

Article

Can Local Government Debt Decrease the Pollution Emission of Enterprises?—Evidence from China's Industrial Enterprises

Hai Xie ¹, Weikun Zhang ²  and Hanyuan Liang ^{1,*}

¹ China Center for Special Economic Zone Research, Shenzhen University, Shenzhen 518060, China; 1950121004@email.szu.edu.cn

² School of Social and Public Administration, Lingnan Normal University, Zhanjiang 524037, China; weikunz@lingnan.edu.cn

* Correspondence: 1950121005@email.szu.edu.cn

Abstract: The rapid growth of local government debt size in China has aroused the attention of academia and policy circles due to its impact on environmental pollution. This paper aims to explore the impact of local government debt size on corporate pollution emissions and its mechanism. This paper uses the China Local Government Debt Database, Industrial Enterprise Database, and Industrial Enterprise Pollution Database from 2006 to 2013, and adopts the two-way fixed effect model and difference-in-differences method to conduct an empirical analysis of industrial enterprises in 31 provinces of China. The results show that the local government debt size has a significant positive impact on corporate pollution emissions, and each unit increase in the local government debt size leads to an increase of 0.002 units in corporate pollution emissions. Further mechanism tests show that this effect is realized through the expansion of regional fixed asset investment and the reduction of enterprise R&D investment. In addition, there is significant heterogeneity among enterprises of different ownership, location, and industry. This paper provides practical references for local governments and micromarket actors to improve environmental protection and debt governance in the new era.



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Keywords: local government debt; implicit debt; environmental pollution; difference-in-differences method

1. Introduction

The ecological environment has externality and public character. Ecological governance and environmental protection essentially depend on the authority of the government. Government debt is an important financial tool for promoting economic growth and providing public services, as well as an important means for local governments to obtain environmental governance funds, which has a significant impact on the level of regional environmental governance. In 1994, China implemented a tax-sharing system reform that increased the central government's tax-sharing ratio, causing local governments to face the problem of a mismatch between fiscal revenue and public expenditure. Therefore, local governments tend to use investment and financial platforms for financing, on the one hand, to solve the problem of insufficient public expenditure and, on the other hand, to use them for infrastructure construction to drive the development of the local economy. Local governments can narrow budget gaps, stimulate economic expansion, and increase taxes through reasonable financing [1]. At the same time, it can also provide the necessary financial funds for environmental pollution prevention and control, thereby improving environmental issues. However, if local governments excessively raise funds to stimulate the economy, it will lead to excessive and ineffective investment, which may exacerbate environmental pollution, hinder sustainable economic growth and green development, and also pose risks to public health [2]. Therefore, it is very meaningful to conduct in-depth research on the impact of local government debt on environmental degradation in China.

Most research on local debt mainly focuses on its impact on economic growth [3–7] as well as its impact on corporate efficiency [8–10]. In recent years, the impact of local government bonds on non-economic factors in China has received increasing attention, including their impact on corporate innovation and financing. However, there is relatively little research on the impact of local government bonds on the environment in China. Earlier studies analyzed the issue of local debt and the environment from the perspective of fiscal decentralization [11–14]. Yuan et al., (2022) [14] studied the impact of fiscal decentralization on air quality and found that fiscal decentralization worsens local air quality. Recent research has directly studied the impact of local government debt scale on the environment [15–19]. Guo and Xue (2021) [16] believe that when government debt pressure is high, they tend to relax environmental regulations and allow enterprises to expand production scale, thereby obtaining more taxes. Therefore, government debt increases enterprise pollutant emissions. Mao et al., (2022) [17] demonstrated the negative impact of local government debt on the environment from the perspective of large-scale land development brought about by local government debt. However, the above research lacks a systematic analysis of local government debt in China, fails to fully clarify public debt and implicit debt, and also lacks consideration of the impact of the 2008 World Financial Crisis on local debt in China.

It is worth noting that due to the imperfect information disclosure system, in addition to public debt, there is also a considerable portion of non-public debt in China's local government debt. We refer to undisclosed local government debt as implicit debt, and the scale of implicit local government debt in China gradually exceeds public debt. Therefore, it is necessary to analyze and calculate the implicit local government debt in China. The implicit debt of local governments in China includes the following aspects: First, the debt of local government investment and financing platform companies. Investment and financing platform companies established by local governments have always played a crucial role in urban construction, basic public facility services, and infrastructure construction, assuming the function of providing certain public products. Therefore, they belong to the category of implicit debt of local governments. The second is the historical debt formed by state-owned institutions before 2015. Due to China's unique institutional mechanisms, public institutions bear certain public responsibilities, such as public schools and hospitals. In the process of development, due to insufficient financial investment or funding, public debt has formed, which is also the source of implicit local debt. The third is the debt generated by the reconstruction of shanty towns and affordable housing projects. This part of the project is a public welfare project carried out by local governments to improve the housing conditions of vulnerable or impoverished families. Debt investment focuses on people's livelihoods. Therefore, it is also a type of implicit local debt. The fourth is the historical liability of land reserves. Urban land belongs to the local government, and land reserve management is coordinated and managed by the city and county governments. Therefore, historical land reserve debts should also be included in the scope of the implicit debts of local governments. The fifth is the debt that local governments undertake as guarantee obligations. The debt that the local government undertakes as the guarantee obligation is the "ultimate responsible person", responsible for repaying the principal and interest. Therefore, it should also be included in the implicit debt.

After the reform of the self-sharing tax system, the central government gradually granted local governments the power to independently finance, which has led to a rapid increase in the level of public and implicit debt of local governments in China. Especially after the 2008 global financial crisis, in order to stimulate economic growth, the scale of local government debt rapidly increased [20]. Figure 1 depicts the changes in implicit and public debt of local governments in China from 2006 to 2013. It can be seen from the figure that local government public debt increased by nearly 2.5 times, from 3501.528 billion yuan in 2006 to 8674.691 billion yuan in 2013. However, local government implicit debt increased by 12 times from 1254.6 billion yuan in 2006 to 15,140.88 billion yuan in 2013 and exceeded public debt in 2010. As of the end of 2013, the scale of implicit local government debt was

1.75 times that of public debt. The rapidly growing local debt has attracted attention from the academic community [21–23].

