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Tax credit rating and corporate innovation decisions

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ABSTRACT

The tax credit rating mechanism was formally implemented in 2014. As an important tax collection and management innovation, it has attracted the attention of regulatory authorities and scholars. Different from the literature that directly examines corporate tax compliance, we focus on the impact of tax credit rating implementation on corporate research and development (R&D) investment decisions. Using listed companies' data from 2014 to 2019, we find that companies with higher tax credit ratings invest more in innovation, because the system helps managers identify R&D opportunities, alleviates corporate financing constraints and reduces agency costs. We confirm that tax credit ratings have manifold impacts on corporate information environments and business decisions, with better ratings positively affecting firms' business decisions. This discovery can inform tax policy reform, encourage corporate innovation and construct social credit systems.

1. Introduction

Taxation is the main source of income in most countries (Musgrave, 1959). The payment of taxes reduces the profits retained by enterprises, which implies that firms naturally have a strong motivation for tax avoidance and even tax evasion. The ability of the government to effectively collect taxes is important as it not only conveys the effectiveness of the functional performance of the government, but it also reveals the concentrated expression of national governance capabilities, especially for transitional countries (Brautigam et al., 2008). To this end, various countries are constantly improving their tax collection and management systems. Current tax collection and management methods mainly comprise the compulsory and incentive systems. The compulsory system commonly uses tax inspection and punishment, wherein the government investigates and punishes

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corporate tax evasion, tax fraud, tax arrears and other non-compliance behaviors to increase the cost of tax non-compliance and ultimately act as a deterrent. The incentive system commonly increases the income from tax compliance and ultimately achieves a win–win effect by classifying management *ex ante* with corresponding rewards and penalties (Sun et al., 2019; Li et al., 2020). Theoretically, the tax collection and management method of tax inspection-punishment restricts corporate tax evasion, tax avoidance and other non-compliance behaviors through clear legislation and strict law enforcement, which increases the cost of corporate tax violations. However, its supervisory and management role manifests as actually seizing and penalizing taxpaying companies rather than as simply deterring them. As a result, the tax collection and management method of tax inspection-punishment has limited audiences as it only restrains taxpayers from violating regulations without significantly affecting a firm's original tax-compliance; it even negatively affects a firm's normal production and business activities (Devos, 2004; Pan et al., 2013; Mohdali et al., 2014). In practice, to identify the increasingly hidden tax violations by enterprises, the tax inspection and punishment method relies on sound laws, regulations and multiple strict and complicated inspection procedures, which increase the tax collection costs borne by regulatory agencies. Taxpaying companies must provide a large amount of tax information to facilitate taxation review, thereby increasing the organization cost of the company. Meanwhile, excessive law enforcement hinders normal corporate business activities due to the excessive occupation of resources. In particular, when the economy is under great downward pressure and remains relatively difficult, the tax collection and management method of tax inspection and punishment cannot meet the requirements advocated by the government to simplify administration, delegate power and reduce the burden on enterprises, which are important for stimulating the vitality of market entities and improving the efficiency of resource allocation. As highlighted in many economic work conferences and government reports by the Party Central Committee, it is necessary to deepen system reforms, reduce the burden on enterprises through tax and fee reductions and encourage the green, efficient and sustainable development of enterprises. Classification and reward tax collection and management is a major means of innovating regulatory methods. Exploring the economic consequences of these efforts, especially on corporate decision-making, has important theoretical and practical significance.

The deepening of market-oriented reforms has increased the value of the role of corporate credit and the business environment in economic development. Issued by the State Council in 2014, the "Notice of the State Council on Printing and Distributing the Planning Outline for the Construction of the Social Credit System (2014–2020)" clarified the direction and measures for the construction of the social credit system, and the "Administrative Measures for Tax Credit Ratings (Trial)" issued by the State Administration of Taxation is a useful measure in this direction as it aims to standardize tax credit management, promote taxpayers' integrity and self-discipline and improve tax law compliance by providing incentives and guidance in advance. Specifically, the State Administration of Taxation evaluates all taxpaying companies based on historical credit, internal tax and external information every year and scores companies based on the above indicators. If the companies score >90 points, then they are rated as A-level taxpayers; these levels effectively capture tax compliance by enterprises and supplement the shortcomings that, in the past, could only be evaluated from the perspective of tax violations. Meanwhile, the State Administration of Taxation, together with the People's Bank of China, the Ministry of Land and Resources, the General Administration of Customs, the State Administration for Industry and Commerce, the State-Owned Assets Supervision and Administration Commission and other ministries jointly implemented the "Memorandum of Cooperation on the Implementation of Joint Disciplinary Methods for Major Tax Violation Cases" in 2016 and the "Memorandum of Cooperation on the Implementation of Joint Incentive Methods for A-level Taxpayers" in 2015, with the aim of improving tax compliance by enterprises through the reward and punishment mechanism based on classified management. To implement preferential policies for A-level taxpayers and avoid the negative impacts of lower ratings, taxpaying companies have the motivation to improve the information reporting system and pay taxes in accordance with existing laws and regulations. Moreover, tax credit ratings have an important signaling effect due to the impact of the tax regulatory authority (Sun et al., 2019). Studies find that the implementation of a tax credit ratings system stimulates the enthusiasm of corporate tax compliance through positive incentives, reduces the organization costs of various economic activities for enterprises and mutually benefits both the government and enterprises (Sun et al., 2019; Tao et al., 2019; Li et al., 2020). From a long-term perspective, we examine whether incentive-based tax collection and management policies can help companies obtain

resources and facilitate their future development or whether they occupy too many corporate resources and hinder the long-term planning of companies. Although tax compliance increases corporate costs, can it also benefit companies' long-term development? Specifically, we examine the impact of tax credit ratings on corporate research and development (R&D) investment.

R&D is a powerful weapon that helps companies survive in a complex and changeable international market. It is also the fundamental driving force of national development, especially during the coronavirus disease 2019 outbreak. The 2020 government work report clearly emphasizes the need to achieve major breakthroughs in key areas. R&D investment is characterized by high investment risk, delayed return and strong information asymmetry, implying that it fluctuates greatly across various corporate investments. Feasible innovation projects, sufficient innovation resources and approval from managers are important factors that affect corporate innovation investment. Studies find that higher information quality, smaller financing constraints and lower agency costs can increase corporate innovation (Li and Song, 2010; Brown et al., 2012; Foucault and Fresard, 2014). To stimulate enthusiasm for innovation, the government uses policy guidance, financial support, talent introduction and other means, thereby effectively solving the practical problems of enterprise innovation and profoundly affecting the will of the state and corporate decision-making (Xie et al., 2009; Hunt and Gauthier, 2010; Yu et al., 2016; Bloom et al., 2019). In this context, we examine whether innovative taxation supervision methods cater to the needs of the government and enterprises to achieve the "double innovation" of system reforms and firms' R&D, which can help comprehensively evaluate policy effects and determine possible incentives for innovation.

We select 2014–2019 non-financial A-share listed companies as samples to examine the impact of tax credit ratings on corporate innovation investment decisions. We find that tax credit ratings significantly increase corporate innovation investment. We also find that a higher tax credit rating indicates better internal information collection and transmission, which helps managers more accurately identify R&D projects. A higher tax credit rating not only grants direct financial funds and bank loans to the enterprise, but it also implies that the company's internal information system is complete. The improvement in information quality reduces information asymmetry, attracts external investors and jointly alleviates financial constraints. Moreover, tax credit ratings can restrict and supervise managers, ensure the effectiveness of executive compensation incentives and alleviate the principal-agent problem. After using a change model, the propensity score matching (PSM) method and the PSM-difference-in-differences (DID) method to alleviate the endogeneity problem, the above results remain valid. Cross-sectional tests further confirm that tax credit ratings ease information asymmetry, reduce agency costs and complement compulsory tax policies with incremental contributions, thereby improving corporate tax compliance and inspiring corporate enthusiasm for innovation.

