Innovative Technology, Audit Fees and Audit Quality: A Quasi-Experiment from China

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Abstract

This study examines how the introduction and application of innovative technology affect audit fees and audit quality. Additionally, we investigate whether this impact will vary under the different ownership structures. China has occupied a position in cutting-edge technology with the support of policies from the Chinese government, which provides us with a quasi-experiment to investigate the perplexing problems above. Using the sample from Chinese listed firms and their annual reports, we find that audit fees increase after the introduction and further application of innovative technology. However, the introduction of innovative technology is asymmetric between state-owned enterprises (SOEs) and non-state-owned enterprises (NSOEs), where the ownership structure that SOEs will mitigate the upward audit fees led by innovative technology. Moreover, our research finds that audit quality is improved during the application of innovative technology as measured by three earnings management.

Key Words: Chinese Market; Audit Fees; Audit Quality; Innovation; Textual Mining

JEL Classification: M41, M42, M48, O38, O32

1. Introduction

This paper systematically examines the impact of innovative technology on audit fees at both the introduction and application stages where we find that the moderating effect of ownership structure does exist. It further attests to the positive relationship between the application of innovative technology and audit quality.

In the past few decades, technology has advanced rapidly and challenged the traditional business mode as well as the workflow within organizations. Some disruptive technologies have been applied in the audit process to change traditional audit pricing, e.g., Blockchain. Sandro Psaila, Deloitte (2017) reported the following:

"Blockchain can be used as a source of verification for reported transactions. An example might be where, instead of asking clients for bank statements or sending confirmation requests to third parties, auditors can easily verify the transactions on publically available blockchain ledgers such as http://www.blockchain.info or http://www.blockexplorer.com. The automation of this verification process will drive cost efficiencies in the audit environment."

Many hold the optimistic view that innovative technologies can simplify the audit process in addition to the reduction of audit fees without the sacrifice of audit quality. However, it has not been evidenced for the baseless remarks from imagination. Although extant research (Chen et al., 2014) has concluded that the capability improvement of information system does mitigate the upward audit fees by the investigation on the effect of some technology (e.g., information technology capabilities) applied to audit fees, this mitigation of increasing audit fees is not equivalent to the diminution of audit fees. In fact, due to the large procurement of technology equipment and R&D input, the introduction of innovative technology in corporations even increases the complexity of audits and the risk of accounting fraud (Karpoff, 2021). In addition, audit quality will also be doubtful because of the hardship of accounting fraud detection. However, some characteristics of innovative technology (e.g., the decentralization of blockchain) can mitigate the risk of internal audit failure and enhance the external audit quality simultaneously, which shows the ambiguity in the relationship between audit quality and innovative technology to be discovered. Since there is a lack of crucial evidence to shed light on the impact of innovative technology and auditing, we are motivated to conduct this research to uncover this relationship.

With the regard to the audit pricing, it has been contentious for a long time on how to price a reasonable equilibrium price for relevant audit services in a competitive audit market. Scholars (Simunic, 1980; Palmrose, 1986; Francis & Stokes, 1986; Craswell & Francis, 1999; Pong & Whittington, 1994) have found that audit fees are a conjunction of determinants, including firm size, firm complexity and auditor reputation, etc. Many of these factors have been carefully studied except for innovative technology due to the limitation of time. Logically, the impact of innovative technology on audit fees may be moderated by ownership structure. Prior research (Chen et al., 2010) concluded that state-owned enterprises (SOEs) adopt less conservative accounting than non-state-owned enterprises (NSOE). The fact is that they ignore the latent political pressure that SOEs face. Although we reckon that this empirical evidence is not adequate for the adoption of innovative technology, SOEs show stronger accounting conservatism when they apply innovative technology than NSOEs. For a long time, SOEs have not played a dominant role compared with small and medium-sized enterprises (SMEs) on the aspect of innovation in China (Chen, 2006), which provides evidence that SOEs have the proclivity to avoid potential losses under accounting conservatism. It is prevailing that SOEs are the source of capital raising for several SMEs, yet they refuse to introduce and apply innovative technology. We deem that SOEs enhance accounting conservatism and are conservative in the case of technological investment. Based on the prior analysis, investment in innovative technology will increase audit fees for which SOEs will mitigate the increase of audit fees or induce a potential anticlimactic trend in audit fees. Based on the association between audit fees and audit quality, we presume that the impact of innovative technology on audit fees may also be delivered to audit quality. Prior research (Venkataraman et al., 2008;

Choi et al., 2010) indicates that audit fees vary positively with audit quality under some circumstances which are usually of risk-driven restrictions or motivations (e.g., litigation risk), and upward audit pricing can be more transparent with the improvement of quality for auditing. We found that the bilateral causality between audit fees and audit quality does exist. Inspired by this ambiguous relation, we reckon that there must be some changes after the introduction of innovative technology which is often regarded as a coin with two sides.

Using a sample from Chinese listed firms from 2003 – 2020, we draw on the exogenous policy shock and DID model to capture the impact of innovative technology on audit fees and audit quality and found that the introduction and application of innovative technology do increase audit fees. We then investigated the moderating effect of different ownership structures on the relationship between innovative technology and audit fees. At the stage of introduction, SOEs does mitigate upward audit fees, regardless of the substantial increase in audit fees. Although audit fees increase synchronously for both SOEs and NSOEs, we did not find evidence that this influence of ownership structure plays a role at the stage of application. Ultimately, using a variety of proxies for audit quality, we found that the application of innovative technology does improve audit quality without inducing accounting fraud, which can be also supported by our robustness check.

This study makes several major contributions based on prior research and provides an innovative application of simple textual mining for further research.

First, for methodology, we combine the exogenous policy shock and textual mining via Python to capture the impact induced by enterprises' innovative technology, which helps us clarify innovative technologies of different levels. We designed our experiments by the use of Natural Language Processing (NLP) to parse the annual report and construct the relevant proxy as core dependent variables.

Second, our research provides direct and brief evidence for the role of innovative technology in the reduction of audit fees. We divided the process into two stages for the use of innovative technology within firms so as to provide a more credible result, where the evidence from these two stages indicates that the innovative technology cannot decrease audit fees. Simultaneously, this elaboration of our research design also enhances the robustness of our findings.

Third, we contribute to the previous findings about accounting conservatism within SOEs. We found that the increase of audit fees can be mitigated by the state-owned ownership structure, a factor decided by the accounting conservatism within SOEs, at the stage of introduction for innovative technology, but we did not find identical evidence at the stage of application for innovative technology. This finding also hints the true innovative pioneer in China which is the NSOEs to provide reference for the regulators.

Finally, our research testifies the positive relationship between the application of innovative technology and audit quality, which hints the positive correlation between audit fees and audit quality. Our empirical results support the use of innovative technology because it curbs the manipulation of earnings management within firms and increases the external audit quality.

The remainder of this paper is structured as follows. Section 2 and 3 discuss the relevant prior research with the development of our own hypothesis. Section 4, 5 and 6 present the empirical results respectively for the report of research design with the methodology of event study. Section 7 is the robustness check for the results we have obtained to enhance the credibility of our research. The final section contains our conclusion.

2. Literature Review

We anatomized the components of audit fees from two sides, which are the supply end and demand end with the reference to Hay et al. (2006) and found that innovative technology does have an influence on both the supply end and demand end. Obviously, innovative technology enhances the complexity and enlarges the measurement of asset size (especially for the allowable R&D capitalization under the Chinese Generally Accepted Accounting Principles) for listed firms. Although the minority (Menon & Williams, 2001) reckons that there is no conspicuous relationship between audit fees and firm's complexity irrespective of some idiosyncratic intervention, the majority (Firth, 1985; LOW et al., 1990) supports the positive relationship between firm size, audit complexity and audit fees based on the joint auditors' workload, where the inventory and accounts receivable have been emphasized in the early year. On the other hand, innovative technology brings challenges to traditional external auditing as well as requirement for the highly seasoned specialization of auditors, which causes forecasted increases in audit fees. However, little previous research supports this point; instead, Jensen & Payne (2005) attest the high-quality audit service by specialized auditors to lower audit fees, which may leave out technical skills rather than incorporating accounting skills only.

Furthermore, other factors within corporate governance also make a difference to audit fees, which leads to the ex-ante evaluation of the risk of falsification and then affects the auditors' workload during auditing process, of which audit fees may increase or earn a concession due to the difference of risk premium. Thereinto, early scholar captures the effect of institutional ownership on audit fees where there is a positive association between diffused external institutional stock ownership and audit fees but a negative association between the managerial stock ownership and audit fees (Mitra et al., 2007). Later, Nelson & Mohamed-Rusdi (2015) find a positive relationship between audit fees and firms' foreign or state-owned ownership of which the agency cost under the different ownership structures breeds a series of changes in cost (e.g., audit fees). In contrast, Alkordi et al. (2017) find that accounting conservatism can be affected positively by multiple ownership structures except for SOEs, which lacks credibility because of the different proportions of SOEs and the degree of marketization of the capital market. Collectively, all research above ignores the moderation of ownership structure in innovative technology, which should be distinguished from most traditional research because it is not only influenced by the voting right and other relevant causes conceived in different ownership structures, but also influenced by different corporations' missions and visions toward innovation and the circumstances of the Chinese domestic capital market.

Extended by audit fees, extant research has built the correlation between audit quality and audit fees, though it is ambiguous. Scholars (Venkataraman et al., 2008; Choi et al., 2010) have previously found that audit fees vary positively with audit quality under some circumstances (e.g., litigation risk) and that upward audit pricing can be more transparent under high-quality auditing. Apart from that, research from Lobo et al. (2018) and Nguyen et al. (2020) indicates an identically negative association between innovation and audit quality. Specifically, firms with more innovation will have to face pressure from external practitioners and implement earnings management, which sacrifices audit quality. However, the mutual benefit acquired by audit firms does exist (Rozario, 2019), and little finds that disruptive innovation (e.g., Blockchain) can enhance audit quality via strong external supervision with the improvement of transparency. And there exists a bilateral causality between innovative technology and audit quality, but it requires a robust research design to clarify the ambiguity.

3. Hypothesis Development

3.1. Audit Fees and Innovative Technology

As per the positive model of audit fees proposed by Simunic (1980), audit pricing is a conjunction of normal audit compensation, audit source cost and audit risk premium. In common sense, the introduction and further application of innovative technology may influence the audit resource cost and audit risk premium.

Prior research (Fischer, 1996) finds that new technology cannot improve audit efficiency directly as it is unlikely for all inter auditors to reach a consensus. Rather, the reduction and elimination of audit processes brought by technology decrease audit fees, which means that the diminution of audit resource cost does not originate from the new technology; instead, the risk premium inclines to increase as per the elimination of some audit processes. Therefore, the risk premium among audit fees will increase with both the introduction and application of innovative technology.

