

Research on The Impact of Local Government Debt on Corporate Green Innovation

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Abstract. The 1994 tax-sharing reform and the 2008 financial crisis triggered an expansion of local government debt in China. This not only disrupts financial market order and increases systemic financial risks but may also exert significant impacts on micro-level enterprises. Such effects include squeezing corporate credit resources, distorting resource allocation within enterprises, and ultimately affecting corporate green investments and innovation. Green innovation serves as both a key driver for economic transformation and upgrading, and a vital lever for achieving the dual carbon goals. Deepening our understanding of its influencing factors can help precisely elevate the level of green innovation development. Based on this rationale, this paper employs firm-city matching data from 2013 to 2023 to empirically examine the impact of local government debt on corporate green innovation and its underlying mechanisms.

Keywords: Local government debt; Green Innovation; Crowding-out effect.

1. Introduction

According to China's Local Government Bond Information Disclosure Platform, the combined balance of general and special-purpose local government debt reached 25.66 trillion yuan in 2018 and 40.74 trillion yuan in 2023. Numerically, this represents a nearly 60% increase in national local government debt over five years, highlighting its rapid growth rate. The continuous rise in local government debt disrupts financial market order and increases systemic financial risks, undermining long-term economic stability. Moreover, it exerts significant impacts on micro-level enterprises, such as crowding out credit resources and distorting resource allocation, thereby hindering high-quality corporate development. If this affects corporate access to credit resources, might it also influence innovation investments—particularly green innovation? If so, through which channels and mechanisms does this impact manifest?

Current research on the impact of local government debt primarily focuses on macro-level effects, such as economic growth, household consumption and income, and employment. Studies examining micro-level impacts have mainly concentrated on corporate financing, risk, and investment efficiency, with few works directly investigating the influence of local government debt on corporate green innovation. Against this backdrop, this paper will build upon theoretical analysis to empirically investigate the effects and underlying mechanisms of local government debt on corporate green innovation. The aim is to provide theoretical support and empirical validation for understanding how local government debt influences micro-level corporate green innovation, thereby serving corporate green transformation, sustainable development, and competitiveness enhancement. Additionally, it seeks to offer insights for regulating the scale and financing methods of local government debt issuance.

2. Theoretical Analysis and Research Hypotheses

2.1. The Impact of Local Government Debt on Corporate Green Innovation

The combined pressures of fiscal constraints and promotion expectations have driven local governments to engage in reckless, large-scale borrowing, resulting in rapid debt expansion [1]. However, given the finite nature of market capital, this creates a crowding-out effect on enterprises' external financing. Compared to conventional technological innovation, green innovation activities pose higher risks, longer return cycles, and require greater capital investment to enhance their likelihood of success [2]. These characteristics dampen firms' willingness to pursue green innovation voluntarily. Consequently, when local government debt expansion crowds out corporate credit resources and deteriorates the external business environment, firms without external constraints further reduce investments in green innovation. Instead, they allocate limited funds to activities with higher returns and shorter payback periods, aiming to stabilize income and mitigate uncertainty arising from risks.

Based on the above analysis, this paper proposes Hypothesis 1: Local government debt expansion exerts a negative inhibitory effect on corporate green innovation.

2.2. Analysis of the Impact Mechanism Based on Financing Constraints

When local governments expand their debt scale, enterprises are at a disadvantage in the competition for funds between the two, leading to increased difficulty and cost in obtaining external financing. This also implies that enterprises will face greater financing constraints [3]. At this point, their access to funding channels becomes more restricted, and the amount of available funds decreases. Consequently, enterprises tend to substitute high-investment, long-cycle, high-risk green innovation activities with projects requiring less input, offering shorter return cycles, and posing lower risks.

Based on the above analysis, this paper proposes Hypothesis 2: Local government debt expansion inhibits corporate green innovation by intensifying financing constraints on enterprises.

2.3. Analysis of the Impact Mechanism of Government Subsidies

Government subsidies represent direct or indirect transfers of funds provided by the government to enterprises without requiring the delivery of goods or services in return [4]. This expenditure constitutes a significant component of local government fiscal outlays. For governments, providing such non-repayable subsidies means voluntarily forgoing the potential returns that these funds could generate. Therefore, when local governments face significant debt repayment pressures due to rapidly expanding debt levels, they may be motivated to reduce the number of subsidies provided to enterprises. This approach helps meet their own funding needs and lower the risk of debt default. A reduction in government subsidies not only diminishes the funds available to enterprises for their own operations and development but also leads to negative expectations among external investors regarding the enterprises' future prospects, thereby decreasing their willingness to invest. These dual effects reduce the funds available to enterprises for green innovation activities and consequently lower their motivation to engage in such activities.