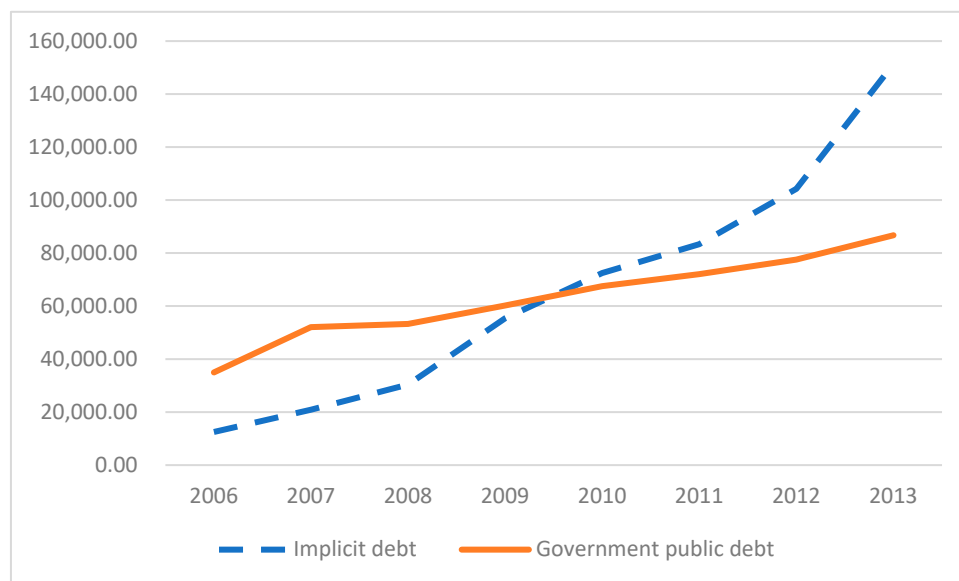


Figure 1. China's public debt scale and implicit debt scale from 2006 to 2013 (unit: 100 million yuan).

The rapid growth of local government debt has driven the construction of local public infrastructure and driven investment by enterprises. Economic growth is accompanied by a rapid increase in enterprise pollutant emissions. According to the data in the Chinese enterprise pollution database, the pollution volume of Chinese enterprises continued to increase from 2006 to 2013, causing huge environmental pressure. According to the China Environmental Analysis (2013) [24] issued by the Asian Development Bank, seven of the world's top ten polluted cities are on the Chinese Mainland. The main focus of this study is whether local government debt in China has had a negative impact on the environment. Due to the fact that public debt is legal local financing, which includes expenditures for environmental governance and ecological construction, it will not have a negative impact on the environment [25,26], while implicit debt is debt beyond a reasonable range and may have a significant negative impact on the environment. Therefore, this paper employs local government implicit debt data for research, which can more clearly reveal the causal relationship between the two, which is a significant difference between this study and most studies.

This article adopts the Wind database, China Statistical Yearbook, and China Local Debt Database from 2006 to 2013 to analyze and calculate implicit local debt and applies the industrial enterprise database and industrial enterprise pollution database to calculate pollutant emissions from enterprises. To ensure the reliability of the conclusion, we conducted an empirical analysis of the impact of local implicit debt on enterprise pollutant emissions. In terms of research methods, in addition to using a fixed effects model, this article also takes the financial crisis as an exogenous impact and uses the difference in differences (DID) model to identify the causal relationship between the scale of local implicit debt and enterprise pollutant emissions. The research results indicate that local government debt in China has a significant positive impact on enterprise pollutant emissions. Compared with existing research, the potential contributions of this article include the following three aspects. Firstly, this article collected financing data from local governments, their financing platforms, public institutions, and state-owned enterprises in China, and comprehensively calculated the amount of local debt, including a large amount of implicit debt. This can provide a more comprehensive and accurate calculation of local debt. Secondly, compared to most similar articles that use fixed effects models, this article uses the DID model for causal relationship identification, with more rigorous analysis methods and more reliable

conclusions. Finally, this article analyzes its mechanism from both macro and micro levels, providing a new perspective for such research.

The following parts of this article are arranged as follows: Section 2 is the theoretical analysis and theoretical hypothesis. Section 3 includes the measurement model of local debt scale and corporate pollution emissions, as well as data sources and indicator construction. The findings and discussion of the measurement model are in Sections 4 and 5. The impact mechanism of local debt on corporate pollution emissions is examined in Section 6, and the study results are presented in Section 7.

2. Theoretical Analysis and Research Hypothesis

2.1. Theoretical Analysis

The research object of this article is interdisciplinary issues, mainly involving two theoretical mechanisms. The first is the theory of fiscal decentralization. Firstly, taxpayers “vote with their feet” to choose a suitable place of residence, which requires an optimal combination of the public services provided by the local government and the taxes collected to maximize the effectiveness of residents [27]. Therefore, to compete for outstanding talents, there is competition between local governments in terms of public service level [28–30]. In the case of limited financial resources, local governments will solve the difficulties of obtaining financial funds through debt [31–33]. Secondly, the Chinese style of fiscal decentralization also has its particularities. Local government officials in China are appointed by the central government, and the Chinese government has entrusted them with the responsibility of managing the local economy. If local government officials want to be promoted, they must achieve rapid growth in the local economy [34,35]. While achieving economic growth, it will also provide more job opportunities and attract more residents. Therefore, under the influence of the assessment and promotion system for local government officials, to achieve economic growth, local government officials will resort to a large amount of debt to achieve rapid economic growth [36–38]. Due to the competition brought about by fiscal decentralization in both aspects, local government debt will rapidly expand, and it will also lead to a large amount of infrastructure construction [39–41], consuming a large number of building materials and natural resources. This will inevitably directly lead to an increase in pollution emissions from construction enterprises and industrial production enterprises such as building materials, as well as an increase in pollution emissions from related industry enterprises [42].

The second is the financing constraint theory. Local government debt has, to some extent, had a crowding-out effect on corporate financing [43,44]. First of all, from the perspective of capital competition, as local governments can use land use rights as collateral and predictable taxes as guarantees, and the central government has the “bottom line”, local governments have obvious advantages over enterprises in the credit market. A large amount of debt financing by local governments will reduce the availability of enterprise credit funds. Secondly, from the perspective of price competition, local government debt financing will increase the financing costs of enterprises. On the one hand, government bond yields are often seen as alternative indicators of risk-free returns, and the default risk of enterprises is usually higher than that of local governments, leading to financing providers charging higher financing fees to enterprises. On the other hand, the funds in the credit market are limited, and a large amount of government debt leads to a decrease in the balance of the credit market. In a situation of tight funds, financing providers are bound to increase financing costs and fees, which will be passed on to enterprises [45]. The existence of financing constraints will reduce technological innovation in clean production by enterprises, leading to an increase in pollutant emissions per unit of output. At the same time, due to the externality of pollution discharge, enterprises will reduce their capital investment in pollutant treatment, which will also directly increase their pollutant discharge.

2.2. Research Hypothesis

The “GDP championship” is primarily manifested externally in China through the ongoing growth of local government debt [13]. The primary way that local governments obtain funding is via financing platforms that are connected to them. The central government finds it challenging to regulate the financing of platform corporations since their debt is implicit. Undeveloped land is provided by local governments to enterprises that employ platform finance, which uses the property for both land development and maturation. The mature land is then transferred by the government, and the proceeds are utilized to pay off loans and other debt associated with the building of infrastructure [33]. The fast development of the land area and the building of numerous facilities in different locations have been made possible by the financing model of employing land mortgages for loans and land transfers to repay loans. As a means of luring investment, several areas have simultaneously opened numerous new industrial parks. The rate of industrial park expansion has surpassed the rate of increase in the total output value of industrial enterprises, and the situation of excess industrial parks is becoming more and more prominent, lowering the barrier to entry for businesses. Local governments must entice more businesses to locate there to recoup land transfer revenues more quickly. To minimize the excess in the park, the government would simultaneously loosen the regulation of industrial pollution discharge, encourage more businesses to locate there to generate land revenue, and increase output in the park to raise tax revenues. This article suggests the initial research hypothesis based on the analysis shown above.