The Statement on Auditing Standards No. 47 (American Institute of Certified Public Accountants, 1983) first provides the official audit risk model, which defines that audit risk is an integration of inherent risk, control risk and detection risk, and innovative technology does increase the latter two factors at both stages.

On the one hand, internal auditors are unfamiliar with innovative technology, which enhances the difficulty to measure the appropriation of possible tremendous R&D expenditures incurred, where latent malicious fraud is conceived. Masli et al. (2010) find that efficient internal control monitoring technology is negatively associated with material weakness and upward audit fees. Logically, the extant internal mechanism lacks an effective method to confine such a case which makes it impossible for internal control and increases the control risk. On the other hand, innovative technology also challenges external auditors and increases detection risk. Consequently, firms may harness innovative technology to impede external auditing and implement accounting fraud, which requires high-level technical skills and seasoning audit skills. Overall, this uncertainty from both sides will increase the expected potential risk as well as the risk premium in audit fees. Thus, we propose our first hypothesis:

H1a: The introduction of innovative technology increases audit fees.

H1b: The application of innovative technology increases audit fees.

3.2 Ownership Structure and Impact of Innovative Technology on Audit Fees

In China, SMEs contribute 66% of patent applications, 74% of technological innovation and 82% of new products, which dominate field of innovative technology compared with giant SOEs.[1]

Girma et al. (2009) find that inward foreign direct investment (FDI) in the sector impedes innovative activity within SOEs, but there is a positive effect on the sector-level for few SOEs which have undertaken R&D activity. It means significant polarization of innovation within

[1] *China Economic Weekly*, July 15, www.ceweekly.cn.

SOEs groups, and most SOEs tend to be followers instead of pioneers.

We conjecture that this phenomenon is related to accounting conservatism within SOEs. Chinese scholars (Xia & Zhu, 2009) found that the burden of Chinese SOEs is heavier than NSOEs in terms of political concerns and pressures, which makes it more likely for SOEs to adopt accounting conservatism. Those of accounting conservatism call for quick verification on any profit that a company can make a claim to, in which uncertain liabilities are required to be recognized as quickly as possible. In contrast, the revenues will be recorded only when they are assured of being received. Such myopic behavior will curb firm-level R&D activity.

R&D activity often accompanies high long-term returns but a higher risk with short-term loss. According to those of the accounting conservatism, uncertain liabilities and potential losses are recorded instantly before the immediate disclosure to external market practitioners, which causes adverse shock for firms' development and puts SOEs' managers under political and social pressure. Therefore, SOEs have a weaker incentive to adopt innovative technology or increase R&D expenditure all the time, which fundamentally owes to the state-owned ownership structure. Finally, this weaker incentive of SOEs will mitigate the increase in audit fees compared with NSOEs under the premise of the positive association between audit fees and innovative technology. Thus, we posit the following:

H2a: State-owned ownership structure alleviates the increase in audit fees incurred by the introduction of innovative technology.

H2b: State-owned ownership structure alleviates the increase in audit fees incurred by the application of innovative technology.

3.3 Audit Quality and the Application of Innovative Technology

Some hold the pessimistic views and argue that innovative technology also creates more opportunities for accounting fraud. Despite the benefits of innovative technology, it also accompanies with a series of problems, i.e., the improvement in anonymity may reduce the risk of being detected and increase the fraud gain from cheating, which implies the potential deterioration of audit quality due to the undue application of innovative technology (Karpoff, 2021).

However, others point out that innovative technology will improve audit quality. Gökten & Özdoğan (2020) reckon that the development of Blockchain technology may enhance the accounting ecosystem by removing the necessity of intermediaries for monitoring value exchange transactions, reducing the cost of manual registration, and simplifying the traditional complex verification process. Analogously, the characteristics of decentralization, anonymity and data-sharing brought by innovative technology can increase financial transparency, which can reduce the complexity and latent risk of audited firms. Compared to the extremely small possibility where such a fraud case occurs, the wide application of innovative technology improves audit quality more. Also, the firms with tremendous investment in innovative technology tend to be the clients of the Big 4, where the failure of reporting the breach induces "more to lose" for big auditors for which they have to increase their audit quality collaterally and earn high client-specific quasi-rents as premiums (DeAngelo, 1981).

Furthermore, the Chinese domestic audit market has developed since the proposal issued by the Chinese Institution of Certified Public Accountants (CICPA) in 2007. The proposal aims at conceiving more competitive domestic audit firms through mergers, where a minimum of 25 partners and 50 CPAs are required in a special partnership organization (MOF and SAT, 2010). Though extant literature lacks the effect of this proposal on auditing in China, we reckon it must make a difference in audit quality during that period. Therefore, the change in audit quality at the introduction stage may have been blurred by the proposal, but the influence of the proposal will tend to be steady in the long-term and be incorporated into the audit market gradually, which brings us convenience to capture audit quality change at the application stage.

Overall, our conclusion is consistent with that in the review of Francis (2004), outright audit failure is still extremely rare, as it is for the low end of audit quality. Most extant evidence and our common sense still support the improvement of audit quality. Thus, we refine our final hypothesis as follows:

H3: The application of innovative technology enhances audit quality.

4. The impact of innovative technology on audit fees at the stage of introduction

Based on the generalized implementation of the *2012 Opinions on Deepening the Reform of the Scientific and Technological System and Speeding up the Building of a National Innovation System* (thereafter OPINIONS), we select all Chinese listed firms in this section. We use the standard difference in difference (DID) to investigate whether the introduction of innovative technology increases audit fees.

4.1. Sample Collection and Propensity Score Matching (PSM)

To align other exogenous variables and make ex-ante and ex-post audit fees comparable, we collect all audit related and other accounting data from the China Stock Market and Accounting Research (CSMAR) database. The details are shown in Table 1 with preliminary data cleansing.

To address the adverse influence caused by the heterogeneity between the treatment group and control group, we use PSM, which matches samples between the treatment group and control group. Under this premise, we can make a more exact causal effect inference because we have controlled the unobserved error and avoided the latent problem of endogeneity. The detailed PSM result is shown below.

We are also aware of the potential problem which may occur in the matching between different observations in different periods. And we will show the robustness check later.

4.2. Event Study for Chinese Listed Firms

4.2.1. Event Identification

Prior to the publication of *Opinions on Deepening the Reform of the Scientific and Technological System and Speeding up the Building of a National Innovation System* (thereafter

OPINIONS), the Chinese government has already implemented the *Outline of the National Program for Medium and Long-term Scientific and Technological Development (2006-2020)*, which aimed at promoting the accreditation of national independent innovative products. The OPINIONS is the supplementary policy to propel the further reinforcement of the latter policy and keep the heyday of corporate innovative environment prosperous. We use the OPINIONS as the first exogenous shock of which detail is shown in Table 18.

4.2.2. Methodology of Textual Mining and Viability

In our research, we use Python software to harness the Jieba package and parse the relevant keywords from annual reports of listed firms from 2012 to 2020 to measure the application of innovative technology. For the detailed keyword statistics, we count the frequency of each word related to innovative technology (e.g., Blockchain, Big Data, Cloud Computing, etc.). You can find the minutia of each keyword in Table 16 of our Appendix.

Logically, the annual report is an important tie bonding the external investors and firms for which firms are more likely to disclose the relevant information after they use innovative technology.

Moreover, Chinese Generally Accepted Accounting Principles (Chinese GAAP) provides domestic listed firms with strong motivation to innovate and disclose.

Compared to firms following the Generally Accepted Accounting Principles (US GAAP), Chinese listed firms tend to innovate driven by the legal capitalization incentive. In America, the FAS 2 from the Financial Accounting Standards Board Statements of Financial Accounting Standards has already prohibited the capitalization of any research and development costs except for software development costs incurred after feasibility has been established and compelled to report the R&D fees as expense. FAS 2 emphasized the certainty and comparability between the firms' disclosures as below:

"… the relationship between current research and development costs and the amount of resultant future benefits to an enterprise is so uncertain that capitalization of any research and development costs is not useful in assessing the earnings potential of the enterprise …"

"The Board has concluded that no set of conditions that might be established for capitalization of costs could achieve the comparability among enterprises that proponents of 'selective capitalization' cite as a primary objective of that approach."

Nevertheless, similar to International Financial Reporting Standards (IFRS), Chinese GAAP allows the capitalization of R&D fees, which means the R&D cost during the development period may be included in the asset partially with the improvement of some relevant financial metrics so as to increase the investor's confidence subsequently. Here, IFRS and Chinese GAAP reckon that an asset is a source as a result of past events and from which future potential economic benefits are expected to flow back, which is contrary to the views of "uncertainty" held by US GAAP. Thereby, the permission for capitalization of R&D fees provides the conspicuous benefit for Chinese listed firms and increases their motivation to adopt and disclose innovative technology after bearing the expensive start-up cost, where such abidance to government policy will help firms to earn the subsequent political bonus in the future.

Prior research (Oswald et al., 2021) from England finds that the R&D investment has a great upsurge after the transformation of UK GAAP (autonomous capitalization of R&D during the development period, which is similar to GAAP) to IFRS (forced capitalization of R&D).

Furthermore, prior scholar mentions (Dinh Thi & Schultze, 2011) that this kind of capitalization of R&D may bring idiosyncratic noise in comparability between different firms' financial reports, which improves the precision of financial analysis. Thus, we harness the textual mining tool to circumvent this circumstance and enhance the credibility of our further analysis.

4.2.3. Research Design

We use the regression model to evaluate the effect imposed by the implementation of

OPINIONS on audit fees for Chinese listed firms since 2012, which is regarded as the primal era of the overall application of innovative technology as we noted above.

In this section, we firstly use the difference in difference (DID) method as our identification strategy to evaluate the impact incurred by the application of innovative technology as a whole. In detail, we design two models to identify the impact – one is the standard DID model without control variables and the other one is the standard DID model with relevant control variables (Simunic, 1980; Francis, 1984; Palmrose, 1986; Lai, 2009; Dechow, 2010). And we expect an anticlimactic coefficient of policy impact on audit fees because some effects will be absorbed by covariates.

The two models are designed as below:

$$Fee_{i,t} = \beta_0 + \beta_1 Tech_{i,t} * Post_{i,t} + \sum_k \pi_k Year + \sum_l \delta_l Firm + \epsilon_{i,t} \quad (1)$$

$$Fee_{i,t} = \beta_0 + \beta_1 Tech_{i,t} * Post_{i,t} + \beta_2 Big4_{i,t} + \beta_3 Aduito_{i,t} + \beta_4 Inv_{i,t} + \beta_5 Rec_{i,t} + \beta_6 Roa_{i,t} + \beta_7 Lever_{i,t} + \beta_8 size_{i,t} + \sum_k \pi_k Year + \sum_l \delta_l Firm + \epsilon_{i,t} \quad (2)$$

Where the character i indicates the firm individual i and the character t indicates the year i. We coded the Tech variable as a dummy variable to distinguish the control group and treatment group. For the minutia of setting control group and treatment group, we encode a firm as 1 for all time and allocate it into the treatment group if the firm discloses the relevance about innovative technology (we pay special attention to the application of Blockchain) during the period of 2012-2020, otherwise, the firm will be coded as 0. The Post is a dummy variable that is equal to 1 if the time is after 2011, otherwise, it is 0.