Based on the above analysis, this paper proposes Hypothesis 3: Local government debt expansion inhibits enterprise green innovation by reducing government subsidies.

2.4. Analysis of the Transmission Mechanism of Tax Burden

Taxation is the fiscal revenue that the state compels and acquires without compensation from national income, based on laws, through public authority, and according to prescribed procedures and standards, to meet public needs. Enterprises are a major taxpayer base in China, and for local governments, corporate tax payments have always been a significant source of fiscal revenue. When local government debt expands, to alleviate repayment pressures, local governments have an incentive to increase their own fiscal revenue by strengthening tax collection and administration from

enterprises [5]. This imposes heavier tax burdens on enterprises, reducing their free cash flow and available surplus. Consequently, enterprises proactively adjust their operational and investment strategies, scaling back high-risk green innovation activities that require sustained capital support.

Based on the above analysis, this paper proposes Hypothesis 4: Local government debt expansion inhibits corporate green innovation by increasing the tax burden on enterprises.

3. Research Design

3.1. Sample Selection and Data Sources

This study utilizes annual data from A-share listed companies on the Shanghai and Shenzhen stock exchanges between 2013 and 2023 as its research sample. Local government debt data is sourced from the China Local Government Bond Information Disclosure Platform and the Wind database. Corporate green innovation data is derived from the CNRDS database. Firm-level control variables primarily originate from the CSMAR database, while region-level control variables are mainly sourced from the China Urban Statistical Yearbook. To enhance sample reliability, the following data cleaning procedures were applied:

- (1) Exclusion of companies with ST, PT, or *ST status;
- (2) Exclusion of financial sector firms;
- (3) Exclusion of firms with severe data missingness;
- (4) Truncation of all continuous variables at the 1% and 99% levels to mitigate the impact of outliers.

3.2. Variable Selection

3.2.1. Dependent variable

Corporate Green Innovation (Gre). Drawing upon prior scholarly research, this study employs the sum of green invention patents and green utility model patents applied for by enterprises in a given year from the CNRDS database to measure corporate green innovation. Furthermore, to prevent loss of observations in cases where certain enterprises reported zero green patents in specific years, this study adds one to the green patent application count before taking the logarithm, using this adjusted figure as the metric for assessing corporate green innovation levels.

3.2.2. Explanatory variable

Local Government Debt (Debt). The explanatory variable in this paper is measured by the ratio of local government debt stock to GDP. Following the statistical methodology of previous scholars, the specific calculation method for local government debt stock is as follows: Current-year local government debt stock = Current-year local government bond stock + Current-year local urban investment bond stock [6]. This statistical approach encompasses both explicit debt and contingent liabilities while effectively balancing data availability.

3.2.3. Control variables

This paper draws upon previous scholarly research while incorporating control variables at both the firm and regional levels. Corporate-level control variables include: firm size (Size), return on assets (ROA), asset-liability ratio (Lev), fixed assets ratio (Fix), management expense ratio (Mfee), current ratio (Liquid), shareholding ratio of the largest shareholder (Top1), dual positions (Dual), management shareholding ratio (Share), and tobin's q (Tobinq). Regional-level control variables include: GDP growth rate (GDPG) and the proportion of secondary industry (SECOND).

3.3. Model Specifications

3.3.1. Baseline Regression Model

To verify whether local government debt exerts a significant negative impact on corporate green innovation, this paper constructs the following benchmark regression model:

$$Gre_{it} = \alpha_0 + \alpha_1 Debt_{ct} + \gamma Controls_{ict} + \mu_j + \delta_t + \varepsilon_{it} \quad (1)$$

Among these, Gre_{it} is the dependent variable, representing the green innovation level of listed company i in year t ; $Debt_{ct}$ is the independent variable, representing the local government debt level of city c where listed company i is located in year t ; $Controls_{ict}$ denotes the selected control variables, encompassing both firm-level and region-level dimensions; μ_j and δ_t represent industry fixed effects and time fixed effects, respectively; ε_{it} constitutes the random disturbance term of the model.

3.3.2. Mediation Effect Model

To verify whether the causal mechanism between local government debt and corporate green innovation holds, this paper draws upon prior scholarly research to establish the following three-step mediation effect model [7]:

$$Gre_{it} = \alpha_0 + \alpha_1 Debt_{ct} + \gamma Controls_{ict} + \mu_j + \delta_t + \varepsilon_{it} \quad (2)$$

$$Med_{it} = \beta_0 + \beta_1 Debt_{ct} + \gamma Controls_{ict} + \mu_j + \delta_t + \varepsilon_{it} \quad (3)$$

$$Gre_{it} = \theta_0 + \theta_1 Debt_{ct} + \theta_2 Med_{it} + \gamma Controls_{ict} + \mu_j + \delta_t + \varepsilon_{it} \quad (4)$$

The mediation effect model is essentially identical to the benchmark regression model, with Med_{it} serving as the mediating variable selected in this study.