Hypothesis 1 (H1). *Increasing the scale of local government debt will increase the pollutant emissions of local enterprises.*

Investment in fixed assets, such as land development and infrastructure building, has increased significantly as a result of the rise of local debt [35]. The massive investment in fixed assets necessitates the use of numerous building supplies, construction equipment, and power sources. Steel and buffalo are used to symbolize the manufacture of building materials, which is a polluting and energy-intensive business. Numerous construction material businesses have popped up to accommodate the enormous demand for building materials, resulting in significant pollution emissions. Coal is the primary fuel source for China’s electrical supply. As a result, producing energy also involves a significant quantity of coal use and pollutant emissions. This essay suggests the second research hypothesis in light of the aforementioned analysis.

Hypothesis 2 (H2). *The increase in the scale of local debt increases the production activities of enterprises by stimulating fixed assets investment, thus increasing the pollutant emissions of enterprises.*

Enterprise technical innovation is negatively impacted by the growth of municipal debt as well. In the medium run, businesses do not need to increase their market share through technical innovation since, on the one hand, the expansion of fixed assets has allowed them to receive a huge number of orders. On the other hand, as government debt has grown, it has had a crowding-out effect on corporate financing, leading to a lack of investment in production technology and process improvement, which has stymied technological advancement and prevented reductions in energy use and pollution emissions per unit of output [2]. The third research hypothesis was therefore proposed in this investigation.

Hypothesis 3 (H3). *The expansion of local debt has a certain crowding-out impact on corporate financing, which hinders business technology innovation and prevents effective reduction of emission per unit of output.*

3. Methodology and Data

3.1. Data Processing

The data in this paper comes from the following sources: (1) Implicit debt data: the local government implicit debt data is an exclusive implicit debt database formed by the author's manual collection and collation based on the platform caliber data of Wind Urban Investment Company. (2) Industrial enterprise database: including relevant data of state-owned and non-state enterprises above the designated size, it is a micro-enterprise database with a long period, a large amount of data, and a wide range of coverage in China. It includes basic and financial information indicators such as total assets, total liabilities, asset-liability ratio, number of employees, and net profit of enterprises, all from the China Industrial Enterprise Database. (3) Enterprise pollution database: this database includes a series of indicators of enterprise pollution emissions, including sulfur dioxide, industrial wastewater, industrial exhaust gas, etc. This database is not currently widely used by the academic community. (4) City-level database: the prefecture-level city data includes economic data indicators at the city level, including regional GDP, the proportion of the secondary industry to GDP, the proportion of the tertiary industry to GDP, and the natural growth rate of the population. It is sourced from the China Urban Statistical Yearbook [46].

This article employs macro- and micro-data matching for the period 2006–2013. First, use the prefecture-level city database to match the implicit debt data to form a macro panel database, then use the industrial enterprise data to match the enterprise pollution database to form a micro panel database, and finally perform a mixed matching of macro and micro panels to obtain the macro and micro panel databases that we need to use; The data span eight years and cover the year in which the impact of the international financial crisis occurred in 2008, enabling causal identification and estimation (in Table 1). Table 1 includes the dependent variable, core explanatory variable, and all control variables for this article. The first column is the variable name, the second column is the construction method of the variable, and the third column displays the sample observation values of the variable. The fourth to eighth columns represent the mean, standard deviation, minimum, and maximum values, respectively.

Table 1. Descriptive statistics.

Variables	Definition/Measurement	Total Observations	Mean	Std. Dev.	Min	Max
<i>poll</i>	Weighted pollution emissions to construct overall pollution indicators.	93,941	−0.028	0.16	−0.078	1.165
<i>Indebt</i>	Implicit debt logarithm.	85,180	5.138	1.802	−4.605	9.131
<i>treat</i>	Grouped according to the median of implicit debt, if greater than or equal to the median, it is marked as 1, otherwise, it is 0.	93,941	0.546	0.498	0	1
<i>post</i>	Time dummy variable, greater than or equal to 2008, denoted as 1, otherwise 0.	93,941	0.773	0.419	0	1
<i>gdp</i>	Regional GDP.	90,102	79,588.61	81,830.85	3943.344	466,996.2
<i>ind_ratio</i>	The proportion of secondary industry output value to GDP.	93,767	51.938	7.01	15.93	89.75
<i>fisspt</i>	Fiscal expenditure/Fiscal revenue.	92,993	1.543	0.823	0.649	18.025
<i>fiscal</i>	Fiscal expenditure/GDP.	89,166	0.111	0.042	0.043	0.688
<i>fdi</i>	Foreign investment/GDP.	87,733	0.272	0.308	0	1.443
<i>size</i>	The logarithm of total assets.	93,920	11.849	1.597	0	19.455
<i>lnL</i>	The logarithm of the number of employees.	65,591	5.994	1.16	0	12.316
<i>lev</i>	Total liabilities/total assets of the enterprise.	83,216	0.551	0.28	−0.581	18.385
<i>age</i>	Current year minus year of business opening.	93,920	12.309	12.319	0	100
<i>lnwage</i>	ln(Total payroll payable/number of employees).	54,817	3.339	0.968	−6.526	11.036
<i>lnkl</i>	ln(Total fixed assets/number of employees).	54,496	4.598	1.481	−6.436	13.576
<i>profit</i>	Total profit/total assets of the enterprise.	83,200	0.087	0.264	−41.092	20.046
<i>kc</i>	Fixed assets/total industrial output value.	82,721	2.49	604.934	0	173,987
<i>fi</i>	Local government per capita fiscal income/Central government per capita fiscal income	92,985	2.129	2.586	0.046	16.352
<i>fe</i>	Local government per capita financial expenditure/Central government per capita financial expenditure	92,985	6.779	7.352	0.779	48.466
<i>finance</i>	Interest expense/Fixed assets	80,211	0.108	5.556	−2.992	1259.143

Note: The industrial enterprise database contains information about all state-owned and non-state-owned enterprises above the designated size, with a large sample size, a long span time, and wide coverage. The database of Chinese industrial enterprises is a true reflection of the actual economic operation and valuable material for telling the story of China well. The database spans 10 years from 1998 to 2007, with over 2 million sample observations, covering detailed information on industrial enterprises, including total assets, total liabilities, total industrial output value, total sales output value, number of employees, total fixed assets, and so on.

3.2. Model Specification

To empirically analyze the impact of local government debt scale on corporate pollution emissions, we need to first verify the causal relationship between debt scale and corporate pollution emissions. Therefore, we build a measurement model based on including local government debt scales and corporate pollution emissions as follows.