To better evaluate the heterogeneity of impact by the adoption of innovative technology under different ownership structures (the SOEs and NSOEs), we develop the DID model by adding the moderator State which equals 1 if the firm is state-owned. To simplify the expression of regression model, we use the vector $CONTROL_{i,t}$ as the combination previous control variables (e.g., Big 4, Aduito, etc.):

$$Fee_{i,t} = \beta_0 + \beta_1 Tech_{i,t} * Post_{i,t} * State_{i,t} + \beta_2 Tech_{i,t} * Post_{i,t} + \beta_3 Post_{i,t} * State_{i,t} + \beta_5 Tech_{i,t} * State_{i,t} + \sum_k \pi_k Year + \sum_l \delta_l Firm + \epsilon_{i,t} \quad (3)$$

$$Fee_{i,t} = \beta_0 + \beta_1 Tech_{i,t} * Post_{i,t} * State_{i,t} + \beta_2 Tech_{i,t} * Post_{i,t} + \beta_3 Post_{i,t} * State_{i,t} + \beta_5 Tech_{i,t} * State_{i,t} + \beta_6 CONTROL_{i,t} + \sum_k \pi_k Year + \sum_l \delta_l Firm + \epsilon_{i,t} \quad (4)$$

4.2.4. PSM Result and Descriptive Statistics

According to the PSM result in Table 2, we find that there is a diminution of standardized difference of mean between the control group and treatment group in all covariates.

Overall, the descriptive statistics (insert the Panel A in Table 3) shows that all these covariates play important roles in our model construction based on the discrepancy of each between different firms. The reduction of each bias demonstrates that the variable Lever, Roa and Rec decreased drastically compared to the unmatching sample, which sheds light on the great discrepancy of financial condition through the statistics.

Panel B is the summary of the mean and median in both the treatment group and control group as well as the difference of them between the two groups. And we find that there is an apparent difference between these two groups except for the firms' accounts receivable and total liabilities scaled by the total assets. Among them, audit fees from firms that take advantage of innovative technology are higher than those that do not introduce innovative technology (e.g., Blockchain), which provides indirect evidence that the first movers of technological innovation have to burden the high expenditure from R&D cost. Furthermore, the difference between States shows that the number of state-owned firms is more than that of private firms, which demonstrates the latent conservatism in the adoption of innovation within state-owned firms. We reckon that the moderator of the ownership structure may be significantly negative due to the characteristic of inherent conservatism. The Aduito variable demonstrates that the firms with innovative technology are more likely to get a clean audit opinion, with high audit quality and high audit fees that are identical to prior hypothesis development. And the correlation matrix also exhibits the positive relationship between audit fees and the introduction of innovative technology (as we noted above, we judge whether the firm introduces innovative technology by the appearance of the keyword Blockchain, to put it in a more specific way, we focus on the correlation between Fee and Tech). what is worthwhile to mention is that the correlation coefficients between each variable also demonstrate there is no multicollinearity between them, which guarantees the validity for the estimation of our regression model (refer to Table 18).

4.2.5. Empirical Result

According to the regression model we designed above, we first test this relationship without the moderation of ownership structure (Hypothesis 1a). The result is shown in Table 4:

As we predicted in advance, the coefficient of the interaction (Post * Tech) elucidates the positive impact of innovative technology on listed firms' audit fees at the stage of introduction. The estimated coefficient in pool regression is larger than that in the fixed effect model regardless of the financial covariates, which means that the firm individual effect may distort the estimation of this kind of impact. Specifically, in the pool regression model, the coefficients in model 1 (0.149) and model 2 (0.088) indicate that there are 14.9% and 8.8% increase after the introduction of innovative technology with time effect control, respectively. With the fixed effect model, we find that the estimated influence is alleviated after controlling the individual effect where the coefficients in model 3 (0.064) and model 4 (0.070) elucidate that there are 6.4% and 7.0% increase after the introduction of innovative technology with both time effect control and individual effect control. Overall, the introduction of innovative technology can increase audit fees.

Table 5 shows the moderating effect of ownership structure on the impact that we have confirmed in Hypothesis 1a.

In detail, the intrinsic of state-owned firms shows the conservatism attitude toward the adoption of innovative technology, which means that they are more likely to act as the first follower instead of pioneers. We find that the introduction of innovative technology by state-owned firms may decrease audit fees compared to private firms without covariates. Specifically, model (1)'s estimation (-0.044 = -0.210 + 0.166) suggests that the introduction of innovative technology reduces audit fees by 4.4%, which is qualitatively contrary to prior estimation without controlling covariates. Model (2) shows the control variable significantly positive estimation for NSOEs, but the moderator is not significant enough. However, estimated by the fixed effect model considering the individual effect, either SOEs or NSOEs show an identical response to the introduction of innovative technology, which follows the Hypothesis 1a that the introduction of innovative technology may increase audit fees (0.106 and 0.100 for NSOEs, respectively; 0.015 and 0.038 for SOEs, respectively) and this impact can be alleviated if the firm is state-owned (the coefficients for the moderating effect are -0.091 and -0.062, respectively). And this moderating effect is also affected by other financial relevance because the estimation of this effect will be mitigated with additional control variables.

5. The Impact of Innovative Technology on Audit Fees at the stage of application

For the examination of the impact of the application of innovative technology on audit fees, we draw on the exogenous event shock to capture this influence of innovative technology at the stage of application.

5.1. Sample Collection

In this section, the sample is taken from section 4 to keep the investigation and effect of the natural experiment consecutive. We filter the initial sample collection in part 4.1 of section 4, where we delete the sample with the age before 2013 because we want to use a symmetric period to examine the effect induced by the application of innovative technology. Ultimately, we acquire the sample with 8,455 observations for the later hypothesis test.

5.2. Event Study for the listed firms' application of innovative technology in China

5.2.1. Event Identification

In 2016, the Chinese Ministry of Industry and Information Technology published the *White Paper on Blockchain Technology and Application Development in China* (thereafter WHITE). Later, the *13th FYP National Informatization Plan* (thereafter INFOPLAN) was published on 27 December 2016. Among them, some innovative technologies have been pointed out repeatedly, including Blockchain, Big Data, etc. We reckon this official document may propel the application of innovative technology dramatically with the consideration of its authority from the Chinese central government. Therefore, we use this event as an exogenous shock for further exploration of the impact brought by innovative technology on audit fees change at the stage of application, which enables us to distinguish audit fees change in different innovative periods (the introduction and the wide application). And the minutia is enclosed in Table 19.

5.2.2. Research Design

The intuition tells us that the intensity of application of innovative technology led by the exogenous policy is apparently different between each firm at each stage after the implementation of the policy. In terms of the exogenous event shock, we design a regression model based on the generalized DID method to evaluate the impact of innovative technology (especially the Blockchain) on audit fees at the stage of application, where there is slack on the assumption of the treatment group and control group under the generalized DID.

Following prior research in the accounting field (Ingram & Frazier, 1980), we mainly use the word frequency to construct a new proxy to measure the application intensity of innovative technology instead of the traditional financial ratio proxy. We believe the disclosure of keywords may be related to the application of innovative technology in China. And the minutia of reasoning has been explained in section 4 where we have explained the motivation of disclosure in China and the viability of this measurement in advance. And we use NLP to parse and split the annual report of each listed firm, and all this token we have acquired previously will be counted as per our need. The minutia has been enclosed in Appendix. After the preliminary process, we construct the intensity proxy as below:

$$Intensity_{i,t} = \frac{frequency_{i,t}}{Max(frequency_t)}$$

Similar to section 4, we develop a series of models to evaluate the application of innovative technology (especially the Blockchain) via the exogenous policy shock. Model (5) is the basic model without any variate. Furthermore, we follow the prior research mentioned above to develop the model (6) to control other relevant factors. Thereinto, the variable $Intensity_{i,t}$ is applied to replace the previous variable $\mathrm{Tech}_{\mathrm{I,t}}$, where we use the continuous variable ranging from 0 to 1 to replace the dummy variable. Specifically, the $Intensity_{i,t}$ exhibits the application intensity of Blockchain technology for firm i in year t, which is equivalent to the application intensity of innovative technology reasoned before.

$$Fee_{i,t} = \beta_0 + \beta_1 Intensity_{i,t} * Past_{i,t} + \sum_k \pi_k Year + \sum_l \delta_l Firm + \epsilon_{i,t} \quad (5)$$

$$Fee_{i,t} = \beta_0 + \beta_1 Intensity_{i,t} * Past_{i,t} + \beta_2 Big4_{i,t} + \beta_3 Aduito_{i,t} + \beta_4 Inv_{i,t} + \beta_5 Rec_{i,t} + \beta_6 Roa_{i,t} + \beta_7 Lever_{i,t} + \beta_8 size_{i,t} + \sum_k \pi_k Year + \sum_l \delta_l Firm + \epsilon_{i,t} \quad (6)$$

In terms of examining the moderating effect of ownership structure, we develop the model below to capture this effect. The regression is designed as below:

$$Fee_{i,t} = \beta_0 + \beta_1 Intensity_{i,t} * Past_{i,t} * State_{i,t} + \beta_2 Intensity_{i,t} * Past_{i,t} + \beta_3 Past_{i,t} * State_{i,t} + \beta_5 Intensity_{i,t} * State_{i,t} + \sum_k \pi_k Year + \sum_l \delta_l Firm + \epsilon_{i,t} \quad (7)$$

$$Fee_{i,t} = \beta_0 + \beta_1 Intensity_{i,t} * Past_{i,t} * State_{i,t} + \beta_2 Intensity_{i,t} * Past_{i,t} + \beta_3 Past_{i,t} * State_{i,t} + \beta_5 Intensity_{i,t} * State_{i,t} + \beta_6 CONTROL_{i,t} + \sum_k \pi_k Year + \sum_l \delta_l Firm + \epsilon_{i,t}$$

(8)

5.2.3. Descriptive Statistics and Correlation Matrix

The descriptive statistics of observations in section 5 have been attached below in Table 6, in which it can be seen that there is a significant upsurge in audit fees relative to the total sample in section 5. Besides, there is an increase of 0.11% for the proportion of auditors in the international Big 4 , which elucidates the change in audit quality. Compared with the data in Table 3 Panel A, the variable Lever (indicating the total liabilities) shows a great increase at the stage of application as well. On the one hand, it may be attributed to the instant procurement of necessary equipment and R&D investments for long-term amortization. On the other hand, this may also be led by the previous severe financial condition that sustains these days.