4. Empirical Analysis

4.1. Descriptive Statistics

Table 1. Descriptive statistics

Variable	N	Mean	SD	Min	Median	Max
Gre	26541	0.374	0.787	0.000	0.000	3.738
Debt	26541	0.248	0.159	0.001	0.224	0.783
Size	26541	22.230	1.295	19.840	22.030	26.390
Roa	26541	0.033	0.070	-0.322	0.037	0.198
Lev	26541	0.412	0.208	0.0540	0.399	0.935
Fix	26541	0.196	0.152	0.00200	0.163	0.677
Mfee	26541	0.087	0.075	0.008	0.067	0.497
Liquid	26541	2.677	2.703	0.300	1.784	16.980
Top1	26541	0.336	0.146	0.083	0.312	0.743
Dual	26541	0.316	0.465	0.000	0.000	1.000
Share	26541	0.150	0.199	0.000	0.021	0.677
TobinQ	26541	2.089	1.398	0.833	1.642	9.237
GDPG	26541	0.062	0.027	-0.002	0.066	0.125
SECOND	26541	0.377	0.109	0.149	0.383	0.594

Table 1 presents the descriptive statistics for the key variables in this study. The minimum value for corporate green innovation (Gre) is 0, the maximum is 3.738, and the mean is 0.374. It can be observed that the mean of this variable is closer to 0 and significantly lower than the maximum value, indicating that the overall level of green innovation among the sampled enterprises is relatively low, with notable disparities in green innovation levels among some firms. The minimum value for local government debt (Debt) is 0.001, while the maximum is 0.783. The minimum is nearly zero, yet the maximum approaches 80%, indicating substantial disparities in government debt scales across different regions in China. Concurrently, excessive borrowing in certain areas may expose them to significant debt risks and repayment pressures. Comparing the statistical values of the remaining firm-level and region-level control variables with existing literature reveals minimal discrepancies, indicating that all control variables in this study fall within a reasonable range.

4.2. Benchmark Regression Analysis

To test whether Hypothesis 1 holds, this study conducted a regression based on Equation (1), with the results presented in Table 2. Column (1) includes no control variables, while Column (2) incorporates both firm-level and region-level control variables. The results indicate that regardless of whether control variables are included, the regression coefficient for local government debt remains consistently negative and statistically significant at the 1% level. This confirms that the expansion of local government debt does indeed inhibit corporate green innovation, thereby validating Hypothesis 1.

Table 2. Benchmark regression results

	(1)	(2)
	Gre	Gre
Debt	-0.324***	-0.342***
	(-4.533)	(-4.941)
Control variables	NO	YES
Constant	0.454***	-2.856***
	(21.022)	(-8.652)
Year FE	YES	YES
Industry FE	YES	YES
Observations	26541	26541
R-squared	0.093	0.150

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

4.3. Mediation Analysis

4.3.1. Financing constraint mechanism

To test whether Hypothesis 2 holds, this study adopts the KZ Index as a measure of financing constraints (KZ), drawing upon prior scholarly research. A stepwise regression analysis was conducted in three stages, with the results presented in Table 3. Column (2) presents the regression results for local government debt's impact on corporate financing constraints. The regression coefficient is significantly positive, indicating that an expansion in local government debt significantly exacerbates the financing constraints faced by enterprises. Column (3) shows the regression results with both local government debt and corporate financing constraints as explanatory variables. It can be observed that the regression coefficients for both variables are significantly negative, suggesting that financing constraints partially mediate the relationship between local government debt and corporate green innovation. Thus, Hypothesis 2 holds.

Table 3. Financing constraint mechanism

	(1)	(2)	(3)
	Gre	KZ	Gre
Debt	-0.343***	0.380***	-0.340***
	(-4.703)	(3.141)	(-4.652)
KZ			-0.010**
			(-1.995)
Control variables	YES	YES	YES
Constant	-2.893***	2.499***	-2.869***
	(-8.358)	(6.226)	(-8.323)
Year FE	YES	YES	YES
Industry FE	YES	YES	YES
Observations	24221	24221	24221
R-squared	0.152	0.633	0.152

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

4.3.2. Government subsidy mechanism

To test whether Hypothesis 3 holds, we conducted a regression analysis using the logarithm of the government subsidy amount received by firms as the measure of government subsidies (GSUB), based on the mediation effect model constructed earlier. The regression results are presented in Table 4. Column (2) shows the regression results for local government debt on enterprise government subsidies. The regression coefficient is significantly negative, indicating that an expansion in local government debt leads to a reduction in government subsidies to enterprises. Column (3) presents the regression results with both local government debt and government subsidies as explanatory variables. Here, the regression coefficient for local government debt is significantly negative, while that for government subsidies is significantly positive. This indicates that government subsidies partially mediate the relationship between local government debt and corporate green innovation. Specifically, the expansion of local government debt inhibits corporate green innovation by reducing government subsidies, confirming Hypothesis 3.