3.2.1. Basic Regression Model (Two-Way Fixed Effects Model)

It can be found that the core explanatory variable, $lndebt_{ct}$, is the logarithm of the scale of implicit debt issued by local governments, and the explained variable, $pollution_{ict}$, is a synthetic indicator of pollution emissions from enterprises, used to measure the level of pollution emissions from enterprises. X_{ict} represents a series of control variables at the corporate and regional levels. θ_c denotes fixed effects at the enterprise level. σ_t stands for a fixed effect at the city level. ε_{ict} means a fixed effect of time, ε_{ict} is a random perturbation term. The model is essentially a two-way fixed effect model that examines the basic causal effect between local government debt and corporate pollution emissions. Its core estimation coefficient is α_1 . If the coefficient is positive, it indicates that there is a positive correlation between the scale of local government debt and corporate pollution emissions.

$$pollution_{ict} = \alpha_0 + \alpha_1 lndebt_{ct} + \gamma_0 X_{ict} + \delta_i + \theta_c + \sigma_t + \varepsilon_{ict} \quad (1)$$

The above models still have some endogenous problems, which are fatal to estimation in econometrics. Due to possible measurement errors, missing variables (unobservable variables), or reverse causal-related issues, the results may have the possibility of inaccurate estimation, which may be questioned. To clarify the true causal relationship and solve the endogenous problems, we use the outbreak of the 2008 financial crisis as an exogenous impact, introduce a model, and construct a strength DID to identify the impact of local debt expansion on corporate pollution emissions. After the outbreak of the financial crisis in 2008, the Chinese government implemented a “four trillion” economic stimulus plan in response to the crisis, thereby opening a new round of local government debt expansion. Therefore, the financial crisis of 2008 provided us with a very good exogenous impact in analyzing local government debt behavior, and we constructed a DID model as follows.

3.2.2. Causal Variable Model (Difference in Differences Model with Exogenous Shocks)

This article adopts the strength difference in differences method, which is different from the traditional difference in differences method. In fact, it uses a data-driven method to group according to the median and divide it into a treatment group and a control group. The significant difference from the traditional difference in differences method is that the policy impact in this article is a “one size fits all” policy that is rolled out nationwide in a short period of time without clear treatment and control groups. Under such conditions, we use data from local government debt issuance for causal identification, which can solve the endogeneity problem of inference, make up for the shortcomings of existing literature research, and also be an innovative point in the methodology of this article. The adoption of intensity DID requires that the intertemporal period of panel data before and after the financial crisis in 2008 not be too long. We use the expansion of local government debt after the financial crisis in 2008 as an exogenous shock. The ideal, of course, is to select the period of panel data around 2008. Therefore, we chose 2006–2013, which can not only cover the year when the policy shock occurred but also draw consistent micro-estimation conclusions.

$$pollution_{ict} = \beta_0 + \beta_1 treat \times post + \gamma_1 X_{ict} + \delta_i + \theta_c + \sigma_t + \varepsilon_{ict} \quad (2)$$

where $pollution_{ict}$ represents enterprise i located in phase t of city c , and $treat \times post$ means the difference in differences interaction term. $treat$ is grouped according to the median of local debt issuance intensity, with those greater than or equal to the median being recorded as 1, and those less than the median being recorded as 0. $post$ denotes a dummy variable at the time level, with a value greater than or equal to 2008 marked as 1, and a value less than

2008 marked as 0. X_{ict} means a series of control variables at the enterprise and city levels. δ_i stands for fixed effects at the enterprise level, θ_c indicates a fixed effect at the urban level. σ_t is a fixed effect of time and ε_{ict} is the random perturbation term.

4. Analysis of Empirical Results

4.1. Analysis of Basic Regression Results

Based on the macro and micro data from 2006–2013, model (1) is estimated, and the estimated results are shown in Table 2. When performing econometric regression models to examine the causal relationship between variables, the regression coefficients and their standard errors may be affected by fixed effects and different clustering standard errors. To guarantee the reliability of the research conclusions, we did not add any control variables to the regression in the first column and separately investigated the impact of local debt issuance scale and corporate pollution emissions. The regression result coefficient was positive and passed a 1% significance test, indicating that each unit increase in local government debt scales increased corporate pollution emissions by 0.002 units. In column (2), based on the first column, we added prefecture-level city control variables such as regional GDP, the proportion of secondary industry, regional fiscal decentralization, and regional openness to the outside world to control related variables that may affect debt issuance and economic growth. The regression coefficient we obtained is still significantly positive, and significant at the 1% level. In column (3), based on column (2), we continued to add enterprise-level control variables such as enterprise size, number of employees, age of the enterprise, and profit margin. After controlling the relevant variables and indicators that affect the production and operation of the enterprise, we can find that the results remain unchanged and the significance level remains consistent. Therefore, we can draw a preliminary basic conclusion that the increase in the scale of local government debt has led to an increase in corporate pollution emissions, resulting in a “deterioration effect” on the environment. The empirical results are consistent with research Hypothesis 1 of this article, that is, an increase in local debt levels will increase corporate pollutant emissions. The research conclusion of this article is similar to that of Mao et al., (2022), who found that debt from financing platforms increases environmental pollution through land competition [17]. Peer research findings further support the credibility of our research.

To overcome the impact of model endogeneity and obtain reliable causal identification estimates, we subsequently used macro and micro data from 2006–2013 to estimate model (2). The estimated results are shown in Table 3. We also use the stepwise regression method to successfully add urban-level and enterprise-level control variables to the model. The estimated coefficients of the difference in differences are both positive and significant at the 5% level. The comparison shows that there are no significant changes in the regression coefficient or significance level, indicating that the intensity difference in the difference estimation results is reliable. After the global financial crisis of 2008, it was discovered that local government debt growth not only fueled economic growth and drained resources from the private sector but also had detrimental effects on the environment, increasing corporate pollution emissions significantly. The regression results also control dummy variables at the individual, time, and regional levels of the enterprise, and we cluster the standard errors of the regression result coefficients at the enterprise level.

Table 2. Two-way fixed effect regression results.

	(1)	(2)	(3)
	a1	a2	a3
Variables	new_poll	new_poll	new_poll
<i>lndebt</i>	0.002 *** (0.001)	0.002 *** (0.001)	0.002 ** (0.001)
<i>gdp</i>		−0.000 (0.000)	−0.000 (0.000)

Table 2. *Cont.*

	(1)	(2)	(3)
	a1	a2	a3
Variables	new_poll	new_poll	new_poll
<i>ind_ratio</i>		−0.000 (0.000)	−0.001 ** (0.000)
<i>fisspt</i>		0.002 (0.003)	0.003 (0.005)
<i>fiscal</i>		0.001 (0.058)	−0.044 (0.062)
<i>fdi</i>		0.001 (0.003)	−0.009 * (0.005)
<i>size</i>			0.007 *** (0.002)
<i>lnL</i>			0.005 *** (0.002)
<i>lev</i>			0.001 (0.002)
<i>age</i>			0.000 (0.000)
<i>lnwage</i>			0.002 * (0.001)
<i>lnkl</i>			0.002 *** (0.001)
<i>profit</i>			0.003 (0.002)
<i>kc</i>			−0.003 ** (0.001)
Constant	−0.039 *** (0.003)	−0.035 ** (0.016)	−0.113 *** (0.028)
Observations	76,083	70,228	40,402
R-squared	0.903	0.903	0.942

Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 3. Regression results of the causal variable model.