Furthermore, in the correlation matrix (refer to Table 19), we find there is a positive relationship between the total liabilities and audit fees. And the deterioration may cause the adverse issue of audit opinion. Under the negative correlation between audit opinion and audit fees (the higher audit fees usually require more audit work due to the complexity and the requirement of additional detection work), we therefore presume that the application of innovative technology as a pretext for severe financial circumstance may complicate the audit work and increase audit fees.

5.2.4. Empirical Results

The regression results in Table 7 show the estimation of the impact of innovative technology on audit fees at the stage of application, in which we use the variable Intensity to measure the application of innovative technology.

In the pool regression group, we find both the two coefficients are significant under the 99%

significance level. Without the covariates, the result indicates that the application of innovative technology may increase audit fees by 75.8% (0.758) at most, which double the primal audit fees. However, the anticlimactic diminution of the coefficient reveals the omitted variable bias does exist. After controlling the covariates, we estimate the coefficient as 0.279, which means that the application of innovative technology may increase audit fees by 27.9% at most.

In the fixed effect model, we find the estimation from the basic fixed effect model in group (3) is almost identical to the estimation in group (2) and more than the estimation for the basic model in group (1), which demonstrates the significant individual effect within samples, that is, the discrepancy between each firm is greatly large. Without covariates, the estimation via the fixed effect model indicates the increase of 32.7% (0.327) at most in audit fees. The quantitative decrease in this impact has been predicted before, however, the coefficient is not statistically significant. By the control of all covariates, we find that there is an increase of 12.9% (0.129) in audit fees, which is significant and qualitatively identical to precedent results.

The results in Table 8 exhibit the moderating effect of ownership structure. All estimations of interaction Intensity * Past show qualitatively identical to prior conjecture, but we do not find the firm evidence for the true difference between SOEs and NSOEs. We only find the item Intensity * Past * State significant in group (1) where we do not control any covariate, and the estimation indicated a twist of result for SOEs. The final estimation of the impact for SOE (-0.537 = -1.315 + 0.788) shows the diminution in audit fees. In summary, the application of innovative technology may decrease audit fees by 53.7% at most for SOEs. But we do not find abundant similar phenomena in other groups.

6. The Impact of Innovative Technology on Audit Quality at the stage of application

In this section, we will develop the empirical model to evaluate the impact of innovative technology on audit quality at the stage of application. Specifically, we take advantage of the word frequency statistics at the stage of application to evaluate this impact and examine the hypothesis 3 above.

6.1. Research Design and Specification of Proxy Construction

Following the prior research (Jones, 1991; Dechow et al., 1995; Dechow & Dichev, 2002; McNichols, 2002; Kothari et al., 2005), we harness three proxies related to accrual management to measure audit quality which are modified Jones Model, D&D Model and McNichols Model, respectively.

6.1.1. Modified Jones Model

Firstly, we applied Modified Jones Model to evaluate audit quality, where we decomposed the Total Accruals into Discretionary Accruals (DA) and Nondiscretionary Accruals (NDA).

$$TA_{i,t} = DA_{i,t} + NDA_{i,t} \qquad (9)$$

$$\frac{TA_{i,t}}{Asset_{i,t-1}} = \beta_0 \frac{1}{Asset_{i,t-1}} + \beta_1 \frac{\Delta REV_{i,t}}{Asset_{i,t-1}} + \beta_2 \frac{\Delta PPE_{i,t}}{Asset_{i,t-1}} + +\epsilon_{i,t} \quad (10)$$

$$\frac{TA_{i,t}}{Asset_{i,t-1}} = \beta_0 \frac{1}{Asset_{i,t-1}} + \beta_1 \frac{\Delta REV_{i,t} - \Delta REC_{i,t}}{Asset_{i,t-1}} + \beta_2 \frac{\Delta PPE_{i,t}}{Asset_{i,t-1}} + +\epsilon_{i,t} \qquad (11)$$

In the formula above, the Asset indicates the total assets of each firm, and the ΔREV is the incremental part of operational income. ΔPPE is the change of fixed assets and ΔREC is the incremental amount of accounts receivable.

Next, we applied the formula (10) for the regression of the regression coefficient. After that, we applied the coefficient of estimation in formula (10) to predict the $NDA_{i,t}$ based on formula

(11) and calculate the $DA_{i,t}$ by formula (9). In our research, we reserved the absolute value of $DA_{i,t}$ as the unobserved discretionary accruals for each listed firm (M_jones), which indicates the progress of implementation for earnings management activity of listed firms.

6.1.2. D&D Model

Under the view of cash flow, prior scholar provides the innovative estimation of abnormal accruals, which regresses the change in working capital of the previous, current and future cash flows as below:

$$\frac{TA_{i,t}}{Asset_{i,t-1}} = \beta_0 \frac{1}{Asset_{i,t-1}} + \beta_1 \frac{CFO_{i,t-1}}{Asset_{i,t-1}} + \beta_2 \frac{CFO_{i,t}}{Asset_{i,t-1}} + \beta_3 \frac{CFO_{i,t+1}}{Asset_{i,t-1}} + \epsilon_{i,t} \quad (11)$$

Where the calculation of TA has been enclosed in Table 17. And the CFO is the net operational cash flows and the Asset is as same as above.

We estimated the model (11) by year and industry and then interpreted the residuals from the regression model as the final proxy of abnormal accruals (DD). We only paid attention to the progress of earnings management instead of the deviation and reserved the absolute value of each residual as the final proxy to measure audit quality (ABDD).

6.1.3. McNichols Model

McNichols combined the idea of Dechow & Dichev and Jones into the other new model to estimate the total accruals as below:

$$\frac{TA_{i,t}}{Asset_{i,t-1}} = \beta_0 \frac{1}{Asset_{i,t-1}} + \beta_1 \frac{CFO_{i,t-1}}{Asset_{i,t-1}} + \beta_2 \frac{CFO_{i,t}}{Asset_{i,t-1}} + \beta_3 \frac{CFO_{i,t+1}}{Asset_{i,t-1}} + \beta_4 \frac{\Delta REV_{i,t} - \Delta REC_{i,t}}{Asset_{i,t-1}} +$$

$$\beta_5 \frac{\Delta PPE_{i,t}}{Asset_{i,t-1}} + \epsilon_{i,t} \quad (12)$$

Where, the definition of each variable is identical to the precedent formulas above. To eliminate the influence of firms' size, all variables have been scaled by the total assets in a lagged year. We designed the regression model (12) and interpreted the residual of regression to measure the progress of earnings management. Since we focusd on the progress instead of the deviation, we adopted the absolute value of the residual as the final proxy of audit quality

(McNichols).

6.1.4. Empirical Model Construction

Based on the three proxies that measure audit quality above, we constructed the empirical model below to investigate the impact of innovative technology on audit quality at the stage of application. The model is still identical to the precedent except for the dependent variable:

$$Adquality_{i,t} = \beta_0 + \beta_1 Intensity_{i,t} * Past_{i,t} + \sum_k \pi_k Year + \sum_l \delta_l Firm + \epsilon_{i,t} \quad (13)$$

$$Adquality_{i,t} = \beta_0 + \beta_1 Intensity_{i,t} * Past_{i,t} + \beta_2 Big4_{i,t} + \beta_3 Aduito_{i,t} + \beta_4 Inv_{i,t} + \beta_5 Rec_{i,t} + \beta_6 Roa_{i,t} + \beta_7 Lever_{i,t} + \beta_8 size_{i,t} + \sum_k \pi_k Year + \sum_l \delta_l Firm + \epsilon_{i,t} \quad (14)$$

Where the $Adquality_{i,t}$ indicates the different audit quality proxy (M_jones, ABDD, McNichols) for firm i in year t, the definition of other variables is same as before.

Next, we constructed the DID model with moderation to investigate the difference under the different ownership structures, and the model is shown below:

$$Adquality_{i,t} = \beta_0 + \beta_1 Intensity_{i,t} * Past_{i,t} * State_{i,t} + \beta_2 Intensity_{i,t} * Past_{i,t} + \beta_3 Past_{i,t} * State_{i,t} + \beta_5 Intensity_{i,t} * State_{i,t} + \sum_k \pi_k Year + \sum_l \delta_l Firm + \epsilon_{i,t} \quad (15)$$

$$Adquality_{i,t} = \beta_0 + \beta_1 Intensity_{i,t} * Past_{i,t} * State_{i,t} + \beta_2 Intensity_{i,t} * Past_{i,t} + \beta_3 Past_{i,t} * State_{i,t} + \beta_5 Intensity_{i,t} * State_{i,t} + \beta_6 CONTROL_{i,t} + \sum_k \pi_k Year + \sum_l \delta_l Firm + \epsilon_{i,t} \quad (16)$$

6.2. Empirical Result

The result can be seen in Table 9, where we find the identical evidence from the significant coefficient to testify our hypothesis 3.

The empirical result of our research shed light on the benign impact of innovative technology on audit quality at the stage of application. Specifically, all other estimations other than one insignificant positive estimation indicate that the application of innovative technology may decrease the earnings management, in other words, it may improve audit quality.

Thereinto, we find both the D&D model and McNicols model indicate an apparent increase in the estimation of this benign impact. For D&D model, the estimation changes from -0.172 to -0.227 by the control of covariates. And for McNicols model, the estimation changes from -0.192 to -0.219 by the control of the covariates.

However, the estimations under the modified jones model could not support our hypothesis 3. Nevertheless, we do not reckon the result of modified jones model can be controversial because the effect of diagnosis by Modified Jones model is relatively weaker than other models. Besides, McNicol combined the D&D model and Modified Jones model in which the effectiveness of the modified jones model has been incorporated.

Overall, the empirical estimation shows qualitatively identical results that the application of innovative technology may improve audit quality significantly.

In addition, we also examine the latent moderating effect of ownership structure on the relationship between the application of innovative technology and audit quality (Table 10). The regression result does not show the significant heterogeneity between SOEs and NSOEs, where all the items show that Intensity * Past * State are insignificant for which we could not capture the discrepancy between SOEs and NSOEs.

7. Robustness Check

In this section, we will develop a series of robustness check to confirm the credibility of our prior hypothesis examination. Specifically, there are two parts and each part is the robustness test for section 4 and section 5 respectively.

7.1. Robustness for Section 4

7.1.1. Parallel Trend Test

We first examine whether the parallel trend test is satisfied. The result is shown in figure 1 in Appendix. We choose the previous 6 periods (each period is equal to 1 year) and 5 periods for our test, and the current period is last year before the implementation of OPINIONS. We find the discrepancy is not significant from 0, which means there is no significant difference between the control group and the treatment group for which the assumption of DID is satisfied.