The contributions of this study are reflected in the following aspects. First, we add to research on the economic consequences of tax credit ratings. To evaluate the effect of tax policy implementation, it is necessary to pay attention to the impact of policy implementation on corporate decision-making in addition to corporate tax compliance. From the perspective of corporate innovation, we find that the implementation of tax credit ratings helps the long-term development of enterprises. However, the tax credit rating system differs from the original tax violation penalties in that it is an incentive-based tax supervision mechanism. At present, relatively few studies focus on this innovative supervision method, with most studies concentrating on the short-term impact on enterprises (Sun et al., 2019; Li et al., 2020). Although Ye et al. (2021) study the impact of incentive supervision on corporate innovation, they use an event study and only explore one channel that affects innovation. Our study effectively complements research in this field from a long-term perspective by examining cumulative effects and more comprehensively analyzing the policy effects of tax credit ratings.

Second, we extend the study of the economic consequences of tax compliance. Previous studies mostly evaluate corporate tax violations from the perspective of tax punishment and examine the negative consequences of excessive tax avoidance from the perspective of tax planning (Desai et al., 2007; Kim et al., 2011; Liu and Ye, 2013). However, this method can only identify companies that have violated regulations. In addition, the rationality of tax avoidance is difficult to accurately measure. The tax credit rating is available for all taxpayers and represents the degree of tax compliance, which can be used to describe the research problem more meticulously and accurately. We also focus on the impact of policy implementation on the long-term development of enterprises, which supplements the conclusions of research in related fields.

Third, we enrich research on the determinants of corporate innovation. Innovation is the source of an enterprise's core competitiveness and the internal driving force of a country's economic development. For a long time, it has been a hot issue discussed in the theoretical and practical circles, especially in the context of economic globalization. Breaking technical barriers is not only key to corporate profitability but also a powerful weapon for economic and political negotiations. Given China's comprehensive poverty alleviation plan, stimulation of the innovative vitality of enterprises and rational regulation of the economy are significant topics of focus for the government. From the perspective of tax system reform, this study has practical significance and policy reference value, as we examine the impacts of tax credit ratings on corporate innovation investment and meticulously analyze the role of tax credit ratings in searching for and implementing R&D projects.

The remainder of this paper is organized as follows. Section 2 reviews the literature and develops the research hypothesis. Section 3 describes the research design and sample selection process. Section 4 presents the empirical results: main results, robustness tests, endogeneity tests, channel tests and cross-sectional tests. Section 5 concludes the paper.

2. Literature review and hypothesis development

2.1. Economic consequences of tax administration

Due to the compulsory and gratuitous nature of taxation, enterprises have strong incentives to avoid or even evade taxation. As the most important source of a country's income, the ability of the government to effectively collect taxes is critical; it not only conveys the effectiveness of the functional performance of the government, but also reveals the concentrated expression of national governance capabilities (Brautigam et al., 2008). To protect national taxation schemes, the government has introduced a number of tax collection and management systems to regulate the taxpaying behaviors of enterprises in an "enhanced and vigorous manner." Current tax collection and management methods mainly comprise compulsory and incentive methods. The compulsory method uses *ex post* tax inspections to investigate and deal with non-compliance behaviors, such as tax evasion, tax fraud and tax arrears, to increase the cost of tax non-compliance and ultimately act as a deterrent. The incentive method uses *ex ante* classified management, supplemented by corresponding reward and punishment mechanisms, to increase the income of tax compliance and ultimately achieve a win–win effect (Sun et al., 2019; Li et al., 2020). Compulsory taxation supervision reviews the taxation results of enterprises *ex post* and penalizes violations by enterprises, which deters taxation behaviors in the future; many studies confirm the effectiveness of such disciplinary methods in inhibiting corporate tax avoidance violations. Jiang (2013) studies the consequences of tax collection and management from the perspective of stock price crush risks, based on the study of Kim et al. (2011), and finds that compulsory tax collection and management improves corporate governance, restrains managers' aggressive tax avoidance behaviors and eventually reduces firms' stock price crush risks. Zhang and Zhu (2015) conduct a study from the perspective of investment efficiency and find that tax administration reduces the degree of corporate tax avoidance and improves investment efficiency. Li and Xu (2013) show that strict tax collection and management curb the illegal tax avoidance effect of political connections. Meanwhile, compulsory tax collection and management standardizes managers' decision-making. From the perspective of agency problems, compulsory tax collection and management system reduces firms' related transactions, major shareholder interest encroachments and agency costs (Dyck and Zingales, 2004; Desai et al., 2007; Zeng and Zhang, 2009; Xu et al., 2011). Ye and Liu (2011) find that tax collection and management increases the cost of corporate upward earnings management, thereby reducing corporate earnings management behaviors. From the perspective of other stakeholders, Guedhami and Pittman (2008) find that the strengthening of tax collection and management increases the confidence of creditors in business operations and reduces corporate bond interest rates. Pan et al. (2013) further verify this conclusion with Chinese data and find that stronger tax collection and management reduces the cost and increases the scale of debt, effectively alleviating corporate financial constraints.

With the continuous reform of tax supervision methods, incentive-based tax collection and management enhances corporate tax compliance and provides "double dividends" to the government and enterprises through *ex ante* guidance. Alm et al. (1992) verify that the reward mechanism promotes tax compliance.

Feld and Frey (2007) and Bazart and Pickhardt (2011) further find that the reward mechanism supplements the punishment mechanism, thus increasing the internal source of corporate tax compliance. However, relatively few studies focus on the impact of incentive tax regulation on enterprises. Sun et al. (2019) investigate the impact of flexible taxation supervision and find that the improvement of tax credit ratings helps enterprises obtain large-scale credit financing at lower costs, which implies that flexible taxation supervision provides incentives by improving corporate reputation and alleviating corporate financing constraints. Li et al. (2020) further distinguish the reward and punishment mechanisms of flexible tax supervision and find that such mechanisms can promote corporate tax compliance, improve corporate performance and have spillover effects that benefit both the government and enterprises.

2.2. Determinants of corporate innovation investment

R&D is an important investment decision for companies. The advent of new products and technologies helps companies surpass technical barriers, gain or maintain competitive advantages amid fierce market competition and enhance their long-term profitability. However, the input and output of corporate innovation are relatively volatile because innovation investment is characterized by high information asymmetry, high investment risk and delayed return. Only when the innovation project is of high quality and accurately identified, material and financial resources for R&D are sufficiently procured and the implementation is effectively supervised can facilitate innovation investment and yield positive results.

Financial constraints and agency problems are important factors that affect corporate innovation decisions. From the perspective of financial constraints, studies show that it is difficult to obtain stable external financing. Therefore, R&D activities mainly rely on internal funds, especially for companies in the early stages of development (Himmelberg and Petersen, 1994; Brown et al., 2009). The reasons for this are as follows. First, R&D investments require large-scale financing with long periods of capital occupation. Second, due to the high uncertainty of R&D output, the success of R&D and the market recognition of innovation output cannot be controlled in advance. Third, the information asymmetry of innovation projects may cause adverse selection and moral hazards. To protect proprietary technology, companies disclose less R&D-related information and as a result, external stakeholders have relatively little information on such activities (Liu et al., 2015), making it difficult for investors to evaluate the expected returns and stabilize investments (Hall, 2002). As the shortage of funds precludes meeting the demand for innovation, the R&D capabilities of enterprises are limited, which ultimately damages the development of the national economy (Zhang et al., 2012). Benfratello et al. (2008) and Brown et al. (2009) find that the development of the banking industry and the entry of venture capital can prompt corporate R&D investments. Brown et al. (2012) find that the development of financial markets can ease corporate financial constraints, which, in turn, increases corporate innovation. Ma et al. (2014) find that stable external financing channels, measured by the size of credit line and whether or not companies obtain bank credit, help companies increase their innovation investment. The conclusion of these studies further confirm that more financing stimulates firms' innovation investment.