	(1)	(2)	(3)
	b1	b2	b3
Variables	new_poll	new_poll	new_poll
<i>did</i>	0.003 ** (0.001)	0.003 *** (0.001)	0.002 ** (0.001)
<i>ind_ratio</i>		0.000 (0.000)	−0.000 (0.000)
<i>fisspt</i>		−0.002 (0.002)	−0.002 (0.002)
<i>fi</i>		−0.003 ** (0.001)	−0.004 *** (0.001)
<i>fe</i>		−0.000 (0.000)	−0.000 (0.000)
<i>size</i>			0.010 *** (0.001)
<i>lev</i>			−0.000 (0.002)
<i>finance</i>			−0.000 (0.000)
<i>age</i>			−0.000 (0.000)

Table 3. Cont.

	(1)	(2)	(3)
	b1	b2	b3
Variables	new_poll	new_poll	new_poll
<i>profit</i>			0.005 *** (0.002)
<i>kc</i>			−0.002 *** (0.001)
Constant	−0.028 *** (0.001)	−0.023 ** (0.011)	−0.125 *** (0.018)
Observations	83,498	82,740	68,871
R-squared	0.899	0.900	0.907

Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$.

4.2. Robustness Test

The difference in the difference results in Tables 2 and 3 show robustly that the expansion of local government debt has exacerbated the rise in corporate pollution emissions, but there is still no way to eliminate endogenous issues caused by factors such as missing variables, measurement errors, and corporate endogeneity. To further confirm the reliability of the research results, we conducted a series of robust estimation tests.

4.2.1. Parallel Trend Test

A prerequisite assumption for the difference in differences model is to conduct a trend, which means that before a policy impact occurs, the treatment group and the control group need to meet parallel trends. For this study, the parallel trend hypothesis means that before the impact of the 2008 financial crisis, the changes in the size of local debt issuance in the treatment group and the control group were similar. This article adopts the event-study method to conduct parallel trend testing. We set an econometric regression model as follows:

$$pollution_{ict} = \alpha_{\tau} \sum_{\tau=2006}^{2013} treat \times D_{\tau} + \gamma_1 X_{ict} + \delta_i + \theta_c + \sigma_t + \varepsilon_{ict} \quad (3)$$

where, D_{τ} is a dummy variable for the year, α_{τ} means a key parameter that we need to focus on, and other parameters are consistent with the meaning of the model (2). The model sets the initial year of the sample, 2006, as the base year for event analysis. The meaning of the parameter α_{τ} whether there exists any significant difference in pollutant emission intensity among enterprises in different local debt issuance scales in year τ . If before the financial crisis hit in 2008 α_{τ} , if it is not significant and equals 0, then the parallel trend assumption is satisfied. To further simplify the analysis, we treat the last five periods of policy shocks as the second period after the occurrence of policy shocks.

Figure 2 shows the estimated results of the parallel trend test. The point shown in Figure 2 is the regression estimate of α_{τ} . The dotted line through the point perpendicular to the X-axis represents the 95% horizontal confidence curve. The parameter *pre_1* represents the estimated value of the corresponding α_{τ} in the year before the policy shock occurred and *post_1–post_2* denotes the estimated value of the corresponding α_{τ} in the year and two years after the occurrence of the policy shock. *Current* suggests the estimated value of the year in which the policy happens. As can be seen from Figure 2, *pre_1* fluctuates around 0, and the corresponding 95% confidence interval width broadly crosses 0, indicating that there is no significant change in the difference between the treatment group and the control group between the occurrence of policy shocks. Therefore, before the impact of the financial crisis in 2008, there was no significant change in the gap between the pollution emissions of enterprises in the regions where the treatment group and the control group were located. Therefore, the parallel trend in this article is satisfied. Additionally, Figure 2 also reflects

the dynamic impact of the expansion of local government debt on corporate pollution emissions. During the current period and after the policy shock, corporate pollution emissions were significantly positive, indicating that the expansion of local government debt began to play a role in 2008 and that its “pollution effect” had a sustained impact. According to the size of the regression coefficient, in 2008, due to the expansion of the scale of local government debt issuance, the pollution emissions of enterprises increased rapidly and remained at a high level for the next two years, further indicating that the expansion of local government debt has had a significant environmental pollution effect.

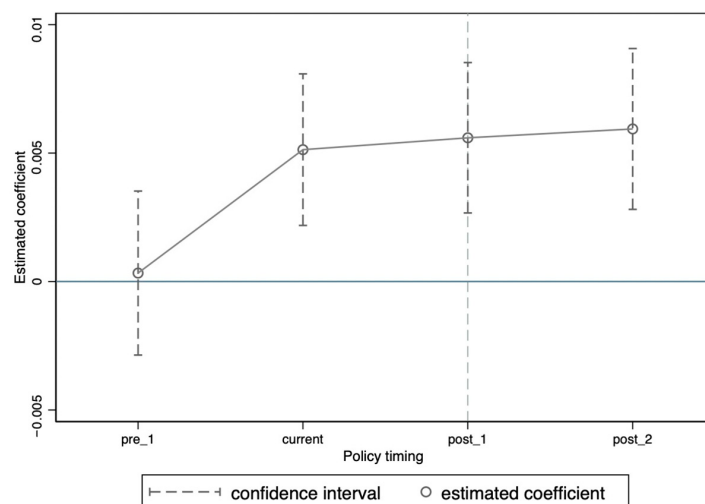


Figure 2. Parallel trend test.

4.2.2. Placebo Test

The difference-in-differences model controls the fixed effects and major factors that may lead to non-randomness of the core explanatory variables and passes the parallel trend test. However, it is still theoretically impossible to eliminate the interference of omitted variable bias. For this purpose, we conducted a placebo test on the basic regression results. The method is to select all enterprises that were impacted in 2008 from all panel data, and randomly select 50% of them to match with all panel data. The selected 50% of enterprises were used as the experimental group, and the rest were used as the control group. On this basis, the difference in differences regression was performed 500 times repeatedly. The results of 500 random processes are shown in Figure 3. Specifically, the X-axis indicates the magnitude of the estimated coefficient of the “pseudo policy dummy variable”, and the Y-axis means the magnitude of the density value and the p -value. The curve is the kernel density distribution of the estimated coefficient, the origin is the p -value corresponding to the estimated coefficient, the vertical dashed line is the true estimated value of 0.002 for the DID model, and the horizontal dashed line is the significance level of 0.1. The true estimate of the DID model is an obvious exception value, indicating that the policy implementation effect is significantly different from the placebo effect. The expansion of local government debt caused by the impact of the 2008 financial crisis is the main reason for the change in corporate pollution emissions.