Table 4. Government subsidy mechanism

	(1)	(2)	(3)
	Gre	GSUB	Gre
Debt	-0.352***	-0.274**	-0.347***
	(-4.980)	(-2.372)	(-4.943)
GSUB			0.028***
			(3.527)
Control variables	YES	YES	YES
Constant	-2.881***	-3.634***	-2.780***
	(-8.456)	(-9.802)	(-8.224)
Year FE	YES	YES	YES
Industry FE	YES	YES	YES
Observations	25631	25612	25612
R-squared	0.149	0.496	0.151

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

4.3.3. Tax burden mechanism

To test whether Hypothesis 4 holds, this study calculated the ratio of the net amount of taxes and fees paid by firms minus tax rebates received to their operating revenue, using this as a measure of the firm's tax burden (TAX) [8]. This measure was then regressed using the constructed mediation model, with the regression results shown in Table 5. Column (2) presents the regression results for local government debt on corporate tax burden. The regression coefficient for the core explanatory variable is significantly positive, indicating that local government debt expansion increases corporate tax burden. Column (3) presents the regression results with both local government debt and tax burden as explanatory variables. Both regression coefficients are significantly negative, indicating that local government debt inhibits corporate green innovation by increasing the tax burden on enterprises. The tax burden partially mediates the relationship between the two variables, confirming Hypothesis 4.

Table 5. Tax burden mechanism

	(1)	(2)	(3)
	Gre	TAX	Gre
Debt	-0.333*** (-4.685)	0.017*** (3.244)	-0.320*** (-4.495)
TAX			-0.792*** (-4.415)
Control variables	YES	YES	YES
Constant	-2.854*** (-8.508)	-0.065*** (-3.957)	-2.906*** (-8.660)
Year FE	YES	YES	YES
Industry FE	YES	YES	YES
Observations	25915	25915	25915
R-squared	0.151	0.317	0.153

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

4.4. Robustness Test

4.4.1. Replace the explanatory variable

In the benchmark regression, the local government debt-to-GDP ratio was used as the explanatory variable. However, beyond the debt-to-GDP ratio, the local government debt-to-revenue ratio also serves as a crucial metric for assessing its relative scale. Therefore, in the robustness test, the local government debt-to-revenue ratio (Debt1) was substituted for the original explanatory variable, and the regression was rerun. The results are presented in Table 6. The table indicates that the regression coefficient for the core explanatory variable remains significantly negative, consistent with the results of the prior benchmark regression. This confirms the robustness and reliability of the benchmark regression employed in this study.

Table 6. Replace the explanatory variable

	(1)	(2)
	Gre	Gre
Debt1	-0.020***	-0.023***
	(-3.985)	(-4.740)
Control variables	NO	YES
Constant	0.430***	-2.913***
	(23.499)	(-8.769)
Year FE	YES	YES
Industry FE	YES	YES
Observations	26464	26464
R-squared	0.093	0.150

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

4.4.2. Replace the dependent variable

In the benchmark regression, corporate green innovation is measured by the volume of green patent applications. In this robustness test, the number of granted green patents (DGre) is used as an alternative indicator. Table 7 presents the results obtained after re-regressing with the modified dependent variable measurement. The data show that the regression coefficient remains significantly negative, consistent with the previous benchmark regression results. This confirms the robustness and reliability of the benchmark regression findings.

Table 7. Replace the dependent variable

	(1)	(2)
	DGre	DGre
Debt	-0.317***	-0.337***
	(-5.118)	(-5.665)
Control variables	NO	YES
Constant	0.388***	-2.337***
	(20.575)	(-8.211)
Year FE	YES	YES
Industry FE	YES	YES
Observations	26541	26541
R-squared	0.100	0.151

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

5. Conclusion

This study empirically examines the impact and mechanism of local government debt on corporate green innovation at the micro level. Findings reveal that local government debt expansion exerts a negative, inhibitory effect on corporate green innovation, with financing constraints, government subsidies, and tax burdens partially mediating this relationship. Based on these findings, the following recommendations are proposed: First, governments should rationally control debt levels and optimize debt management models. Second, enterprises should proactively diversify financing channels and enhance risk-bearing capacity.

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