From the perspective of the principal-agent problem, business owners pay attention to long-term development of firms and therefore do not hesitate to increase R&D investment to consolidate or enhance a company's market position through the advent of new technologies and products. When faced with short-term performance pressures, managers always do everything possible to increase short-term returns, weaken the execution of long-term plans formulated by shareholders and reduce innovation investment to maximize personal benefits. Therefore, effective incentives and supervision for managers are important requirements for corporate innovation (Balkin et al., 2000). Several studies discuss the impact of managers' incentives on R&D from the perspectives of executives' monetary compensation (Li and Song, 2010), equity incentives (Bizjak et al., 1993) and incentive structures (Mehran, 1995). These studies find that increasing salaries improves the rationality of managers' R&D decision-making and that the adoption of equity incentives has a positive effect. Tolerance of managers' short-term failures and affirmation of long-term values can prompt them to increase innovation investment (Manso, 2011). Larger shareholdings by institutional investors, more analyst following and the employment of higher-level auditors with stronger information acquisition and analysis capabilities can help rationally elevate the decision-making quality of managers, strengthen external

supervision, effectively restrain managers' short-sighted behaviors and promote corporate innovation (Chung and Kallapur, 2003; Cheng, 2006; Chen et al., 2017).

As innovation is the internal driving force of economic growth, the government also mobilizes corporate enthusiasm for innovation through policy support and financial appropriations. For one thing, the government supplements the resources needed for innovation. First, the government subsidies, "national team" shareholding and direct financial investments alleviate the financial pressures within enterprises and thereby increasing corporate R&D investments (Xie et al., 2009; Yu and Fang, 2020). Second, the implementation of policies, such as the opening of high-speed rail and the introduction of talents, enriches the supply of materials and human resources, which, in turn, strengthens corporate innovation capabilities (Hunt and Gauthier, 2010; Chen et al., 2019). The government also regulates the behaviors of corporate insiders through administrative regulations to ensure the effective implementation of innovation, protects the exclusiveness of innovation output through legislative procedures (e.g., patent protection) and enhances the innovation enthusiasm of enterprises (Yu et al., 2016; Bloom et al., 2019). In addition, tax policy regulations and tax system reforms also make tax avoidance motivation as the starting point of corporate innovation. Li et al. (2016) focus on the tax discounts of high-tech enterprises and find that tax discounts improve corporate innovation performance by increasing innovation investment and that tax discounts act as a tax shield. Yu et al. (2019) focus on the economic consequences of the implementation of the Environmental Protection Tax Law and find that the collection of environmental taxes encourages companies to increase green innovation and reduce pollution, thereby increasing firms' long-term value.

2.3. Impact of tax credit ratings on corporate innovation investment

Following "Tax Credit Management (Trial)," the State Administration of Taxation evaluates all taxpaying companies based on historical credit, internal tax and external information every calendar year from October 2014 onward. The assessment covers the entire process, from firms' economic operations to external information reporting. The internal information reflects the taxation basis and tax avoidance doubts, including recurring indicators, such as tax-related information declaration, tax payment, registration and account books, invoices and tax control equipment, and non-recurring indicators, such as tax audit information. Historical credit and external information reflect the overall credit status of enterprises and are mutually verified using information provided by banks and other administrative departments. Based on the above indicators, an enterprise is designated as an A-level taxpayer if it has a score of 90 or more. The assessment result of the tax credit rating reflects the overall quality of a company's information reporting system, effectively measures its tax compliance and supplements any previous evaluation shortcomings from the perspective of tax violations. The State Administration of Taxation, together with the People's Bank of China, the Ministry of Land and Resources, the General Administration of Customs, the State Administration for Industry and Commerce, the State-Owned Assets Supervision and Administration Commission and other ministries, implemented the "Memorandum of Cooperation on the Implementation of Joint Disciplinary Methods for Major Tax Violation Cases" in 2015 and the "Memorandum of Cooperation on the Implementation of Joint Incentive Methods for A-level Taxpayers" in 2016, with the aim of improving tax compliance by enterprises through the reward and punishment mechanism based on classified management. Specifically, A-level taxpaying enterprises receive appropriate preferential treatment in terms of bank credit, land qualification and government procurement, with the government reducing unnecessary tax reviews and interventions for these companies. However, taxpaying companies that commit major violations are directly judged as D-level in the tax credit rating and issued joint punishments, such as the restriction of consumption and prohibition of leaving the country and the right to use government land. To obtain better tax credit ratings, companies must improve their internal information collection and processing systems, which not only increases the number and quality of managers' information sources but also reduces the information asymmetry between insiders and external investors, thereby facilitating a supervision role for external stakeholders and restricting the decision-making abilities of managers. In addition, various policy benefits of higher tax credit ratings and endorsements from tax authorities ease the financial constraints of enterprises, ultimately affecting a firm's actual business decision-making processes. As detailed in this study, we focus on the impact on corporate R&D investments.

First, a higher tax credit rating indicates better collection and transmission of internal information, which helps managers identify R&D projects more accurately. Tax credit ratings measure the compliance of voucher management, tax declaration and tax payment, all of which comprehensively evaluate whether professionals can complete tax-related work accurately and in a timely manner, and examine the process from the occurrence of economic business to the payment of related taxes and from the review results of regulatory agencies to the process of corporate rectification. A better tax reporting system implies that the processing and bottom-up transmission system of information is more efficient so that the quality of the information is better (Sun et al., 2019), which can help in the identification and implementation of innovation projects. On the one hand, the improvement of the quality of tax information has a positive spillover effect on other internal information reporting and external information disclosures (Dorantes et al., 2013; Samuels, 2021). The effective integration of internal and external information improves the overall quality of useful information for managers' decision-making, thereby helping managers identify better investment opportunities, accurately predict future returns (Bushman and Smith, 2001) and improve investment efficiency (Chen et al., 2011). However, low-quality information leads to excessive investment (McNichols and Stubben, 2008). With respect to innovation investment, high-quality and sufficient information can alleviate the information asymmetry problem of R&D innovation, thus helping managers identify R&D projects with long-term benefits and make wiser decisions (Huang et al., 2020). On the other hand, the improvement of the tax information reporting system has additional spillover effects on other information reporting systems because the generation of tax information is based on the accurate measurement of various production and operation activities of a company, which requires information integration from various departments and businesses; thus, a better tax credit rating indicates that a company has a dynamic and efficient information exchange and coordination system. Corporate innovation also involves communication and collaboration between different functional departments and employees (Ostergaard et al., 2011). Therefore, the establishment, improvement and integration of the internal information system can reduce the cost of negotiation and the possibility of decision failure (Park, 2018), which again helps managers identify projects with development potential and lead their teams toward innovation goals.

Second, the tax credit rating can alleviate financial constraints, thereby promoting corporate innovation. A high tax credit rating directly brings external financing to an enterprise because A-level taxpayers have priority in fiscal fund arrangement and certain financial subsidies specifically supplement funds needed for innovation. Moreover, as their ratings are recorded in the basic database of financial credit information as good credit records, it is easier for A-level taxpayers to obtain bank loans. Financial funds and bank loans require less short-term income than equity financing and are more likely to be used for corporate innovation. The tax credit rating is implemented by the State Administration of Taxation and the evaluation process refers to historical information and current internal and external information, all of which comprehensively evaluates the credit status of the enterprise. This strict tax supervision significantly improves the reputation of A-level taxpayers. Upon receiving such positive signals, external investors increase their trust in these companies, thereby helping A-level taxpayers obtain external financing (Ye et al., 2010; Sun et al., 2019). Furthermore, tax credit ratings encourage taxpayers to complete their information systems and improve information quality, thereby indirectly alleviating firms' financial constraints. The tax credit rating is one of the important aspects of the social credit system and tax compliance serves as an important reference for banks, customs and other departments when they evaluate enterprises. A-level taxpayers not only enjoy priority in tax services and management, such as receipt of invoices and export tax rebates, but also obtain convenient waivers in environmental protection permits, land bidding and import and export declarations; therefore, enterprises have the motivation to optimize and improve internal information processing and provide accurate and timely information to regulatory agencies (Li et al., 2020). The overall improvement of the internal information system not only improves the quality of tax information but also has a spillover effect on other types of information disclosed by the company, which reduces the information asymmetry between external investors and corporate insiders; thus, investors increases their willingness to invest, thereby reducing the required risk compensation and easing financial constraints (Hall, 2002; Ma, 2017).

