 3.)

Variables	*Inv4*			
	(1)	(2)	(3)	(4)
Tax3	0.1376***	0.0746**	0.1181***	0.1968***
	(0.0296)	(0.0310)	(0.0318)	(0.0610)
Inv		-5.2254***	-4.8704***	-0.2844
		(0.3418)	(0.3465)	(0.5164)
Size		-0.0405***	-0.0842***	-0.0749
		(0.0150)	(0.0180)	(0.0495)
Roa		0.0095	0.0169	0.0445
		(0.0207)	(0.0209)	(0.0344)
Tobin			0.0811***	0.0702***
			(0.0179)	(0.0243)
Lev			1.0148***	0.2349
			(0.1026)	(0.2072)
Cash			0.0393	0.2425
			(0.1358)	(0.1901)
Top1				0.0017
				(0.0033)
Ind				-0.0268
				(0.6091)
Constant	2.3198***	3.5355***	3.8448***	-49.3321**
	(0.0256)	(0.3272)	(0.3962)	(20.8650)
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
N	33,058	32,043	31,289	31,214
Adj_R^2	0.0258	0.0587	0.0842	0.0041

Table 4. Robustness tests: Sensitivity tests

The table shows a series of sensitivity tests, including the exclusion of non-manufacturing firms, changes to the sample interval, and adjustment of the model settings. Column (1) displays the results when only firms in the manufacturing industry are retained. Column (2) displays the results when the sample interval is changed to 2009–2021. Column (3) denotes the results of transforming the unbalanced panel data into balanced panel data. Column (4) denotes the results with the inclusion of the proxy variables characterizing corporate governance. Column (5) denotes the results of including industry-year interaction fixed effects in the benchmark model.

Variables	*Inv4*				
	(1)	(2)	(3)	(4)	(5)
Tax3	0.2212***	0.2162***	0.2639***	0.2688***	0.2776***
	(0.0701)	(0.0683)	(0.0966)	(0.0973)	(0.0970)
Controls	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Ind-Year FE	NO	NO	NO	NO	YES
N	20,109	19,666	9,430	9,271	9,430
Adj_R^2	0.0066	0.0046	0.0068	0.0073	0.0141

Table 5. Robustness tests: Excluding other possible explanations

The table displays the robustness test results that exclude other possible explanations. Column (1) excludes the effect of abnormal sales in the fourth quarter. Column (2) excludes the effect of abnormal stock returns in the fourth quarter. Column (3) excludes the effect of CEO turnover. Column (4) excludes the impact of CEO gender. Column (5) excludes the effect of CEO age.

Variables	*Inv4*				
	(1)	(2)	(3)	(4)	(5)
Tax3	0.2016***	0.2007***	0.2035***	0.2045***	0.2059***
	(0.0609)	(0.0609)	(0.0619)	(0.0618)	(0.0618)
S4	0.0018				
	(0.0013)				
E4		0.0788**			
		(0.0328)			
Tounovr			0.0588		
			(0.0402)		
Ceosex				0.3110***	
				(0.1153)	
Ceoage					-0.0020
					(0.0038)
Controls	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
N	31,204	31,214	31,214	30,386	30,386
Adj_R^2	0.0050	0.0044	0.0043	0.0044	0.0047

Table 6. Mechanism: Corporate tax base

The table displays the results of a mechanism test of the corporate tax base designed to test the logic of tax planning behind the abnormal investment behavior of firms. We describe the corporate tax base in terms of whether the firm has positive earnings before interest and taxes (*Taxable*), and the ratio of earnings before interest and taxes to total assets (*Taxable1*). The corresponding regression results are presented in columns (1) and (3). Furthermore, we use whether the firm has a positive income before depreciation and amortization (*Ebitda*), and the ratio of income before depreciation and amortization to total assets (*Ebitda1*) as robustness indicators of the corporate tax base. The corresponding results are presented in columns (2) and (4).

Variables	*Inv4*			
	(1)	(2)	(3)	(4)
Taxable	0.2010***			
	(0.0672)			
Ebitda		1.4735***		
		(0.4950)		
Taxable1			0.1979**	
			(0.0804)	
Ebitda1				1.2205**
				(0.4903)
Controls	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
N	31,214	31,214	31,214	31,214
Adj_R^2	0.0042	0.0041	0.0040	0.0040

Table 7. Mechanism: Corporate tax avoidance

The table displays the mechanism test results for corporate tax evasion. The measure of corporate tax evasion (*Evasion1*) is equal to the difference between pre-tax accounting earnings (total profits) and taxable earnings (end-of-period income tax expense divided by income tax rate) divided by total assets. The corresponding regression results are shown in columns (1) and (2). We also use the residual (*Evasion2*) obtained from the regression of *Evasion1* on total profits to measure the extent of corporate tax evasion. The corresponding results are shown in columns (3) and (4).