4.2.3. Variable Regrouping

In addition to the parallel trend test and placebo test, this paper also conducts other robustness tests on the previous difference in differences model. We conducted a sample grouping based on the average value of local government debt issuances. Namely, enterprises with larger or equal to the average debt issuance value in their location are put in the processing group, while enterprises with a lower debt issuance value than the average value are put in the control group. The difference in the difference estimation is performed for the regrouping results, and the regression results are shown in Table 4.

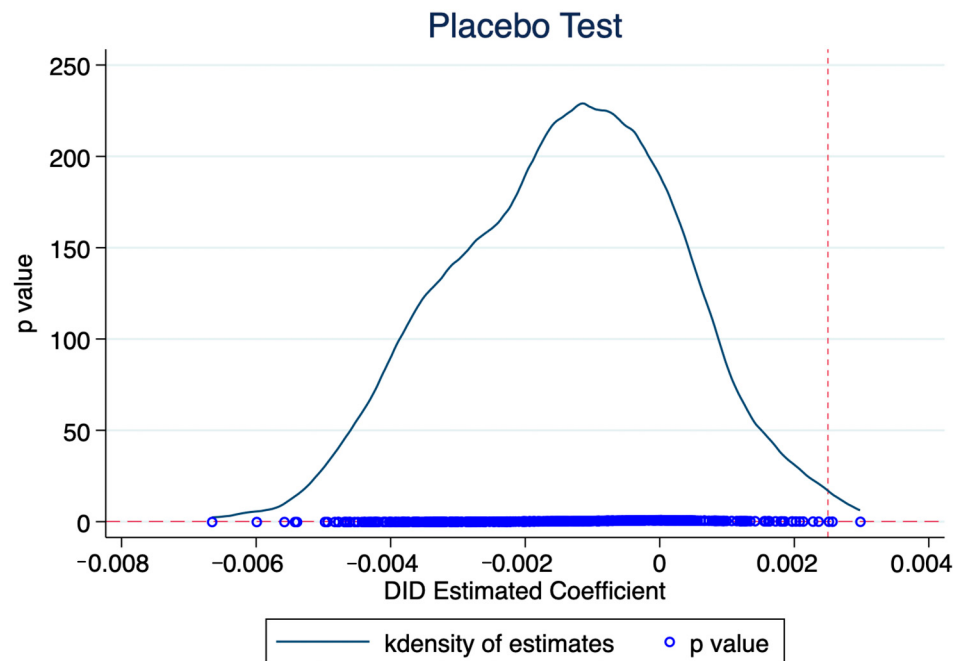


Figure 3. Placebo test. The horizontal red dotted line represents the 0.1 marking line, which is used to show the significance of the estimation coefficient. The vertical red dotted line represents the base regression result at 0.0025.

Table 4. Regression results of variable regrouping.

	(1)	(2)	(3)
	c1	c2	c3
Variables	new_poll	new_poll	new_poll
<i>did1</i>	0.002 ** (0.001)	0.003 ** (0.001)	0.002 * (0.001)
<i>ind_ratio</i>		0.000 (0.000)	−0.000 (0.000)
<i>fisspt</i>		−0.002 (0.002)	−0.002 (0.002)
<i>fi</i>		−0.003 ** (0.001)	−0.004 *** (0.001)
<i>fe</i>		−0.000 (0.000)	−0.000 (0.000)
<i>size</i>			0.010 *** (0.001)
<i>lev</i>			−0.000 (0.002)
<i>finance</i>			−0.000 (0.000)
<i>age</i>			−0.000 (0.000)
<i>profit</i>			0.005 *** (0.002)
<i>kc</i>			−0.002 *** (0.001)
Constant	−0.028 *** (0.001)	−0.023 ** (0.011)	−0.125 *** (0.018)
Observations	83,498	82,740	68,871
R-squared	0.899	0.900	0.907

Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5. Heterogeneity Analysis

To further expand the depth of the empirical analysis and demonstrate the validity of the conclusions in this article, we further employ heterogeneity analysis in the basic regression to identify the heterogeneity of conclusions under various conditions.

5.1. Heterogeneity of Geographical Location

This study refers to the “HYT094-2006 Classification and Code of Coastal Administrative Regions” issued by the China Oceanic Administration, divides the cities where the enterprises are located into coastal areas and inland areas, and classifies and regresses the samples according to these standards. The results of the regression are shown in Table 5. Columns (1) and (2) stand for the regression results for inland areas, and columns (3) and column (4) represent the regression results for coastal areas. Furthermore, columns (1) and (3) are regression results of the basic results, and columns (2) and (4) are regression results with all control variables added. It can be seen that the sample from coastal areas has a significantly positive regression coefficient for local government debt expansion enterprises and has passed the 1% significance test; However, enterprises in inland regions have no significant relationship with the expansion of local government debt. The reason may be that the business environment in coastal areas is sound, and corporate behavior is more sensitive to changes in government policies. After the 2008 financial crisis, local governments increased their expansionary debt strategies. On the one hand, the economy in coastal areas is more active, and the local government debt demand and deficit scale will also be larger. On the other hand, enterprises in coastal areas are more sensitive to policy changes, which can be more quickly transmitted to corporate behavior when government policies change [42].

Table 5. Regression Results of geographical location heterogeneity.

	(1)	(2)	(3)	(4)
	d1	d2	d3	d4
	Inland Areas	Inland Areas	Coastal Areas	Coastal Areas
Variables	new_poll	new_poll	new_poll	new_poll
<i>did</i>	0.000 (0.002)	0.000 (0.002)	0.005 *** (0.001)	0.004 *** (0.002)
<i>ind_ratio</i>		−0.000 (0.000)		0.000 (0.000)
<i>fisspt</i>		−0.003 (0.003)		0.016 * (0.009)
<i>fi</i>		−0.002 (0.006)		−0.003 ** (0.001)
<i>fe</i>		−0.002 (0.002)		−0.000 (0.000)
<i>size</i>		0.011 *** (0.002)		0.008 *** (0.002)
<i>lev</i>		−0.001 (0.005)		0.000 (0.002)
<i>finance</i>		−0.001 *** (0.000)		0.000 *** (0.000)
<i>age</i>		−0.000 (0.000)		0.000 (0.000)
<i>profit</i>		0.005 * (0.003)		0.005 ** (0.002)
<i>kc</i>		−0.002 *** (0.001)		−0.001 * (0.001)
Constant	−0.012 *** (0.001)	−0.112 *** (0.029)	−0.044 *** (0.001)	−0.160 *** (0.027)
Observations	39,816	32,597	43,682	36,274
R-squared	0.904	0.911	0.889	0.898

Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5.2. The Heterogeneity of Enterprise Ownership