Finally, tax credit ratings alleviate the agency problem and ensure the implementation of innovation projects. Due to the separation of ownership and control rights of modern enterprises, managers have the motivation to maximize personal income by damaging the value of firms. Through strict punishment and supervision, tax credit ratings can limit managers' opportunistic behaviors, prompt managers to make scien-

tific decisions and alleviate the principal-agent problem. On the one hand, the tax credit rating system increases the penalties for violations. Companies with tax avoidance doubts, such as false tax-related information declarations, are directly rated as D-level. On the other hand, the public nature of tax credit ratings reveals strictly censored corporate tax and external information, which can help information users obtain information, facilitate the supervision role of external and internal stakeholders and prevent executives from plundering the wealth of shareholders or creditors (Fama and Jensen, 1983). Therefore, managers are more likely to make decisions that are beneficial to the long-term development of the company. Further, the principal-agent problem, which is more related to innovation investment, occurs due to delayed returns for large amounts of short-term investment. Managers may sacrifice the long-term benefits of R&D investment in light of future career development opportunities and personal salaries that are linked to earnings performance. Studies point out that the boards of directors fully consider the impact of innovation expenditure on corporate short-term performance when designing executive compensation contracts. In the case of manager retirement and decreasing or negative earnings by a company, the relationship between executive compensation and R&D investment is significantly positive. By directly linking salaries with R&D expenditure, managers are encouraged to actively innovate (Cheng, 2004), thereby alleviating the principal-agent problem. However, the effectiveness of this incentive mechanism depends on the accurate accounting of R&D expenditure. The tax credit rating system guarantees that the accounting treatment of innovation expenditure is complied with and accurately disclosed due to improvements in internal control. On the one hand, companies have the motivation to strengthen their tax bases and standardize information processing and transmission procedures in order to access the convenience of better tax credit rating systems; this implies that companies accurately report their R&D expenditure so that they meet the high measurement and confirmation requirements of R&D expenditure for accounting treatments. On the other hand, the tax credit rating system examines the compliance of enterprises that obtain tax subsidies, whereas R&D expenditure involves a number of preferential tax policies that are closely related to the collection and refund of taxes and fees. R&D expenditure significantly affects the calculation of tax payables, with higher tax compliance by enterprises indicating that R&D expenditure is effectively measured, which, in turn, improves the transparency of information related to corporate innovation, helps the board of directors evaluate managers' real efforts, reduces possible salary reductions for or even the dismissal of managers due to short-term performance failures (Bushman and Smith, 2001) and eventually enhances managers' incentives to innovate (Manso, 2011; Zhong, 2018).

Based on the above analysis, our hypothesis is stated formally as follows:

Hypothesis. *Ceteris paribus*, companies with an A-level tax credit rating have higher innovation investment.

However, theoretically, tax credit ratings may not affect corporate innovation. On the one hand, tax compliance implies that the level of corporate tax avoidance is reduced and that companies therefore share more profits with the government. The payment of taxes affects the cash flow of the company, resulting in a shortage of funds for the supply of innovation and further increasing financial constraints. On the other hand, incorporating the tax credit rating into the social credit system implies that corporate tax violations will incur more serious consequences. It is difficult for companies to carry out earnings management through simple means, such as manipulating accruals. Therefore, they use real earnings management to escape monitoring, with the reduction of innovation input being one of the methods of increasing short-term returns. The above effects also make our research topic a question that mandates empirical testing.

3. Research design and sample selection

3.1. Model specification

According to previous studies (Chen et al., 2019; Sun et al., 2019), we construct the following regression model to test the impacts of corporate tax credit rating on innovation investment:

$$\begin{aligned} RD/TA = {} & \alpha + \beta_1 * \ TAXCREDIT \ + \beta_2 * \ LNTA \ + \beta_3 * \ LEV \ + \beta_4 * \ QUICK + \beta_5 * CASH \\ & + \beta_6 * \ COCF \ + \beta_7 * \ ROA \ + \beta_8 * \ BM + \beta_9 * \ BH + \beta_{10} * \ PRIVATE \ + \beta_{11} \\ & * \ OWNERSHIP \ + \beta_{12} * \ BIG10 + \beta_{13} * \ MAO \ + \beta_{14} * \ MINDEX \\ & + \sum INDUSTRY \ + \sum YEAR \end{aligned} \quad (1)$$

The dependent variable *RD/TA* is the ratio of R&D investment to total assets in year $T + 1$ and the independent variable *TAXCREDIT* is the tax credit rating of the listed company evaluated by the State Administration of Taxation. When a company has an A-level tax credit rating in year *T*, *TAXCREDIT* equals 1, and 0 otherwise. The higher the tax credit rating is, the better the corporate tax compliance is (Li et al., 2020). Drawing on previous studies, we control other variables that may affect corporate innovation investment, such as the liquidity of funds (*QUICK*, *CASH*, *COCF*), profitability (*ROA*), the character of the ultimate controller (*PRIVATE*) and the top 10 audit firms (*BIG10*). We also include the fixed effects of industry and year. To eliminate the influence of extreme values on the regression results, we winsorize all of the variables by 1%. See Table 1 for the definitions of the main variables used in this study.

3.2. Data and sample selection

In view of the implementation of "Tax Credit Management (Trial)" on 1 October 2014, the data period for the tax credit rating is from 2014 to 2018. As the innovation variable in the research model is in the T + 1 period, the data period of the innovation variable is 2015–2019 and that of other firm-level control variables is 2014–2018. We obtain data on firms' tax ratings from the official website of the State Administration of

Table 1
Main variable definitions.

	Symbol	Name	Definition
Dependent Variables	*RD/TA*	R&D Investment	The ratio of R&D investment to total assets in year $T + 1$
Independent Variables	*TAXCREDIT*	Excellent Tax Credit	Binary indicator that equals 1 if the tax credit rating of the listed company is A
Control Variables	*LNTA*	Firm Size	Log (Total asset)
	LEV	Leverage	Total debt/Total assets
	QUICK	Quick Ratio	Current assets-inventory/Current liabilities
	CASH	Cash Holdings	Monetary funds/Total assets
	COCF	Operating Cash Flow	Operating cash flow/total assets
	ROA	Return on Assets	Profit/Total assets
	BM	Book to Market Ratio	The ratio of the book value of total assets to the market value
	BH	B/H Share	Binary indicator that equals 1 if the company has B/H shares
	PRIVATE	Ultimate controller	Binary indicator that equals 1 if the ultimate controller is private
	OWNERSHIP	Control	Ultimate controller's shareholding/Total shares
	BIG10	Big 10 Audit Firm	Binary indicator that equals 1 if the auditor is from the top 10 firms in audit income
	MAO	Modified Audit Opinion	Binary indicator that equals 1 if the annual report is issued by the auditor with an unqualified opinion, with highlighted matters, a qualified opinion or a negative opinion or if an opinion cannot be expressed
	MINDEX	Marketization Index	Marketization index, sorted by decile (Fan et al., 2011)
	INDUSTRY	Industry Dummy Variables	Binary indicator that equals 1 if the firm belongs to a certain industry
	YEAR	Year Dummy Variable	Binary indicator that equals 1 if the observation belongs to a certain year

Taxation. The remaining data are obtained from the China Stock Market and Accounting Research Database. We exclude missing data from our sample and ultimately obtain 12,578 firm-year observations.

Descriptive statistics are shown in Table 2. Corporate R&D investment accounts for a small proportion of total assets, with a sample average of 1.5% and a median of 1%, indicating that the proportion of R&D investment by listed companies is generally low. The average value of the tax credit rating is 0.453, which means that 45.3% of the companies have an A-level tax rating, and the standard deviation is 0.498, indicating that the tax ratings of the companies in our sample are quite different. The average proportion of private enterprises (*PRIVATE*) is 0.648 and the average shareholding ratio of major shareholders (*OWNERSHIP*) is 0.363, indicating that there are more private companies in the sample, that the ultimate controllers hold a higher proportion of shares and that the ownership structure is more concentrated. The average proportion of the top 10 audit firms (*BIG10*) is 0.460, which means that 46% of companies use the top 10 audit firms for auditing, and the average of *MAO* is 0.042, indicating that very few companies in the sample are issued modified opinions.