	Evasion1	*Evasion1*	*Evasion2*	*Evasion2*
Variables	(1)	(2)	(3)	(4)
Tax3	-0.0012*	-0.0026***	-0.0013***	-0.0020***
	(0.0006)	(0.0006)	(0.0004)	(0.0004)
Controls	NO	YES	YES	YES
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
N	34,195	31,765	34,193	31,765
Adj_R^2	0.0271	0.0606	0.0032	0.0706

Table 8. Heterogeneity of corporate tax burden

The table displays the heterogeneity test results for corporate tax burden. We measure the corporate tax burden in two ways: *Taxburden1* = Income tax expense/Total profit, and *Taxburden2* = (Income tax expense - Deferred income tax)/Total profit. We then categorize the sample firms into two groups based on the median of *Taxburden1* and *Taxburden2*. Samples at and above the median are categorized as firms with high tax burdens and the rest as firms with low tax burdens. The differences in between-group coefficients pass the Chow test.

Variables	*Inv4*			
	Taxburden1		*Taxburden2*	
	High	Low	High	Low
	(1)	(2)	(3)	(4)
Tax3	0.3579***	0.0378	0.3377***	0.0826
	(0.0876)	(0.0900)	(0.0867)	(0.0918)
Controls	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
N	15,451	15,763	15,485	15,729
Adj_R^2	0.0035	0.0057	0.0038	0.0047

Table 9. Heterogeneity of financing constraints

The table displays the heterogeneity test results for financing constraints. Columns (1) and (2) show the results of grouped regressions based on the nature of firms' property rights. Columns (3) and (4) show the results of grouped regressions based on the SA index, a proxy variable for financing constraints. The differences in between-group coefficients pass the Chow test.

Variables	*Inv4*			
	The nature of firms' property rights		SA index	
	Non-SOEs	SOEs	High	Low
	(1)	(2)	(3)	(4)
Tax3	0.2204***	0.1500	0.2043**	0.0941
	(0.0793)	(0.0976)	(0.0843)	(0.0941)
Controls	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
N	19,778	11,436	16,313	14,901
Adj_R^2	0.0048	0.0062	0.0060	0.0033

Table 10. Heterogeneity of capital intensity

The table shows the results of the heterogeneity test for capital intensity. We classify the capital intensity of the sample firms into the firm and industry dimensions, respectively. We use the natural logarithm of corporate net fixed assets divided by the number of employees to measure the corporate capital intensity and classify firms above their median as high capital-intensive firms and those below as low capital-intensive firms. The corresponding regression results are shown in columns (1) and (2). We use the industry mean of corporate capital intensity to measure industry capital intensity and classify industries above the median as high capital-intensive industries and the rest as low capital-intensive industries. The corresponding regression results are shown in columns (3) and (4). The differences in between-group coefficients pass the Chow test.

Variables	*Inv4*			
	Corporate capital intensity		Industry capital intensity	
	Low	High	Low	High
	(1)	(2)	(3)	(4)
Tax3	0.1392*	0.2552**	0.1399*	0.2592***
	(0.0735)	(0.1051)	(0.0794)	(0.0943)
Controls	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
N	15,753	15,461	15,661	15,553
Adj_R^2	0.0064	0.0050	0.0046	0.0056

Table 11. Heterogeneity of cost-shifting ability

The table shows the results of the heterogeneity test for cost-shifting ability. We measure cost-shifting ability in two ways. First, we calculate the Herfindahl index based on the primary operational revenue of firms as a measure of industry competitiveness and classify the group with a revenue above the median (less competitive) as firms with strong cost-shifting abilities and the rest as those with weak cost-shifting ability. Second, we classify the group in the eastern provinces as firms with strong cost-shifting abilities and those in the central and western provinces as firms with weak cost-shifting abilities. The differences in between-group coefficients pass the Chow test.

Variables	*Inv4*			
	Degree of industry competition		Geographic location	
	Low	High	East	Midwest
	(1)	(2)	(3)	(4)
Tax3	0.1448	0.2308***	0.1533**	0.2662**
	(0.0947)	(0.0855)	(0.0718)	(0.1139)
Controls	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
N	15,640	15,574	21,552	9,662
Adj_R^2	0.0023	0.0045	0.0047	0.0063

Table 12. Economic consequences analysis

This table shows the results of the economic consequence analysis of the company's overall operational conditions. We measure the overall operational conditions of the firms in terms of three dimensions: return on equity (*ROE*), profit growth rate (*Growth*), and firm value (*Tobin's Q*), respectively, and correspond to columns (1), (2), and (3).

	ROE	*Growth*	*Tobin's Q*
Variables	(1)	(2)	(3)
Tax3	-0.1267*	-0.2079*	-0.0817***
	(0.0658)	(0.1070)	(0.0191)
Controls	YES	YES	YES
Firm FE	YES	YES	YES
Year FE	YES	YES	YES
N	31,660	25,874	31,900
Adj_R2	0.0017	0.0100	0.0907