7.1.2. Placebo Test

In section 4, we conclude that the introduction of innovative technology will increase audit fees significantly.

Based on the DID model we use, we apply the placebo test to investigate the robustness of DID model, in which we split each observation into treatment group and control group randomly to examine whether the effect of this kind of increase is significant enough. besides, we also adjust each period of observation randomly, specifically, we allocate each observation into groups that are either before 2012 or after 2012 randomly.

The placebo tests in Figure2 and Figure 3 indicate that the impact of innovative technology on audit fees is not significant under the different random distributions, where the t value of the coefficient is the approximately normal distribution and it is quite far away from the real t value (4.7), which testifies the suitability of selecting the time of exogenous shock and the group.

7.1.3. PSM under each Cross Section

In the precedent experiment design, we use PSM to match the adjacent individual throughout different years. Though we posit the ideal condition is the match of one observation with the introduction of innovative technology to the other observation without the introduction of innovative technology in the same year, we could not ignore the occurrence of cross-period matching. Therefore, we match the observations from the treatment group with the other from the control group by year, respectively. And then, we follow the models from model (1) to model (4) to examine the robustness of our matching method. The results are shown below:

Table 11 shows qualitatively identical estimation for the impact of innovative technology on audit fees at the stage of application, though the estimated influence decreases relatively compared with the results in Table 4.

And Table 12 shows the moderating effect of ownership structure. Compared with the results in Table 5, we find that the impact of innovative technology on audit fees at the stage of application shows the opposite influence between SOEs (negative estimation with a decrease) and NSOEs (positive estimation with an increase). But model (4) is remained with the qualitatively identical estimation, which means, all listed firms will face an increase in audit fees after introducing innovative technology.

7.2. Robustness for Section 5

In section 5, we use one ratio proxy to measure the application of innovative technology. However, the self-defined variable may not be reliable, for which we apply other proxy to measure this intensity for the examination of robustness. Based on the counterfactual framework assumption, we examine whether the productivity behind each ratio proxy changes or not. Ideally, we hope that there is no difference between the productivity before and after the application of innovative technology so that we can attribute the increase in audit fees to the application of innovative technology precisely instead of the change induced by the change in productivity.

7.2.1. Change of Proxy

In this part, we first change the proxy for further examination of the relationship between the application of innovative technology and audit fees. Prior research (Mairesse & Mohnen,2010; Martinez-Conesa et al., 2017) has pointed out that some direct measurements may be applied for the evaluation of the innovative capability of firms (e.g., the proxy that the proportion of tertiary education employees, the proxy that the proportion of the R&D expenditure, etc.). Therefore, we use $\mathrm{Rdspend}_{i,t}$ to measure the intensity of application of innovative technology at the stage of application. This variable is the proportion of R&D expenditure that the operational income for firm i in year t. And we construct models as below:

$$Fee_{i,t} = \beta_0 + \mathrm{Rdspend}_{i,t} * Past_{i,t} + \sum_k \pi_k Year + \sum_l \delta_l Firm + \epsilon_{i,t} \quad (17)$$

$$Fee_{i,t} = \beta_0 + \beta_1 \mathrm{Rdspend}_{i,t} * Past_{i,t} + \beta_2 Big4_{i,t} + \beta_3 Aduito_{i,t} + \beta_4 Inv_{i,t} + \beta_5 Rec_{i,t} + \beta_6 Roa_{i,t} + \beta_7 Lever_{i,t} + \beta_8 size_{i,t} + \sum_k \pi_k Year + \sum_l \delta_l Firm + \epsilon_{i,t} \quad (18)$$

$$Fee_{i,t} = \beta_0 + \beta_1 \mathrm{Rdspend}_{i,t} * Past_{i,t} * State_{i,t} + \beta_2 Intensity_{i,t} * Past_{i,t} + \beta_3 Past_{i,t} * State_{i,t} + \beta_5 Intensity_{i,t} * State_{i,t} + \sum_k \pi_k Year + \sum_l \delta_l Firm + \epsilon_{i,t} \quad (19)$$

$$Fee_{i,t} = \beta_0 + \beta_1 \mathrm{Rdspend}_{i,t} * Past_{i,t} * State_{i,t} + \beta_2 Intensity_{i,t} * Past_{i,t} + \beta_3 Past_{i,t} * State_{i,t} + \beta_5 Intensity_{i,t} * State_{i,t} + \beta_6 CONTROL_{i,t} + \sum_k \pi_k Year + \sum_l \delta_l Firm + \epsilon_{i,t}$$

(20)

Compared with the result in Table 7, the coefficient in Table 13 is significant with a positive value as expected in the most robust model (4), which provides direct evidence that the application of innovative technology may increase audit fees after the control of the time effect and individual effect.

In terms of the moderating effect of ownership structure on the relationship above, Table 14 also provides the same evidence that audit fees increase with the application of innovative technology as well, but we do not find the obvious evidence that the state-owned ownership structure may weaken or enhance this impact.

7.2.2. Recognition of Assumption of Counterfactual Framework

As mentioned above, we want to attribute the increase in audit fees to the application of innovative technology. However, the productivity behind each proxy can also change audit fees. For example, an increase in productivity may increase the efficiency and effectiveness of R&D expenditure, which may also enhance internal control and decrease the part of risk premium in audit fees and audit fees as well.

For investigating whether the productivity satisfies the assumption that the productivity at least does not increase audit fees, we regress audit fees to the proxy for the intensity of application of innovative technology at the stage of application dichotomously (before and after 2017) and interpret the coefficient as the productivity under each measurement where the higher the coefficient is, the higher the productivity is. And then, we compare the difference of coefficient in different periods. Based on our primal aim and assumption, we hope that the productivity in 2013-2016 is equal to or less than that in 2017-2020.

Table 15 shows the difference in coefficients by dichotomous time group. We adopt the Seemingly Unrelated Regressions (SUR) for the estimation of coefficients and then compare every two coefficients from different groups under the bootstrap.

In our results, the empirical P-value (0.045) in model (1) under the proxy of Intensity shows that there is a significant difference in productivity. To be more specific, the productivity in 2013-2016 is significantly less than that in 2017-2020, which implies that audit fees are ought to be lower after the exogenous shock. Nevertheless, the value of Chi-square (without rejecting the null hypothesis) implies there is no obvious difference in productivity during these two periods. Furthermore, under the Rdspend proxy – Model (2), both the Chi-square (without rejecting the null hypothesis) and empirical P-value (0.428) support that there is no apparent difference in productivity during these two periods, with no violation to the assumption of our counterfactual framework. Overall, the assumption of our counterfactual framework has been satisfied already, namely, the increase in audit fees is not attributed to the decrease of productivity.

8. Conclusions

This study examines the impact of innovative technology on audit fees and audit quality systematically based on the evidence in China. We draw on the exogenous policy shock to divide innovative technology into two periods – the introduction stage and the application stage. Our research finds that audit fees increase for both of the two stages. In addition, we find that the ownership structure can moderate the upward audit fees at the introduction stage. Specifically, SOEs incline to curb the introduction of innovative technology due to the accounting conservatism, however, there is no strong evidence that they will suppress the application of innovative technology at a later stage, which hints that SOEs are good followers instead of pioneers. In order to avoid the blur on audit quality at the first stage, we investigate the relationship between the application of innovative technology and audit quality, where we find that the application of innovative technology does improve audit quality, which supports the further development of technology in auditing.

Recently, whether innovative technology improves auditing and decreases audit fees is contentious that disturbs the policy makers' decisions. There are very few references in extant literature that elucidate the outright results of innovation, whereas our research makes contributions to the compelling evidence that audit fees will still increase with the development of technology. Furthermore, compared with the previous research, our research testifies accounting conservatism based on the variation of audit fees in SOEs, which consolidates the role of ownership structure in auditing. Also, we find that audit fees vary positively with the application of innovative technology (e.g., Blockchain, etc.) by harnessing the policy shock to examine the impact of innovative technology on audit quality at the stage of application.

Since the 21st century, China has gradually been keeping up with the world in innovative technology for the support of the Chinese government on Internet Technology, which provides us with the ideal natural experiments. Due to the special background in China, our research helps the Chinese government distinguish the pioneers and followers of innovation in Chinese firms. In addition, we believe that our findings can be generalized to other countries. And our study can lend support to regulators for the release of new policies to propel innovative technology among listed firms to reduce the latent accounting fraud.