The correlation matrix is shown in Table 3. The upper right of the main diagonal of Table 3 shows the Spearman correlation coefficients and the lower left shows the Pearson correlation coefficients. The Pearson correlation coefficient between the main independent variable *TAXCREDIT* and the dependent variable *RD/TA* is 0.145 (the Spearman correlation coefficient is 0.192), and the sign and significance of the coefficients are consistent with our expectations (i.e., a good tax credit rating promotes corporate innovation investment), but the above correlation coefficient does not control other variables. Therefore, we use the regression analysis below for more stringent testing.

4. Empirical results

4.1. Main results

The relationship between tax credit rating and corporate innovation is shown in Table 4. The first column shows the regression results using the full sample with industry and year fix effects. The coefficient of the independent variable *TAXCREDIT* is 0.003, which is significantly positive at the 1% level and indicates that listed companies with an A-level tax credit rating invest more in R&D and that a good tax reporting system reflects a better information environment that is conducive to managers identifying R&D projects and securing financing. Incentive tax supervision also reduces agency costs and restricts the opportunistic behaviors of managers. The accurate identification and effective implementation of innovative projects and the decline of resource constraints can help companies increase R&D investment. The second column is a sample of companies with positive R&D investment. The coefficient of the independent variable *TAXCREDIT* is 0.002, which is signif-

Table 2
Descriptive statistics.

	N	Mean	STD	P25	Median	P75
RD/TA	12,578	0.015	0.018	0.001	0.010	0.023
TAXCREDIT	12,578	0.453	0.498	0	0	1
LNTA	12,578	22.269	1.297	21.374	22.120	23.010
LEV	12,578	0.438	0.210	0.270	0.426	0.591
QUICK	12,578	1.754	1.924	0.718	1.165	1.975
CASH	12,578	0.166	0.115	0.086	0.136	0.215
COCF	12,578	0.041	0.071	0.003	0.041	0.083
ROA	12,578	0.048	0.053	0.019	0.043	0.073
BM	12,578	0.418	0.307	0.207	0.338	0.537
BH	12,578	0.055	0.227	0	0	0
PRIVATE	12,578	0.648	0.478	0	1	1
OWNERSHIP	12,578	0.363	0.154	0.245	0.345	0.467
BIG10	12,578	0.460	0.498	0	0	1
MAO	12,578	0.042	0.200	0	0	0
MINDEX	12,578	8.185	1.704	7	9.080	9.630

STD: standard deviation; P25: 25th percentile; P75: 75th percentile.

Table 3
Correlation matrix.

	RD/TA	*TAXCREDIT*	*LNTA*	*LEV*	*QUICK*	*CASH*	*COCF*	*ROA*
RD/TA	1	0.192***	−0.232***	−0.281***	0.324***	0.120***	0.099***	0.258***
TAXCREDIT	0.145***	1	0.015*	−0.104***	0.093***	0.027***	0.076***	0.141***
LNTA	−0.203***	0.016*	1	0.498***	−0.421***	−0.145***	0.058***	0.046***
LEV	−0.239***	−0.113***	0.480***	1	−0.793***	−0.244***	−0.164***	−0.241***
QUICK	0.175***	0.043***	−0.342***	−0.633***	1	0.483***	0.072***	0.241***
CASH	0.113***	0.013	−0.162***	−0.266***	0.411***	1	0.124***	0.119***
COCF	0.107***	0.077***	0.063***	−0.174***	0.055***	0.133***	1	0.451***
ROA	0.225***	0.141***	0.060***	−0.273***	0.138***	0.122***	0.458***	1
BM	−0.164***	0.056***	0.601***	0.180***	−0.181***	−0.160***	0.007	−0.037***
BH	−0.085***	−0.017*	0.270***	0.101***	−0.081***	−0.031***	0.029***	−0.050***
PRIVATE	0.199***	0.036***	−0.356***	−0.258***	0.182***	0.038***	−0.028***	0.152***
OWNERSHIP	−0.035***	0.026***	0.172***	−0.011	0.015*	0.040***	0.138***	0.183***
BIG10	−0.011	−0.025***	0.134***	0.073***	−0.031***	0.008	0.035***	0.002
MAO	−0.053***	−0.084***	−0.109***	0.168***	−0.055***	−0.052***	−0.116***	−0.218***
MINDEX	0.159***	0.085***	−0.032***	−0.100***	0.050***	0.044***	0.019**	0.106***

	BM	*BH*	*PRIVATE*	*OWNERSHIP*	*BIG10*	*MAO*	*MINDEX*
RD/TA	−0.134***	−0.098***	0.256***	−0.002	−0.019**	−0.100***	0.190***
TAXCREDIT	0.078***	−0.017*	0.036***	0.030***	−0.025***	−0.084***	0.094***
LNTA	0.583***	0.211***	−0.343***	0.134***	0.107***	−0.096***	−0.059***
LEV	0.159***	0.105***	−0.260***	−0.010	0.073***	0.141***	−0.102***
QUICK	−0.201***	−0.103***	0.261***	0.014	−0.051***	−0.108***	0.119***
CASH	−0.154***	−0.031***	0.041***	0.037***	−0.000	−0.085***	0.052***
COCF	0.008	0.035***	−0.031***	0.137***	0.036***	−0.109***	0.039***
ROA	−0.021**	−0.053***	0.168***	0.178***	−0.005	−0.190***	0.119***
BM	1	0.188***	−0.273***	0.054***	0.050***	−0.128***	−0.044***
BH	0.250***	1	−0.199***	0.018**	0.179***	−0.015*	0.047***
PRIVATE	−0.289***	−0.199***	1	−0.115***	−0.124***	0.040***	0.211***
OWNERSHIP	0.062***	0.017*	−0.113***	1	0.066***	−0.122***	0.059***
BIG10	0.073***	0.179***	−0.124***	0.068***	1	−0.029***	−0.044***
MAO	−0.089***	−0.015*	0.040***	−0.118***	−0.029***	1	−0.063***
MINDEX	−0.042***	0.066***	0.187***	0.045***	−0.033***	−0.069***	1

icantly positive at the 1% level. The third column uses the ratio of R&D investment to sales revenue (*RD/SALE*) as the dependent variable. The coefficient of the independent variable *TAXCREDIT* is 0.006, which is significantly positive at the 1% level. The fourth column takes firms with R&D investment >0 as the sample and *RD/SALE* as the dependent variable. The coefficient of the independent variable *TAXCREDIT* remains significantly positive at the 1% level.

Among the control variables, the coefficient of *LEV* is significantly negative, which implies that the higher the ratio is, the more serious the level of financial constraints faced by companies is. Financial constraints limit firms' abilities to invest in R&D, which is consistent with the results of older studies (Himmelberg and Petersen, 1994; Zhang et al., 2017). The coefficients of *PRIVATE* are significantly positive at the 1% level, indicating that non-state-owned enterprises have higher innovation capabilities. The coefficient of *OWNERSHIP* is significantly negative, indicating that the concentration of equity is not conducive to corporate innovation and that the agency conflict between large shareholders and small shareholders affects corporate R&D investment. The coefficient of *BIG10* is significantly positive, indicating that top 10 audit firms effectively supervise firms' economic behaviors and enable firms to make innovative decisions that are good for long-term development.

4.2. Robustness and endogeneity tests

To verify the robustness of the results in Section 4.1, we change the measurement method of the dependent variable and re-examine the research question. Previous studies measure the degree of firms' innovation invest-

Table 4
Main results.