To clarify whether enterprises with different ownership would have different performances in the face of government debt expansion, we divide them into state-owned enterprises and non-state enterprises according to their property rights. China is a typical country dominated by common ownership, with natural links between state-owned enterprises and the government. Under the current system, leaders of state-owned enterprises can be transferred to the government as local leaders, and financial institutions such as banks also prefer to provide financing loans to state-owned enterprises [44]. The regression results of enterprises with different ownership are shown in Table 6. Columns (1) and (2) denote the regression results for non-state-owned enterprises. While columns (3) and (4) represent the regression results of state-owned enterprises. Moreover, columns (1) and (3) suggest the regression results of the basic results, and columns (2) and (4) mean the regression results with all control variables added. It can be found that the sample of non-state-owned enterprises has a significantly positive regression coefficient under the condition of local government debt expansion, and has passed the 5% significance test. However, there is no significant relationship between state-owned enterprises and local government debt expansion. The reason may be that after the outbreak of the financial crisis in 2008, the expansion of local debt mainly squeezed out the financing constraints of non-state enterprises, while the crowding-out effect on state-owned enterprises was not obvious. Instead, state-owned enterprises were able to receive more subsidies and administrative incentives from the government, while the private sector faced greater financing constraints and potential “efficiency losses”.

Table 6. Regression results of enterprise property ownership.

	(1)	(2)	(3)	(4)
	e1	e2	e3	e4
	Non-State-Owned Enterprises	Non-State-Owned Enterprises	State-Owned Enterprises	State-Owned Enterprises
Variables	new_poll	new_poll	new_poll	new_poll
<i>did</i>	0.003 ** (0.001)	0.003 ** (0.001)	0.006 (0.006)	0.006 (0.007)
<i>ind_ratio</i>		−0.000 (0.000)		0.002 (0.001)
<i>fisspt</i>		−0.002 (0.003)		−0.007 (0.005)
<i>fi</i>		−0.002 * (0.001)		−0.019 * (0.012)
<i>fe</i>		−0.000 (0.000)		0.002 (0.002)
<i>size</i>		0.009 *** (0.001)		0.013 * (0.008)
<i>lev</i>		0.001 (0.002)		−0.015 (0.012)
<i>finance</i>		−0.000 (0.000)		0.001 (0.001)
<i>age</i>		−0.000 *** (0.000)		0.001 * (0.000)
<i>profit</i>		0.005 *** (0.002)		0.002 (0.009)
<i>kc</i>		−0.001 ** (0.001)		−0.004 ** (0.002)
Constant	−0.038 *** (0.001)	−0.126 *** (0.017)	0.062 *** (0.002)	−0.176 (0.110)
Observations	75,166	61,889	7693	6400
R-squared	0.881	0.890	0.934	0.939

Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5.3. Industry Heterogeneity

According to industry classification, we divide the sample of enterprises into high-tech industry enterprises and non-high-tech industry enterprises to explore how different types of enterprises in different industries perform when facing local debt expansion. The regression results of different industry types of enterprises are shown in Table 7, where columns (1) and (2) represent the regression results of non-high-tech industry enterprises, and columns (3) and (4) denote the regression results of high-tech industry enterprises. Columns (1) and (3) are regression results of the basic results, and columns (2) and (4) are regression results with all control variables added. The sample of non-high-tech industry enterprises has a significantly positive regression coefficient under the condition of local government debt expansion, and has passed the 5% significance test. However, there is no significant relationship between high-tech industry enterprises and local government debt expansion. The reason may be that enterprises in non-high-tech industries already have high pollution levels. Enterprises in high-tech industries focus on investment in technology, environmental standards, and reducing pollution emissions. Therefore, after the expansion of local debt in 2008, enterprises in high-tech industries have been less affected, while enterprises in non-high-tech industries have been greatly impacted, and still adhere to the extensive development path, resulting in increased pollution emissions from enterprises.

Table 7. Regression results of industry heterogeneity.

	(1)	(2)	(3)	(4)
	f1	f2	f3	f4
	Non-High-Tech	Non-High-Tech	High-Tech	High-Tech
Variables	new_poll	new_poll	new_poll	new_poll
<i>did</i>	0.003 ** (0.001)	0.003 ** (0.001)	−0.001 (0.003)	0.000 (0.003)
<i>ind_ratio</i>		−0.000 (0.000)		0.000 (0.000)
<i>fisspt</i>		−0.002 (0.002)		−0.001 (0.003)
<i>fi</i>		−0.005 *** (0.002)		−0.004 (0.003)
<i>fe</i>		−0.000 (0.000)		0.000 (0.001)
<i>size</i>		0.010 *** (0.001)		0.008 ** (0.003)
<i>lev</i>		−0.001 (0.003)		0.001 (0.005)
<i>finance</i>		−0.000 (0.000)		0.000 (0.001)
<i>age</i>		−0.000 (0.000)		0.000 (0.000)
<i>profit</i>		0.006 *** (0.002)		−0.007 (0.006)
<i>kc</i>		−0.003 *** (0.001)		−0.001 (0.001)
Constant	−0.023 *** (0.001)	−0.116 *** (0.020)	−0.056 *** (0.001)	−0.169 *** (0.049)
Observations	70,653	58,182	10,260	8235
R-squared	0.902	0.909	0.828	0.827

Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$.

6. Mechanism Test

The above analysis answers the question of whether the expansion of local government debt would affect the pollution of Chinese enterprises through several tests and a series of robustness analyses. This section examines the specific transmission mechanism of local

government debt expansion on corporate pollution, which is to answer the question of how local government debt affects the pollution of Chinese enterprises.

6.1. Increase the Fixed Assets Investment

After the 2008 financial crisis, the central government formulated a “four trillion” economic stimulus plan to boost the economy, meanwhile, the local governments introduced a 2.28 trillion economic stimulus plan. In this context, policies at all levels have stimulated the expansion of financing platforms and increased the budget without supervision and examination. At the same time, fixed assets investment and infrastructure construction are flaring up like fire set to dry tinder all over the country. The construction will bring an exemplar and incentive effect for enterprises to attract investment and expand production scale, and these will increase the total production and emissions of enterprises. To investigate this mechanism, we regress the core explanatory variable with the logarithm of the regional fixed assets investment scale as the explained variable. The regression results are shown in columns (1) and (2) of Table 8. Column (1) is the regression of the basic results, and column (2) adds all control variables based on column (1). It can be found that in the regression of regional fixed assets investment as the explained variable, the regression coefficient is significantly positive, and has passed the 1% significance test. The results indicate that the increase in regional fixed assets investment is a major channel to induce enterprises to increase pollution emissions [42]. This mechanism test verifies Hypothesis 2 of this paper, that is, government debt increases fixed assets investment, which leads to the increase of enterprise pollutant emissions. The results of such research are entirely predictable, as the main use of local government debt is for land development, increased transportation, and the construction of other municipal facilities [39,41].

Table 8. Regression results of mechanism test.