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Appendix

Figure 1 Parallel Trend Test

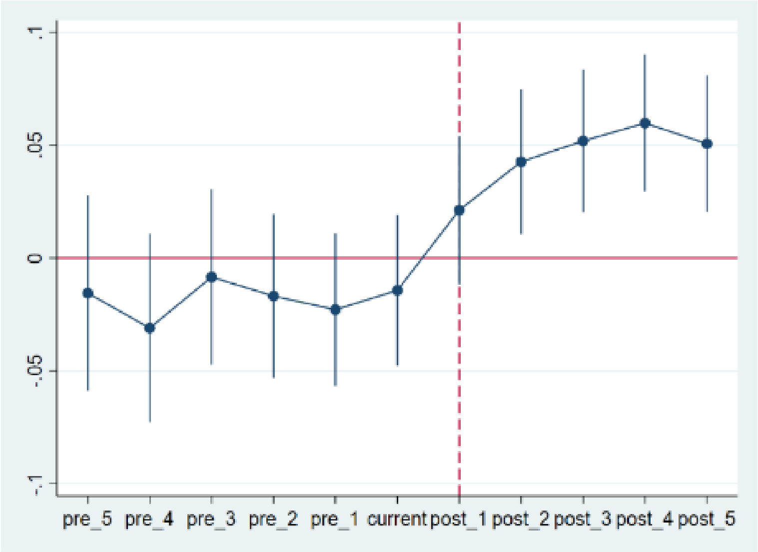

Figure 2 Placebo Test for Group

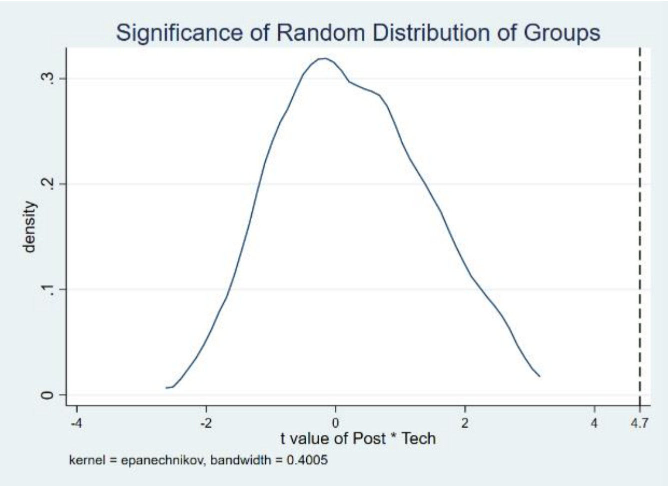

Figure 3 Placebo Test for Time

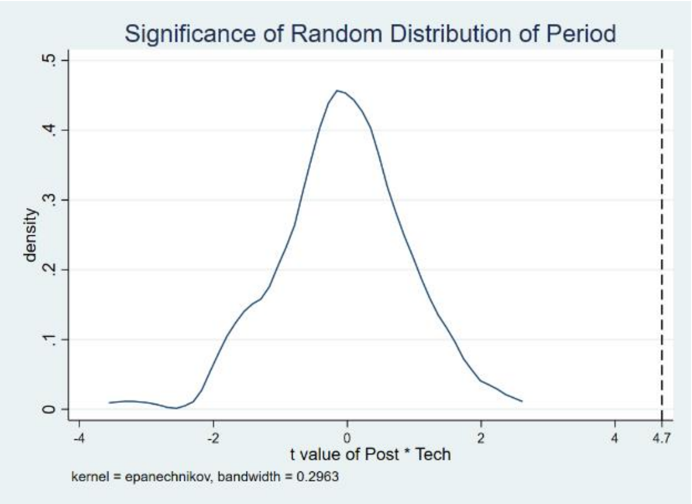

Table 1

Sample Selection Process

	Firm-Years
Initial financial data from CSMAR database from 2000 to 2020	47,287
Merge by year and firm:	
Initial relevant non-financial information data from CSMAR database from 2000 to 2020	43,806
Initial collected application of Blockchain dataset	42,997
Less:	
Observations in financial industry	(682)
Observations with missing data about audit fees	(1,981)
Observations with other relevant missing data (e.g., inventory, account receivable, etc.)	(352)
Sample before PSM (processed raw data)	**39,982**

Table 6 Descriptive Statistics for Section 5

Variable	N	p5	p25	p50	Mean	SD	p75	p95
Fee	7994	13.12	13.46	13.82	13.88	0.545	14.27	14.88
Big4	7994	0	0	0	0.0240	0.154	0	0
State	7994	0	0	0	0.282	0.450	1	1
Aduito	7994	0	1	1	0.924	0.265	1	1
Inv	7994	0.0100	0.0590	0.109	0.134	0.110	0.176	0.351
Rec	7994	0.00700	0.0530	0.116	0.137	0.109	0.196	0.345
Roa	7994	-0.145	0.00700	0.0280	0.00100	0.680	0.0570	0.115
Lever	7994	0.122	0.291	0.435	0.466	0.839	0.592	0.799
Size	7994	20.44	21.36	22.11	22.19	1.176	22.92	24.30
Count	7994	0	0	0	29.08	114.2	0	141
Intensity	7994	0	0	0	0.0220	0.0710	0	0.134

Table 2

Propensity Score Matching Result

Sample		Mean		Bias		T-test	
Variable	Group	Treated	Control	Percent of bias	Reduction of |Bias|	T-value	P > |t|
Big4	U	.03957	.0692	-13.1		-12.79	0.000
	M	.04213	.03622	2.6	80.1	2.54	0.011
State	U	.38206	.45981	-15.8		-15.65	0.000
	M	.40101	.423	-4.5	71.7	-3.75	0.000
Aduito	U	.91248	.97055	-24.9		-25.49	0.000
	M	.96389	.94731	7.1	71.4	6.84	0.000
Inv	U	.15776	.1441	9.5		9.52	0.000
	M	.14813	.15917	-7.7	19.2	-6.50	0.000
Rec	U	.11801	.12025	-2.1		-2.06	0.040
	M	.12034	.12014	0.2	91.4	0.15	0.882
Roa	U	-.07491	.03953	-0.9		-1.00	0.319
	M	.02502	.03336	-0.1	92.7	-2.54	0.011
Lever	U	.62294	.44138	3.6		3.83	0.000
	M	.47738	.46844	0.2	95.1	1.29	0.198
Size	U	21.876	21.932	-4.2		-4.13	0.000
	M	21.891	21.879	0.9	78.4	0.77	0.439

Note: Table 2 shows the result of PSM method, the U and M indicate the unmatching and after matching respectively. We report the reduction of the absolute value of bias to identify the effectiveness of our PSM method.

Table 3 Sample Statistics

Panel A Basic Descriptive Statistics

Variable	N	p5	p25	p50	Mean	SD	p75	p95
Fee	27776	12.61	13.12	13.53	13.58	0.656	14.00	14.79
Big4	27776	0	0	0	0.0350	0.184	0	0
State	27776	0	0	0	0.408	0.492	1	1
Aduito	27776	1	1	1	0.966	0.181	1	1
Inv	27776	0.00600	0.0610	0.117	0.152	0.140	0.196	0.436
Rec	27776	0.00300	0.0360	0.0960	0.121	0.108	0.176	0.327
Roa	27776	-0.0700	0.0120	0.0350	0.0300	0.228	0.0640	0.126
Lever	27776	0.111	0.283	0.443	0.463	0.523	0.602	0.799
Size	27776	20.11	20.98	21.75	21.86	1.250	22.62	24.13

Note: The Panel A in Table 3 shows the descriptive statistics of whole sample (including both treatment group and control group). Therefore, there is difference between the value of mean in Panel A and the value of mean in Panel B.

Panel B Summary Statistic Mean and Median for Treatment and Control Group

Variables	Mean			Median		
	Control Mean	Treatment Mean	Difference in Mean	Control Median	Treatment Median	Difference in Median
Fee	13.5576	13.60525	-.0476472***	13.50763	13.52783	-.0202***
Big 4	.0290257	.0397782	-.0107525***	0	0	-
State	.4166327	.4017794	0.148533**	0	0	-
Aduito	.9479005	.9803365	-.032436***	1	1	-
Inv	.1591655	.1461326	.0130329***	.1195844	.1158776	.003707***
Rec	.1205221	.1211216	-.0005995	.0963217	.0955547	.0000767
Roa	.033856	.0272602	.0065958***	.04	.0306	.0094***
Lever	.4651186	.4615856	.003533	.4259293	.4575337	-.0316***
Size	21.83896	21.88476	-.0458048***	21.73018	21.75693	-.02675**

Note: We do not compare the difference of dummy variables (Big 4, State and Aduito) between treatment group and control group because the median because the weak effectiveness induced by the characteristic of dummy variable.

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

Table 4 Introduction of innovative technology				
MODEL	Pool Regression		Fixed Effect Model	
	(1)	(2)	(3)	(4)
VARIABLES	POOL	CONTROL	FEM	CONTROL
Post * Tech	0.149***	0.088***	0.064***	0.070***
	(7.64)	(6.91)	(3.29)	(4.70)
Big4		0.640***		0.354***
		(18.81)		(9.26)
Aduito		-0.184***		-0.104***
		(-6.93)		(-5.76)
Inv		-0.118***		-0.116***
		(-2.83)		(-2.78)
Rec		0.099**		0.108**
		(2.05)		(2.05)
Roa		-0.017		-0.022
		(-0.87)		(-1.26)
Lever		0.047***		0.032***
		(3.87)		(3.30)
Size		0.317***		0.290***
		(58.22)		(39.98)
Constant	13.055***	6.486***	12.896***	6.959***
	(735.85)	(57.11)	(842.67)	(45.48)
Observations	27,776	27,776	27,776	27,776
R-squared	0.225	0.630	0.588	0.706
FIRM FE	NO	NO	YES	YES
YEAR FE	YES	YES	YES	YES
Number of Firms			3,942	3,942

Note: Robust t-statistics in parentheses and *, **, * indicate significance at the 10%, 5% and 1% levels, respectively.**

Table 5 Moderating Effect of Ownership Structure for Introduction

MODEL	Pool Regression		Fixed Effect Model	
	(1)	(2)	(3)	(4)
VARIABLES	POOL	CONTROL	FEM	CONTROL
Post * Tech * State	-0.210***	0.006	-0.091**	-0.062**
	(-5.25)	(0.22)	(-2.48)	(-2.17)
Post * Tech	0.166***	0.092***	0.106***	0.100***
	(7.84)	(6.47)	(4.04)	(5.01)
State * Post	0.294***	-0.037*	-0.030	0.004
	(10.20)	(-1.94)	(-1.14)	(0.20)
State * Tech	0.150***	-0.021	0.123***	0.044*
	(5.03)	(-1.14)	(4.09)	(1.94)
Big4		0.638***		0.354***
		(18.76)		(9.24)
Aduito		-0.185***		-0.103***
		(-7.01)		(-5.71)
Inv		-0.119***		-0.113***
		(-2.85)		(-2.72)
Rec		0.083*		0.115**
		(1.72)		(2.18)
Roa		-0.018		-0.022
		(-0.86)		(-1.24)
Lever		0.049***		0.032***
		(3.79)		(3.27)
Size		0.321***		0.289***
		(57.64)		(40.00)
Constant	12.992***	6.410***	12.847***	6.969***
	(658.67)	(55.40)	(671.09)	(45.84)
Observations	27,776	27,776	27,776	27,776
R-squared	0.251	0.631	0.591	0.707
FIRM FE	NO	NO	YES	YES
YEAR FE	YES	YES	YES	YES
Number of Firms			3,942	3,942

Note: Robust t-statistics in parentheses and *, **, * indicate significance at the 10%, 5% and 1% levels, respectively.**

Table 7 The Application of Innovative Technology

MODEL	Pool Regression		Fixed Effect Model	
	(1)	(2)	(3)	(4)
VARIABLES	POOL	CONTROL	FEM	CONTROL
Intensity * Past	0.758***	0.279***	0.327***	0.129**
	(6.19)	(3.12)	(4.40)	(1.99)
Big4		0.481***		0.251***
		(8.74)		(3.53)
Aduito		-0.203***		-0.146***
		(-7.71)		(-8.30)
Inv		-0.099		0.027
		(-1.19)		(0.32)
Rec		-0.037		0.118
		(-0.47)		(1.22)
Roa		-0.013		-0.005
		(-0.37)		(-0.20)
Lever		0.022		0.020
		(0.76)		(0.96)
Size		0.293***		0.296***
		(36.53)		(18.43)
Constant	13.619***	7.406***	13.533***	7.234***
	(753.92)	(42.19)	(1,175.67)	(20.82)
Observations	7,994	7,994	7,994	7,994
R-squared	0.077	0.509	0.398	0.535
FIRM FE	NO	NO	YES	YES
YEAR FE	YES	YES	YES	YES
Number of Firms			1,331	1,331

Note: Robust t-statistics in parentheses and *, **, * indicate significance at the 10%, 5% and 1% levels, respectively.**