Variables	(1) *RD/TA* Full Sample	(2) *RD/TA* RD > 0 Sample	(3) *RD/SALE* Full Sample	(4) *RD/SALE* RD > 0 Sample
TAXCREDIT	0.003***	0.002***	0.006***	0.004***
	(8.274)	(5.344)	(7.261)	(4.196)
LNTA	−0.001	−0.001***	0.002**	0.001
	(−1.578)	(−3.791)	(2.277)	(0.870)
LEV	−0.007***	−0.004**	−0.030***	−0.028***
	(−4.280)	(−2.196)	(−6.881)	(−5.510)
QUICK	0.0002	0.0002	0.003***	0.003***
	(0.918)	(0.964)	(4.197)	(4.758)
CASH	0.004*	0.007***	0.003	0.006
	(1.868)	(2.618)	(0.476)	(0.960)
COCF	0.011***	0.013***	0.008	0.004
	(3.894)	(3.610)	(1.266)	(0.536)
ROA	0.033***	0.037***	−0.046***	−0.067***
	(6.096)	(5.944)	(−3.564)	(−4.467)
BM	−0.006***	−0.006***	−0.018***	−0.020***
	(−6.142)	(−5.164)	(−7.457)	(−7.142)
BH	−0.001	−0.0002	−0.004**	−0.001
	(−1.560)	(−0.156)	(−2.339)	(−0.589)
PRIVATE	0.002***	0.0001	0.008***	0.006***
	(3.147)	(0.083)	(6.705)	(4.132)
OWNERSHIP	−0.005***	−0.006***	−0.013***	−0.018***
	(−2.838)	(−3.249)	(−3.723)	(−4.497)
BIG10	0.001**	0.001*	0.002**	0.002*
	(2.250)	(1.838)	(2.029)	(1.850)
MAO	−0.001	0.001	−0.002	0.006
	(−1.160)	(0.464)	(−0.438)	(1.213)
MINDEX	0.001***	0.001***	0.001***	0.001***
	(6.710)	(5.517)	(4.583)	(3.027)
CONS	0.015**	0.034***	−0.021	−0.001
	(2.017)	(4.060)	(−1.309)	(−0.030)
Year	YES	YES	YES	YES
Industry	YES	YES	YES	YES
Observations	12,578	10,484	12,578	10,484
Adj. R^2	0.213	0.186	0.213	0.203

ment in two dimensions. From the perspective of innovation input, they use the R&D expenditure items in the financial statements. From the perspective of innovation output, they use patent application as a proxy. In the robustness test, we choose the number of patent applications in the current year to represent corporate innovation. Specifically, we calculate the number of patent applications in the current year plus 1 and take its natural logarithm as the dependent variable. Li and Zheng (2016) show that invention patents can better represent the substantial innovation of firms with investment value. Therefore, we further distinguish the types of patents and examine the impacts of firms' tax credit ratings on the number of invention patents and other patent applications. The results are shown in Table 5, Panel A. The first column uses the total number of patent applications as the dependent variable. The coefficient of the independent variable *TAXCREDIT* is 0.229, which is significantly positive at the 1% level. The second column uses the total number of invention patent applications as the dependent variable. The coefficient of the independent variable *TAXCREDIT* is again significantly positive at the 1% level. The third column uses the total number of other patent applications as the dependent variable. The coefficient of the independent variable here aligns with our expectations, indicating that from the perspective of innovation output, corporate tax credit rating has a significant positive impact on patent applications.

The main results of this study may have endogeneity problems. Sample self-selection indicates that companies with an A-level tax credit rating may invest more in R&D. Missing variables and other factors that have

Table 5
Endogeneity test results.

Panel A: Change the Measurement of Dependent Variables

Variables	(1)	(2)	(3)
	LNPATENT	*LNINVENT*	*LNOTHER*
TAXCREDIT	0.229***	0.166***	0.160***
	(6.994)	(5.989)	(5.606)
Controls	YES	YES	YES
Year	YES	YES	YES
Industry	YES	YES	YES
Observations	12,578	12,578	12,578
Adj. R^2	0.428	0.371	0.406

Panel B: Change Model

Variables	(1)	(2)
	RD/TA	*RD/SALE*
DUM_P	0.001***	0.005***
	(5.669)	(7.171)
DUM_N	0.0002	−0.001*
	(0.907)	(−1.839)
Controls	YES	YES
Year	YES	YES
Industry	YES	YES
Observations	11,465	11,675
Adj. R^2	0.023	0.030

Panel C: Between-Group T-test

Variables	(1)	(2)	(3)
	TAXCREDIT = 0	*TAXCREDIT* = 1	*DIFF*
RD/TA	0.014	0.017	0.003***
TAXCREDIT	0	1	1.000***
LNTA	22.314	22.298	−0.012
LEV	0.4296	0.4299	0.0003
QUICK	1.751	1.768	0.017
CASH	0.165	0.167	0.002
COCF	0.044	0.043	−0.001
ROA	0.051	0.050	−0.001
BM	0.434	0.428	−0.006
BH	0.054	0.053	−0.001
PRIVATE	0.647	0.649	−0.002
OWNERSHIP	0.366	0.365	−0.001
BIG10	0.456	0.455	−0.001
MAO	0.024	0.028	−0.004
MINDEX	8.261	8.263	−0.002
Observations	4552	4552	0

Panel D: Results of PSM Method

Variables	(1)	(2)	(3)
	RD/TA	*RD/SALE*	*LNPATENT*
TAXCREDIT	0.003***	0.006***	0.217***
	(7.883)	(6.919)	(6.181)
Controls	YES	YES	YES
Year	YES	YES	YES
Industry	YES	YES	YES
Observations	9104	9104	9104
Adj. R^2	0.210	0.217	0.459

not been considered, such as market environment and policy orientation, can affect the relationship between corporate tax credit rating and innovation investment. To address these possible endogeneity problems, we use the following methods:

1. Change model. In the main regression, we use the amount of R&D investment in year $T + 1$ as the dependent variable to solve the alternative explanation of reverse causality. To further characterize the causal relationship between the independent and dependent variables, we use the change model to perform the regression. Specifically, we take the change values of all of the continuous variables in the model for the years T and $T–1$. The independent variable DUM_P indicates that the taxpayer has not been graded A in year $T–1$ but has been graded A in year T. DUM_N indicates that the company has been graded A in year $T–1$ but not in year T. The results are shown in Table 5, Panel B. The first column uses RD/TA as the dependent variable; the coefficient of the independent variable DUM_P is significantly positive. The second column uses $RD/SALE$ as the dependent variable; the coefficient of the independent variable DUM_P is 0.005 and significantly positive at the 1% level. The coefficient of DUM_N is –0.001 and significantly negative at the 10% level, indicating that firms increase their R&D investment after being designated as an A-level taxpayer. On the contrary, when the tax rating is downgraded, alongside the cancellation of preferential policies and changes in the information environment, the listed company reduces its R&D investment.
2. PSM method. To circumvent the issues of missing variables and sample self-selection, we follow Sun et al. (2019), use PSM to perform one-to-one matching and regress model (1) on the matched sample. Specifically, we first construct a PSM sample, in which the treatment group is a sample with an A-level tax credit rating in year T and the control group contains the sample with the remaining tax credit ratings for that year. Second, we calculate the propensity matching score and use a logit model to calculate the probability of obtaining an A-level tax credit rating, with the dependent variable being a binary variable that indicates whether the tax rating for year T is A and the explanatory variables being the same as in model (1). Third, we match the sample using a one-to-one nearest neighbor matching method; the matched sample contains 9104 (4552 pairs) firm-year observations. Table 5, Panel C shows the differences between the treatment and control samples. Fourth, we use the matched sample to perform the multiple regression. As shown in Table 5, Panel D, regardless of whether R&D investment or R&D output is used as the dependent variable, the coefficient of the independent variable $TAXCREDIT$ is significantly positive at the 1% level, indicating that the results of our study remain valid after considering the problem of missing variables and that designation as an A-level taxpayer prompts firms to increase their R&D innovation.
3. DID based on the PSM method (PSM-DID). To further verify the causal relationship between tax credit rating and corporate innovation, we follow Li et al. (2018) and use PSM samples to test for a significant increase in corporate innovation before and after designation as an A-level taxpayer for the first time. $TREAT$ equals 0 if the company has never been rated as an A-level taxpayer and $POST$ is a dummy variable that equals 1 after the company is designated as an A-level taxpayer for the first time, and 0 otherwise. To avoid the effects of other policy and economic factors, we select a 3-year event window around the first year of being designated as an A-level taxpayer. The results are shown in Table 6, Panel A. The significantly positive coefficient of the interaction term indicates that after being designated as an A-level taxpayer for the first time, corporate innovation increases significantly and that a higher tax credit rating can provide firms with the resources and conditions required for innovation. To verify the impact of the tax credit rating policy on corporate innovation, we conduct the PSM-DID test with the tax credit rating policy issued in 2014 and the following joint punishment policy implemented in 2015 as the time of policy impact. We find that the incentive effect of tax credit ratings on corporate innovation must be established on the premise that the corresponding reward and punishment measures are gradually improved. After the gradual establishment of various auxiliary policies, firms innovate more.