	(1)	(2)	(3)	(4)
	g1	g2	g3	g4
Variables	inv	inv	lnyf	lnyf
<i>did</i>	0.367 *** (0.011)	0.285 *** (0.011)	−0.096 *** (0.025)	−0.140 *** (0.027)
<i>ind_ratio</i>		−0.037 *** (0.002)		−0.019 *** (0.005)
<i>fisspt</i>		−0.039 *** (0.012)		−0.116 *** (0.036)
<i>fi</i>		0.559 *** (0.012)		−0.003 (0.048)
<i>fe</i>		0.190 *** (0.005)		0.028 *** (0.005)
<i>size</i>		−0.067 *** (0.012)		−0.111 *** (0.026)
<i>lev</i>		−0.057 ** (0.024)		0.132 *** (0.051)
<i>finance</i>		0.000 (0.000)		0.000 (0.000)
<i>age</i>		0.000 (0.000)		0.003 (0.002)
<i>profit</i>		−0.032 (0.022)		0.224 *** (0.058)
<i>kc</i>		−0.008 * (0.005)		−0.011 (0.008)
Constant	3.396 *** (0.005)	3.723 *** (0.172)	0.394 *** (0.011)	2.631 *** (0.405)
Observations	79,343	65,148	83,485	68,858
R-squared	0.961	0.972	0.522	0.545

Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

6.2. Squeeze Out “Innovation”: Decrease Research and Development Investment

According to the analysis in the previous section, the expansion of local government debt would lead to a reduction in corporate financing constraints, and companies would reduce their investment in research and development departments, resulting in a decrease in corporate research and development funding [47]. Therefore, corporate environmental pollution and emissions would rise, which is not conducive to pollution reduction. To effectively prove this mechanism, we put the enterprise R&D investment in the database as an explained variable in the regression model. The regression results are shown in Table 8. Column (3) is the regression of the basic results, and column (4) is based on column 3, adding all control variables. In the regression of the logarithm of enterprise R&D expenses as the explained variable, the regression coefficient is significantly negative and passes the 1% significance test. Moreover, the expansion of local government debt has indeed led to a decline in enterprise research and development investment, which is not conducive to improving environmental protection technology and process levels and increases pollution levels. This regression result confirms Hypothesis 3 of this article, which states that the increase in government debt leads to a decrease in technological innovation investment by enterprises, thereby increasing their pollutant emissions. Jianyong Fan (2022) and He Chen (2022) have both reached similar conclusions as this article [48,49], supporting the research results of this article.

There are three hypotheses in this article, among which Hypothesis 1 is about the basic conclusion that an increase in local debt scale will increase the pollutant emissions of local enterprises. We examine this conclusion by performing benchmark regression models and difference-in-differences models. The empirical results showed that the expansion of the local government debt scale exacerbated the increase in corporate pollution emissions. For every unit increase in local government debt scale, corporate pollution emissions increased by 0.002 units. Hypothesis 2 is about mechanism 1, that is, the increase in the scale of local debt increases the production activities of enterprises by stimulating fixed asset investment, thus increasing the pollutant emissions of enterprises. In Columns (1) and (2) of Table 8, we tested Hypothesis 2. It can be seen that in the regression of regional fixed asset investment as the explained variable, the regression coefficient is significantly positive and passes the 1% significance test. Hypothesis 3 is about mechanism 2, which states that the increase in local debt scale has a certain crowding-out effect on corporate financing, thereby inhibiting technological innovation and preventing effective improvement in the unit product emissions of enterprises. In columns (3) and (4) of Table 8, we tested Hypothesis 3 and found that in the regression of the logarithm of enterprise R&D expenses as the dependent variable, the regression coefficient was significantly negative and passed the 1% significance test.

7. Conclusions and Policy Implications

China is as precious as “clear waters and green mountains” with “golden and silver mountains,” according to the Chinese government, which has constantly advocated new requirements for high-quality growth since the dawn of the new century. Environmental protection is given unparalleled importance by the Chinese government. This research thoroughly and methodically explores the internal causal link between the rise in local government debt and environmental pollution in China within the context of this scenario. The key findings are listed below. Increased local government debt has greatly encouraged businesses to emit more pollutants. Businesses increase their pollutant emissions by 0.002 units for every unit increase in local government debt. Even after a number of robustness tests, this fundamental conclusion is still true. The additional mechanism demonstrates that the growth in regional fixed asset investments and the fall in the business’s own research and development investments are to blame for the increase in enterprise pollution emissions. The research’s findings show substantial variation across businesses in various ownership, geographic, and industrial sectors. In the modern period, this study provides useful references for enhancing local government and micro-market behavior, as well as China’s

environmental protection and debt administration. The limitations of this study are mainly focused on applied research in Chinese scenarios, and its applicability to foreign countries and other regions is worth further exploration and research in the future.

The study findings in this paper have significant policy and practical ramifications. To encourage the adaptation of local government debt to economic and social growth, the central government, local governments, and market economy ministries should each perform their respective obligations. The proposals are specifically the following:

Firstly, the research findings of this study offer practical policy consequences and helpful recommendations. In the first place, it illustrates the link between the degree of local government debt and environmental damage. In addition to squeezing out the micromarket sector, local government debt also contributes to environmental damage. To prevent the negative effects of the scale's chaotic increase on the economy and social ecology, local government debt must be rigorously regulated. A new chapter in the management of local government debt was launched in 2015 with the enactment of the new Budget Law. All levels of government should implement standard management of local debt under centralized coordination, encourage the government to manage implicit debt, particularly the cleaning up of financing platforms, complete the market-oriented transformation of debt, and prevent and address financial risks brought on by debt.

Secondly, the government must actively direct and regulate government behavior, particularly the issuance and investment of debt, as well as actively direct the government to establish a favorable perception of political performance and unwaveringly promote the strategy of green and sustainable development, to prevent pollution. To clean up a polluted environment, it is necessary to make clear the specific duties of stakeholders, including the federal government, local governments, and market economy organizations; to work together to promote environmental pollution control; to make clear the task list of stakeholders; to integrate macro and micro endowment resources; and to help in environmental protection under the guidance of environmental protection goals.

Finally, environmental contamination is mostly a result of patterns of economic development. In addition to re-establishing a win-win growth model for the economy and environment, this essay offers a fresh viewpoint and way of thinking about the current standards of corporate development and environmental protection. We should direct and set up a green bond issuance mechanism, encourage government public funds to invest and finance green industries and sectors, encourage financial platforms and institutions to increase the scale of green bond issuance, increase investment in environmental protection and green infrastructure, and direct the organic integration of local government debt and ecological environment protection through platform transformation and green investment and financing.

In fact, research on local governments in China is worth continuous attention and further research. Our article focuses on the impact of the era of local debt expansion on corporate pollution emissions. In 2015, the New Budget Law imposed stricter regulations on the issuance and use of local government debt, which led to the decoupling of local governments and financing platforms. It also stipulated that land should not be injected as capital into financing platforms to issue debt, which to some extent suppressed the expansion of implicit debt. The outbreak of COVID-19 has intensified the pressure on local government fiscal expenditure. In the post-pandemic era, how to balance economic growth, green development, and fiscal and financial risks is a problem worth further attention and exploration in the future.

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