Table 8 The Moderating Effect by Ownership Structure for Application

MODEL	Pool Regression		Fixed Effect Model	
	(1)	(2)	(3)	(4)
VARIABLES	POOL	CONTROL	FEM	CONTROL
Intensity * Past * State	-1.315***	-0.232	-0.094	-0.095
	(-3.19)	(-0.88)	(-0.43)	(-0.53)
Intensity * Past	0.788***	0.210**	0.248***	0.077
	(5.64)	(2.15)	(3.49)	(1.15)
State * Past	0.170***	-0.062**	-0.163***	-0.099***
	(4.99)	(-2.55)	(-8.32)	(-6.01)
State * Intensity	1.415***	0.472***	0.340***	0.320***
	(4.81)	(3.27)	(2.86)	(3.05)
Big4		0.481***		0.257***
		(8.73)		(3.65)
Aduito		-0.198***		-0.132***
		(-7.53)		(-7.64)
Inv		-0.095		0.032
		(-1.15)		(0.39)
Rec		-0.044		0.108
		(-0.56)		(1.13)
Roa		-0.011		-0.006
		(-0.31)		(-0.26)
Lever		0.024		0.017
		(0.83)		(0.87)
Size		0.296***		0.287***
		(36.54)		(17.68)
Constant	13.613***	7.339***	13.527***	7.401***
	(754.55)	(41.44)	(1,197.02)	(21.04)
Observations	7,994	7,994	7,994	7,994
R-squared	0.091	0.511	0.415	0.542
FIRM FE	NO	NO	YES	YES
YEAR FE	YES	YES	YES	YES
Number of Firms			1,331	1,331

Note: Robust t-statistics in parentheses and *, **, * indicate significance at the 10%, 5% and 1% levels, respectively.**

Table 9 Audit Quality and Application of Innovative Technology

MODEL	Dechow & Dichev		McNicols		Modified Jones	
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	ABDD	Contorl	McNicols	Contorl	M_jones	Contorl
Intensity * Past	-0.172**	-0.227***	-0.192**	-0.219***	0.025	-0.013
	(-2.29)	(-2.86)	(-2.48)	(-2.67)	(1.38)	(-0.92)
Big4		0.006		0.024		-0.006
		(0.11)		(0.44)		(-0.81)
Aduito		0.008		0.028		-0.007
		(0.31)		(1.40)		(-1.26)
Inv		0.353		-0.018		0.019
		(0.81)		(-0.14)		(0.97)
Rec		-0.393**		-0.355*		0.100***
		(-2.18)		(-1.82)		(5.02)
Roa		-0.134		-0.108		-0.187***
		(-1.36)		(-1.48)		(-6.67)
Lever		-0.031		-0.054		0.031**
		(-0.41)		(-0.66)		(2.47)
Size		0.124***		0.079***		0.006**
		(3.27)		(2.84)		(2.16)
Constant	0.077***	-2.613***	0.073***	-1.602***	0.056***	-0.085
	(7.29)	(-3.05)	(7.65)	(-2.81)	(28.72)	(-1.47)
Observations	7,376	7,376	7,376	7,376	7,376	7,376
R-squared	0.024	0.030	0.039	0.043	0.003	0.146
FIRM FE	YES	YES	YES	YES	YES	YES
YEAR FE	YES	YES	YES	YES	YES	YES
Number of Firms	1,248	1,248	1,248	1,248	1,248	1,248

Note: Robust t-statistics in parentheses and *, **, * indicate significance at the 10%, 5% and 1% levels, respectively.**

Table 10 Audit Quality and Moderating Effect of Ownership Structure

MODEL	Dechow & Dichev		McNicols		Modified Jones	
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	ABDD	Contorl	McNicols	Contorl	M_jones	Contorl
Intensity*Past*State	-0.294	-0.263	-0.039	-0.033	-0.037	-0.032
	(-1.02)	(-0.91)	(-0.17)	(-0.14)	(-0.56)	(-0.53)
Intensity * Past	-0.126	-0.184**	-0.193**	-0.218**	0.017	-0.019
	(-1.53)	(-2.20)	(-2.21)	(-2.38)	(0.73)	(-1.05)
State * Past	0.051*	0.069**	0.020	0.030	-0.011***	-0.002
	(1.86)	(2.13)	(0.87)	(1.19)	(-3.44)	(-0.78)
State * Intensity	0.128	0.087	0.051	0.032	0.068	0.055
	(0.56)	(0.38)	(0.30)	(0.19)	(1.41)	(1.11)
Big4		0.005		0.023		-0.006
		(0.08)		(0.42)		(-0.78)
Aduito		0.002		0.025		-0.007
		(0.08)		(1.28)		(-1.23)
Inv		0.344		-0.022		0.019
		(0.79)		(-0.17)		(0.98)
Rec		-0.386**		-0.352*		0.100***
		(-2.16)		(-1.82)		(5.02)
Roa		-0.141		-0.111		-0.187***
		(-1.42)		(-1.52)		(-6.66)
Lever		-0.024		-0.051		0.031**
		(-0.31)		(-0.62)		(2.43)
Size		0.128***		0.081***		0.006**
		(3.25)		(2.82)		(2.05)
Constant	0.077***	-2.705***	0.073***	-1.645***	0.055***	-0.080
	(7.43)	(-3.04)	(7.65)	(-2.79)	(28.40)	(-1.37)
Observations	7,376	7,376	7,376	7,376	7,376	7,376
R-squared	0.024	0.030	0.039	0.043	0.007	0.147
FIRM FE	YES	YES	YES	YES	YES	YES
YEAR FE	YES	YES	YES	YES	YES	YES
Number of Firms	1,248	1,248	1,248	1,248	1,248	1,248

Note: Robust t-statistics in parentheses and *, **, * indicate significance at the 10%, 5% and 1% levels, respectively.**

Table 11 Introduction of Innovative Technology under Robustness Test

MODEL	Pool Regression		Fixed Effect Model	
	(1)	(2)	(3)	(4)
VARIABLES	POOL	CONTROL	FEM	CONTROL
Post * Tech	0.025	0.068***	0.020	0.061***
	(1.20)	(4.99)	(1.04)	(3.93)
Big4		0.632***		0.333***
		(17.65)		(8.53)
Aduito		-0.167***		-0.101***
		(-6.38)		(-5.62)
Inv		-0.137***		-0.127***
		(-3.07)		(-2.98)
Rec		0.113**		0.075
		(2.19)		(1.33)
Roa		-0.009		0.002
		(-0.33)		(0.07)
Lever		0.038***		0.026***
		(3.94)		(4.47)
Size		0.324***		0.296***
		(54.11)		(37.86)
Constant	13.066***	6.333***	12.909***	6.835***
	(720.81)	(51.20)	(826.95)	(42.08)
Observations	25,472	25,472	25,472	25,472
R-squared	0.240	0.634	0.586	0.700
FIRM FE	NO	NO	YES	YES
YEAR FE	YES	YES	YES	YES
Number of Firms			3,535	3,535

Note: Robust t-statistics in parentheses and *, **, * indicate significance at the 10%, 5% and 1% levels, respectively.**

Table 12 Moderating Effect of Ownership Structure for Introduction under Robustness Test

MODEL	Pool Regression		Fixed Effect Model	
	(1)	(2)	(3)	(4)
VARIABLES	POOL	CONTROL	FEM	CONTROL
Post * Tech * State	-0.212***	0.011	-0.093**	-0.057*
	(-4.99)	(0.38)	(-2.49)	(-1.91)
Post * Tech	0.044*	0.076***	0.073***	0.089***
	(1.93)	(4.98)	(2.93)	(4.55)
State * Post	0.327***	-0.030	-0.014	0.011
	(10.44)	(-1.40)	(-0.52)	(0.48)
State * Tech	0.146***	-0.031	0.111***	0.024
	(4.88)	(-1.59)	(3.44)	(0.97)
Big4		0.630***		0.333***
		(17.56)		(8.52)
Aduito		-0.169***		-0.100***
		(-6.47)		(-5.59)
Inv		-0.137***		-0.127***
		(-3.09)		(-2.98)
Rec		0.098*		0.079
		(1.89)		(1.40)
Roa		-0.012		0.003
		(-0.39)		(0.10)
Lever		0.040***		0.026***
		(3.75)		(4.41)
Size		0.328***		0.295***
		(53.80)		(37.71)
Constant	13.002***	6.257***	12.861***	6.841***
	(625.63)	(49.92)	(645.55)	(42.24)
Observations	25,472	25,472	25,472	25,472
R-squared	0.269	0.635	0.588	0.700
FIRM FE	NO	NO	YES	YES
YEAR FE	YES	YES	YES	YES
Number of Firms			3,535	3,535

Note: Robust t-statistics in parentheses and *, **, * indicate significance at the 10%, 5% and 1% levels, respectively.**

Table 13 The Application of Innovative Technology Proxied by Rdspend for Robustness Test

MODEL	Pool Regression		Fixed Effect Model	
	(1)	(2)	(3)	(4)
VARIABLES	POOL	CONTROL	FEM	CONTROL
Rdspend * Past	-0.010**	0.001	0.000	0.001**
	(-2.49)	(0.39)	(0.00)	(2.04)
Big4		0.641***		0.285***
		(9.16)		(3.51)
Aduito		-0.226***		-0.173***
		(-8.09)		(-9.17)
Inv		-0.102		-0.003
		(-1.08)		(-0.03)
Rec		-0.053		0.124
		(-0.62)		(1.19)
Roa		-0.042		0.006
		(-1.06)		(0.21)
Lever		0.037		0.062**
		(1.02)		(2.09)
Size		0.343***		0.342***
		(30.88)		(19.40)
Constant	13.575***	6.299***	13.534***	6.236***
	(635.97)	(26.47)	(1,115.51)	(16.26)
Observations	8,237	8,237	8,237	8,237
R-squared	0.080	0.589	0.371	0.539
FIRM FE	NO	NO	YES	YES
YEAR FE	YES	YES	YES	YES
Number of Firms			1,332	1,332

Note: Robust t-statistics in parentheses and *, **, * indicate significance at the 10%, 5% and 1% levels, respectively.**

Table 14 Moderating Effect of Ownership Structure Proxied by Rdspend for Robustness Test