Furthermore, we explore the cumulative effect between tax credit ratings and innovation. Specifically, we distinguish how many times a listed company has been rated as an A-level taxpayer. $FIRST$ equals 1 when a company is rated as an A-level taxpayer for the first time. $SECOND$ equals 1 when a company is rated as an A-level taxpayer twice. $THIRD$ equals 1 when a company is rated as an A-level taxpayer more than

Table 6
PSM-DID and cumulative effects results.

Panel A: PSM-DID		
Variables	(1)	(2)
	RD/TA	*RD/SALE*
*TREAT * POST*	0.002***	0.006***
	(3.198)	(3.908)
TREAT	0.003***	0.007***
	(4.110)	(4.106)
POST	−0.0002	−0.002
	(−0.352)	(−1.318)
Controls	YES	YES
Year	YES	YES
Industry	YES	YES
Observations	5777	5777
Adj. R^2	0.161	0.181
Panel B:Cumulative Effect		
Variables	(1)	(2)
	RD/TA	*RD/SALE*
FIRST	0.004***	0.008***
	(10.174)	(9.709)
SECOND	0.003***	0.006***
	(6.809)	(5.549)
THIRD	0.002***	0.002*
	(3.502)	(1.806)
Controls	YES	YES
Year	YES	YES
Industry	YES	YES
Observations	12,578	12,578
Adj. R^2	0.214	0.215

twice. The results are shown in Table 6, Panel B. The coefficients of these three variables follow a decreasing trend from top to bottom, indicating that the greatest promotion effect on corporate innovation occurs when a listed company has been rated as A-level taxpayer for the first time, with the magnitude of this effect decreasing gradually. This also verifies that the tax incentive method brings in the resources needed for firms' R&D to a certain extent. Accompanied by the accumulation of resources, our results reveal a phenomenon of diminishing marginal utility.

4.3. Channel inspection

The above analyses show that better tax credit ratings stimulate innovation investment by firms. We next examine how tax credit ratings affect corporate innovation decisions (i.e., we focus on their influence channels). First, innovation investment usually has greater uncertainty, necessitating more substantial and accurate information for managers' decision-making processes. A higher tax credit rating implies that a company's internal reporting system is relatively complete, that the collection and transmission of internal information is more efficient and that the information obtained by managers is more conducive to the accurate identification of innovative projects and the making of correct innovation investment decisions. To test whether a higher tax credit rating indicates higher internal information validity, which is more helpful to a company's innovation investment, we adopt path analysis and use the number of managerial earnings forecasts (*Voluntary*) to measure the usefulness of information for managers' decision-making processes. We use this parameter because managers' voluntary disclosure contains forward-looking information related to the development of the company, and the higher the accuracy of earnings forecasts is, the better the market response is. Low-quality managerial earnings forecasts negatively affect managers' reputations and future job opportunities. Therefore, the higher the number of voluntary earnings forecasts is, the better the quality of useful informa-

tion for management decisions is (Libby et al., 2006; Li and Xiao, 2015). The results are shown in columns (1) and (2) of Table 7. β (*RD/TA*, *TAXCREDIT*) is significantly positive, indicating that companies with an A-level tax credit rating increase their R&D innovation; β (*Voluntary*, *TAXCREDIT*) equals 0.176 and is significantly positive at the 1% level, indicating that a higher tax credit rating increases the effectiveness of a company's internal information. The indirect effect of internal information effectiveness accounts for 7.89% of the total effect, indicating that the effectiveness of internal information is one of the channels through which tax credit ratings affect firms' innovation investment decisions and that it has a partial mediating effect.

Second, innovation investment is characterized by large investment amounts, high investment risk and long payback periods for funds, increasing the financing requirements. The information asymmetry between external investors and corporate insiders makes the financing of innovation more difficult. Therefore, the implementation of R&D projects is always faced with greater financing constraints. A better tax credit rating directly grants enterprises the convenience of financial funds support and bank loans. Furthermore, it improves the quality of information disclosure and sends positive signals to investors that are validated by tax regulators. As a result, receiving a higher tax credit rating helps companies alleviate financial constraints. Following Almeida et al. (2004), we calculate the KZ index; the larger the KZ index is, the stronger the financial constraints faced by a company are. The results are shown in columns (3) and (4) of Table 7. The indirect effect of financing constraints accounts for 4.68% of the total effect, indicating that the problem of financial constraints is one of the channels through which the tax credit rating affects corporate innovation investment decisions and that it has a partial mediating effect.

Finally, innovation investment has a high spillover effect. Therefore, to protect their own proprietary technologies and core competitiveness, companies may reduce the disclosure of relevant information. This makes their accounting information less transparent, thereby providing more opportunities for managers to manipulate earnings. The establishment of the tax credit evaluation system helps stakeholders obtain true information about the company, strengthens the role of external supervision, restricts the opportunistic behaviors of managers and enhances the accuracy of R&D expenditure accounting, thus ensuring the motivating effect of the executives' compensation mechanism and alleviating the principal-agent problem. Following Li (2007), we use the turnover rate of total asset (*TURNOVER*) to measure agency costs. The results are shown in columns (5) and (6) of Table 7. The indirect effect of agency cost accounts for 4.64% of the total effect, indicating that agency cost is one of the channels through which tax credit rating affects firms' innovative investment decisions and that it has a partial mediating effect.

Furthermore, we examine the impact of tax credit ratings on the internal control system, financial information quality, financing costs and government subsidies in as much detail as possible. Following previous studies, we use the Dibo Internal Control Index (*IC*) to measure the quality of internal control, with a larger IC index indicating more standardized internal processes and higher quality of internal control. We use the infor-

Table 7
Channel inspection.

Variables	Internal Information Validity *Voluntary*		Financial Constraints *KZ*		Agency Cost *TURNOVER*	
	(1) Coefficient	(2) t	(3) Coefficient	(4) t	(5) Coefficient	(6) t
Direct Effect						
β (*RD/TA*, *TAXCREDIT*)	0.003***	(8.274)	0.003***	(9.942)	0.003***	(9.979)
Percentage	92.11%		95.32%		95.36%	
Indirect Effect						
β (*RD/TA*, *MEDIATOR*)	0.001***	(7.486)	0.004***	(8.324)	0.004***	(11.487)
β (*MEDIATOR*, *TAXCREDIT*)	0.176***	(6.453)	0.035***	(6.577)	0.035***	(4.741)
Total Indirect Effect	0.0002***	(6.479)	0.00014***	(5.161)	0.00014***	(4.383)
Percentage	7.89%		4.68%		4.64%	
CONTROLS		YES		YES		YES
Year		YES		YES		YES
Industry		YES		YES		YES
Observations		12,578		12,578		12,578

mation disclosure assessment rating issued by the Shenzhen Stock Exchange (*Opacity*) to measure the quality of financial information, with larger values of *Opacity* indicating lower quality of financial information. We use a residual income valuation model (generalized least squares model) to calculate the cost of equity capital (*COE*) of an enterprise and directly measure the cost of obtaining equity financing from outside investors. We use the ratio of financial expenses paid in the current period and the average balance of bank borrowings to measure the cost of debt (*COD*). The total amount of government subsidies (*Subsidy*) from other income and non-operating income is used to measure the financial funds obtained by an enterprise. The debt financing scale (*FINANC_Debt*) is measured by the cash received from issuing bonds and obtaining loans in the cash flow statement. The regression results are shown in Table 8. Higher tax credit ratings significantly improve the standardization of internal processes, financial information quality, government subsidy funds and debt financing scale. They also reduce corporate equity and debt financing costs, provide necessary resources for corporate innovation and effectively guarantee the implementation of innovative projects.

4.4. Cross-sectional tests

The above analyses show that a good tax credit rating can increase corporate innovation investment. We next examine whether the above effects differ under various circumstances. Specifically, we examine the possible impact of the number of analysts that follow a company from the perspective of the information environment, the internal governance structure from the perspective of corporate governance and the implementation of the Gold Tax Project III from the perspective of policy formulation.