MODEL	Pool Regression		Fixed Effect Model	
	(1)	(2)	(3)	(4)
VARIABLES	POOL	CONTROL	FEM	CONTROL
Rdspend * Past * State	-0.025***	-0.000	0.002	-0.002
	(-2.79)	(-0.06)	(0.76)	(-0.95)
Rdspend * Past	-0.006*	0.001	-0.001	0.001*
	(-1.95)	(0.59)	(-0.92)	(1.76)
State * Past	0.272***	-0.059*	-0.183***	-0.087***
	(5.26)	(-1.85)	(-7.15)	(-4.23)
State * Rdspend	0.009	-0.004*	-0.000	0.002*
	(1.39)	(-1.80)	(-0.02)	(1.77)
Big4		0.641***		0.290***
		(9.22)		(3.64)
Aduito		-0.220***		-0.159***
		(-7.86)		(-8.47)
Inv		-0.100		0.002
		(-1.06)		(0.02)
Rec		-0.059		0.113
		(-0.69)		(1.08)
Roa		-0.039		0.003
		(-0.97)		(0.11)
Lever		0.040		0.057*
		(1.11)		(1.95)
Size		0.347***		0.334***
		(31.05)		(18.50)
Constant	13.568***	6.203***	13.531***	6.379***
	(629.00)	(25.89)	(1,137.69)	(16.19)
Observations	8,237	8,237	8,237	8,237
R-squared	0.094	0.591	0.387	0.544
FIRM FE	NO	NO	YES	YES
YEAR FE	YES	YES	YES	YES
Number of Firms			1,332	1,332

Note: Robust t-statistics in parentheses and *, **, * indicate significance at the 10%, 5% and 1% levels, respectively.**

Table 15 Difference of Coefficient by Time

	(1)	(2)
Variable/Measure	Intensity	Rdspend
ΔMeasure	-0.256**	-0.001
	(0.045)	(0.428)
ΔBig4	-0.036	-0.212
	(0.274)	(0.195)
ΔAduito	-0.006	-0.004
	(0.492)	(0.315)
ΔInv	0.018	0565**
	(0.427)	(0.038)
ΔRec	-0.071	-0.120
	(0.222)	(0.485)
ΔRoa	0.027	0.090
	(0.372)	(0.413)
ΔLever	-0.031	-0.173
	(0.339)	(0.170)
ΔSize	0.029***	0.189***
	(0.006)	(0.009)
ΔConstant	-0.785***	-4.354***
	(0.001)	(0.003)
Observations	8,455	7676
Difference of two periods	$\chi^2 = 1.56$	$\chi^2 = 0.36$
Prob > chi2	(0.2119)	(0.5499)

Notes:

1.The value in parentheses is empirical p-value instead of t-value. And the empirical p-value in bootstrap is symmetric, we therefore also need to calculate the (1 – empirical p-value) to examine whether we reject null hypothesis or not.

2. ΔCoefficient = Coefficient in 2013-2016 – Coefficient in 2017-2020.

3. *, **, * indicate significance at the 10%, 5% and 1% levels, respectively.**

Table 16
Bilingual Reference Table for Keywords Mining

Chinese words	English explanation
移动互联网	Mobile Internet
互联网+	Internet plus
物联网	Internet of Things (IoT)
人工智能 (or AI)	Artificial Intelligence
云计算 (or cloud computing)	Cloud Computing
大数据 (Big Data)	Big Data
区块链	Blockchain
电子商务	Electronic Business
O2O	O2O
B2B	B2B
C2C	C2C
P2P	P2P
生物识别	Biometrics
开放平台	Open Platform
云服务	Cloud Service

Table 17 Variable Definition

Variables	Explanation
Control variables	
$Big4_{i,t}$	Dummy variable equals 1 if the firm i is audited by big 4 in year t, otherwise 0.
$Aduito_{i,t}$	Dummy variable equals 1 if the audit opinion for firm i in year t is clean, otherwise 0.
$Inv_{i,t}$	The ending inventory for firm i in year t scaled by total assets for firms i in year t.
$Rec_{i,t}$	The ending net accounts receivable for firm i in year t scaled by ending total assets for firms i in year t.
$Roa_{i,t}$	The ending return of assets for firm i in year t.
$Lever_{i,t}$	The ending total liabilities for firm i in year t scaled by ending total assets for firm i in year t.
$Size_{i,t}$	The natural log of the ending total assets for firm i in year t.

Dependent variable	
$Fee_{i,t}$	The natural log of audit fees for firm i in year t.
$\mathrm{M\_jones}_{i,t}$	The absolute value of the discretionary accruals for firm i in year t calculated by Modified Jones model.
$\mathrm{McNicols}_{i,t}$	The absolute value of the discretionary accruals for firm i in year t calculated by McNicols model.
$ABDD_{i,t}$	The absolute value of the discretionary accruals for firm i in year t calculated by Dechow & Dichew.
$TA_{i,t}$	$\Delta accounts\ receivable_{i,t} + \Delta inventory_{i,t} + \Delta current\ assets_{i,t} - \Delta accounts\ payable_{i,t} - \Delta amortization_{i,t}$.
Other independent variables	
$Post_{i,t}$	Dummy variable equals 1 for firm i if the year t is after 2011, otherwise 0 in section (section 4).
$Past_{i,t}$	Dummy variable equals 1 for firm i if the year is after 2016, otherwise 0 (section 5 and 6).
$Tech_{i,t}$	Dummy variable for firm i in year t equals 1 if there is any keyword relating to the Blockchain in its annual report, otherwise 0.
$Intensity_{i,t}$	Ratio variable to measure the intensity of the application of innovative technology, which is the proportion of the frequency of Blockchain for firm i in year t that the maximum frequency of all firms in year t.
$Rdspend_{i,t}$	Ratio variable to measure the intensity of application of innovative technology, which is the proportion of the R&D expenditure that the operational income.
$Count_{i,t}$	The total word frequency of each word in Table 16 for firm i in year t
Measure	Symbol of Different measurement: $Intensity_{i,t}$ and $Rdspend_{i,t}$.

Table 18 Event Identification for Introduction

Year	Event	Summary of Comment
2012	**OPINIONS Section III**	The section III in OPINIONS emphasizes the dominant status of corporates and empowers them with the driving force for innovation. Thereinto, the relevant policies provide economic support from the pre-tax deduction for the R&D expenses incurred by the application of R&D. in addition, the industries cover almost all corporates (e.g., burgeoning industries of strategic importance, traditional industries and modern service industries), to elucidate the generalization of this policy and the extremely tremendous influence on the innovation of each industry for corporates.
2012	**OPINIONS Section VI**	The section VI in OPINIONS is the improvement of the talent development system and stimulating the enthusiasm and creativity of scientists. The fostering of all kinds of talents and innovators can propel the number of domestic talents. Also, the pressing introduction of outstanding overseas talent can play the same role in industries' prosperity. The increase in the number of the talent reveals the potential growth of the number of R&D relevant people within enterprises.

Event Reliability Analysis

Although the subjectivity of event identification and redundancy of existing policy shock are inevitable, we reckon it can be excluded subtly via the anatomy of the tug of war for different political power.

In China, there are mainly two political powers that impose substantial impact within society, of which one is the municipal power from each district and the other one is the central power from Beijing. Although the central government in Beijing possesses ultimate power in the military, it also has forward-looking function in economic or social policies, that is to say the policies of the central government are dominant, broad and generalized than those of municipal governments. Therefore, the identical exogenous policy shock from the municipal government may be absorbed directly by that of the central government in Beijing, which helps us exclude the latent exogenous shock from other sources.

Table 19 Event Identification for Application		
Year	**Event**	**Summary of Comment**
2016	**WHITE**	This official document is aimed at standardizing the Chinese Blockchain industry and coordinating the domestic high-tech firms to chase the international cutting-edge development of Blockchain technology. The compilation of WHITE is to guide for the application of Blockchain in financial corporates, internet corporates, IT corporates and manufacturing corporates, provided by the basic political support from the Chinese government. Furthermore, Through the extant condition analysis and standardization of Blockchain, the WHITE also suggests the typical application scenarios and the roadmap for the development of Blockchain within firms. And the WHITE analyzes more than 200 cases of Blockchain application worldwide and compiles the typical practices of Blockchain, in which it lists 6 relatively mature, broad and prospective future applications, to help firms learn and prepare future scheme of Blockchain application.
2016	**INFOPLAN**	INFOPLAN promoted Blockchain technology to an unprecedented crucial position. In this official document, some technologies and Blockchain were described as revolutionary innovative technology. "The intergenerational cycle of information technology innovation has been significantly shortened…, triggering a new round of scientific and technological revolution and industrial change at a faster speed, wider scope and deeper level. Internet of things…, Blockchain biological genetic engineering and other new technologies drive the evolution of cyberspace from the interconnection of everyone to the interconnection of everything digital, networked and intelligent services will be everywhere." Apart from the description above, INFOPLAN first depicted Blockchain as a strategic cutting-edge technology and a disruptive technology for a future development direction, which evoked the attention of the Chinese government on Blockchain technology.
Event Reliability Analysis		
Such an emphasis will induce spontaneous obedience from enterprises under the overwhelming political influence in China, which means most enterprises will choose to invest more in Blockchain and relevant technology. In summary, these two events may influence the application of innovative technology (especially Blockchain, which is also a key measurement in subsequent research design) and can be used as an exogenous shock to evaluate the impact of innovative technology on audit fees at the stage of application.		

Table 20 Correlation Matrix for Introduction period

	Fee	Big4	State	Aduito	Inv	Rec	Roa	Lever	Size	Tech
Fee	1									
Big4	0.299***	1								
State	0.035***	0.049***	1							
Aduito	0.056***	0.00400	-0.034***	1						
Inv	0.00400	0.00500	0.063***	0.047***	1					
Rec	-0.076***	-0.064***	-0.158***	-0.056***	-0.092***	1				
Roa	0.00500	0.011*	-0.014**	0.196***	0.00100	-0.051***	1			
Lever	0.054***	0.016***	0.093***	-0.238***	0.090***	0.023***	-0.380***	1		
Size	0.718***	0.203***	0.226***	0.149***	0.100***	-0.177***	0.049***	0.046***	1	
Tech	0.028***	0.019***	-0.030***	0.080***	-0.038***	0.014**	-0.016***	0	0.00600	1

Table 21 Correlation Matrix for Application Period

	Fee	Big4	State	Aduito	Inv	Rec	Roa	Lever	Size	Count	Intensity
Fee	1										
Big4	0.214***	1									
state	0.181***	0.052***	1								
Aduito	-0.077***	0.033***	0.049***	1							
Inv	-0.024**	-0.0160	0.037***	0.075***	1						
Rec	-0.106***	-0.050***	-0.106***	0.00800	-0.025**	1					
Roa	-0.0160	0.00800	0.0110	0.141***	0	-0.00500	1				
Lever	0.088***	0.00600	0.046***	-0.143***	0.044***	0.020*	-0.929***	1			
Size	0.665***	0.124***	0.303***	0.082***	0.026**	-0.149***	0.077***	0.036***	1		
Count	0.115***	0.024**	-0.023**	-0.163***	-0.046***	-0.0110	-0.023**	0.021*	0.052***	1	
Intensity	0.099***	-0.00400	-0.024**	-0.149***	-0.0160	0.00800	-0.024**	0.021*	0.057***	0.424***	1