From the perspective of the information environment, tax credit ratings require the collection and evaluation of corporate tax historical, internal and external information. It not only regulates corporate taxation behavior, but improves the quality of corporate internal reporting and external information disclosure. As information intermediaries, financial analysts use their professional skills to more extensively collect, process and release private information about the company and effectively reduce the information asymmetry between internal and external stakeholders (Schipper, 1991; Fang, 2007). Therefore, we expect tax credit ratings to exert a stronger effect when the number of analysts that follow a company is smaller (i.e., when the information environment is more opaque). The results are shown in columns (1) and (2) of Table 9. Tax credit ratings have a significantly higher promotion effect on corporate innovation for samples with low information transparency than for those with higher information transparency, indicating that good tax credit ratings can improve the quality of information, alleviate information asymmetry, boost corporate innovation and complement the information mining role of analysts.

From the perspective of corporate governance, the separation of corporate ownership and control causes a principal-agent problem between shareholders and management. Executives have the motivation to satisfy their own needs through opportunistic manipulation and harm shareholders' rights and interests. Executive shareholding unifies the goals of corporate managers and owners to a certain extent, reduces conflicts of interest and eases the principal-agent problem (Bizjak et al., 1993; Han et al., 2006). Tax credit ratings improve the collection and reporting of internal information and expand the information sources of external information users; this is more conducive to supervision by external stakeholders, making executives more likely to consider the long-term development of an enterprise during decision-making. Therefore, we expect tax credit rat-

Table 8
Results of Supplementary Tests.

Variables	(1) *IC*	(2) *Opacity*	(3) *COE*	(4) *COD*	(5) *Subsidy*	(6) *FINANC_Debt*
TAXCREDIT	0.114***	−0.090***	−0.002**	−0.018**	0.326***	0.007**
	(4.465)	(−5.909)	(−2.044)	(−2.068)	(4.535)	(2.137)
Controls	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES
Industry	YES	YES	YES	YES	YES	YES
Observations	12,571	7660	9201	11,189	11,264	12,578
Adj. R^2	0.281	0.284	0.143	0.091	0.122	0.298

Table 9
Cross-Sectional Tests.

Variables	*RD/TA*					
	Information Environment		Executive Shareholding		The implementation of Gold Tax Project III	
	High	Low	High	Low	Before	After
	(1)	(2)	(3)	(4)	(5)	(6)
TAXCREDIT	0.002***	0.004***	0.002***	0.004***	0.0033***	0.0026***
	(4.979)	(7.454)	(3.877)	(7.052)	(7.095)	(5.497)
DIFF		**0.002*****		**0.002****		**−0.0007**
CONTROLS	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES
Industry	YES	YES	YES	YES	YES	YES
Observations	7868	4709	6083	6081	7093	5485
Adj. R^2	0.238	0.120	0.202	0.169	0.110	0.303

ings to exert a stronger effect when the managerial ownership is lower (i.e., when the principal-agent problem is more serious). The results are shown in columns (3) and (4) of Table 9. The tax credit rating is significantly more effective in promoting corporate innovation for the sample with low executive shareholding than for that with higher managerial ownership, indicating that the tax credit rating mobilizes the enthusiasm of the managers' scientific decisions, reduces the agency costs and benefits the long-term development of an enterprise.

From the perspective of policy formulation, taxation is an important source of national public finances. As a result, the improvement of compliance with tax laws and promotion of taxpayers' integrity and self-discipline are issues that need to be resolved when developing a taxation system. The Gold Tax Project III is a compulsory tax collection method and tax management information service project established by the State Administration of Taxation. It uses big data and cloud computing to realize information exchange in administrative supervision, with the aim of strengthening tax management and reducing administrative costs. Since 2013, the Gold Tax Project III has successively launched the national and local tax monorails in Chongqing, Guangdong, Hebei, Hunan and other provinces, and it has been implemented nationwide since 2016. The implementation of the Gold Tax Project III has greatly improved firms' internal tax management foundations and may have an alternative or complementary effect to that of tax credit ratings. To test the impact of compulsory tax supervision policies on the effect of tax credit ratings, we divide samples into those before and after the implementation of the Gold Tax Project III. The results are shown in columns (5) and (6) of Table 9. Before the implementation of the Gold Tax Project III, tax credit ratings have a higher promotion effect on corporate innovation, but the difference between these two groups is not significant, indicating that from the perspective of policy effectiveness, tax credit ratings and the Gold Tax Project III have complementary effects. After the implementation of the Gold Tax Project III, tax credit ratings still improve the corporate tax reporting system, incrementally improve the quality of information disclosed to outside investors and enhance the innovation vitality of a company.

5. Conclusion

We examine the economic consequences of tax credit ratings, an innovative means of tax collection and management, and specifically the impact of tax credit ratings on corporate innovation investment decisions. We find that higher tax credit ratings encourage companies to increase innovation investment. This positive impact manifests through three channels. First, tax credit ratings help managers more accurately identify R&D projects; a higher tax credit rating implies that a firm has better internal information collection and transmission. After managers obtain more comprehensive and higher-quality information, they can accurately assess the prospects and future benefits of R&D projects. Second, tax credit ratings can alleviate corporate financial constraints; a higher tax credit rating not only grants the direct convenience of financial funds and bank loans but also indicates better internal information systems in the company. The improvement in information quality reduces information asymmetry. The endorsement of tax supervision also encourages investors to increase their willingness to invest. Third, tax credit ratings alleviate the principal-agent problem;

overall, the establishment of a tax credit evaluation system restricts managers' opportunistic behaviors by strengthening punishments and introducing external supervision. By enhancing the accuracy of R&D expenditure accounting, the tax credit evaluation system facilitates the motivating role of the executive compensation mechanism. After using the change model, PSM method and PSM-DID method to alleviate the endogeneity problem, we reveal a causal relationship between tax credit ratings and corporate innovation investment. Our results also pass robustness tests. Further, we examine whether the above effects differ under various circumstances; we specifically consider the possible impact of the number of analysts that follow the company from the perspective of the information environment, the internal governance structure from the perspective of corporate governance and the difference between the implementation of the Gold Tax Project III and tax credit ratings from the perspective of policy formulation. We find that the relationship between tax credit ratings and corporate R&D investment is more significant for samples with poor information environment and a low proportion of managerial ownership. The implementation of the Gold Tax Project III does not significantly affect the role of tax credit ratings, confirming the effects of tax credit ratings in alleviating information asymmetry and reducing agency costs, which are complementary to the compulsory tax policies and their incremental contributions. Tax credit ratings improve tax compliance by enterprises and stimulate enthusiasm for innovation by firms.

The findings of this study enrich our knowledge of the economic consequences of tax credit ratings. Unlike previous negative constraints imposed by tax violations and subsequent penalties, tax credit ratings use *ex ante* positive incentives to increase corporate tax compliance and stimulate corporate innovation, resulting in double dividends. The results of this study effectively compensate for the lack of research in the field of incentive tax supervision, comprehensively evaluate the impact of the implementation of tax credit ratings on various stakeholders and show that tax compliance can bring real benefits to enterprises instead of simply increasing costs.

Our findings also have practical significance and policy guidance implications. First, incentive-based tax supervision increases companies' tax compliance by improving corporate information systems and is applicable to all taxpayers. Compared with the original penalty-based supervision system, the incentive-based system has a more profound impact on enterprises because of wider coverage. Second, tax credit ratings not only enhance the willingness of enterprises to comply with tax laws and regulations but also promote corporate R&D investment, thereby helping the long-term development of enterprises, generating double dividends for both the government and enterprises and reflecting the significance of policy innovation. Third, the tax credit rating system implemented by the State Administration of Taxation integrates corporate history and current internal tax information with external information from credit and land perspectives, which accurately and comprehensively measures the true credit status of an enterprise and contributes to the construction of a social credit system. Finally, we propose a possible method by which to stimulate innovation by enterprises. The 2020 government work report emphasizes the need to seek breakthroughs in key and important areas, and policy formulation and reforms should play a leading role in this field. The tax credit rating is a reasonable means of encouraging enterprises to participate in innovation and gathering support for national construction and development.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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