

High Government Leverage and High Corporate Leverage: Crowding-in or Crowding-out

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Abstract: This paper uses panel data of non-financial listed companies between 2012 and 2018 to empirically analyze the impact of local government debt on corporate leverage. We find that as the scale of local government debt expands, it has a negative impact on corporate leverage. However, this impact varies a lot across industries. For the real estate industry, we surprisingly found that it has crowding-in effect which is different from others industry. Moreover, this impact on corporate leverage also varies by enterprise size and equity nature. The government's local debt affects the internal cash stock of enterprises, which in turn reduces the leverage of enterprises, verifying the channel through which the crowding-out effect arises. The analysis in this paper provides empirical guidance for improving the leverage structure of the Chinese economy.

Keywords: Local debt, Corporate leverage, Crowding out effect.

1. Introduction

In recent years, the international financial crisis, the increase in government fiscal deficits, and continued rise in debt levels have resulted in local governments entering a phase of high leverage, causing widespread concern. Large-scale fiscal and monetary stimulus programs have also led to a sustained increase in corporate leverage. However, the impact of the size of government debt on corporate leverage has not been thoroughly analyzed.

The level of corporate indebtedness is measured using total liabilities to total assets to measure the level of leverage of a firm (Graham, 2014; Greenwood). While a firm reaps the benefits of leverage, it brings with it a certain amount of financial risk. Corporate leverage affects the development of enterprises in a proportional relationship; the higher the corporate leverage, the greater the financial risk of the enterprise and the more detrimental to the long-term development of the enterprise. If corporate leverage is used correctly, it is conducive to improving the efficiency of capital allocation and promoting stable and faster economic development. Conversely, if leverage is used excessively, it may lead to economic overheating, bubble accumulation debt risk increases and other problems.

This paper uses the panel data of prefecture-level cities and enterprises, and finds that: in general, there is a negative correlation between local governments and corporate leverage, that is, local governments can squeeze out corporate leverage, the higher the local debt level, and the lower corporate leverage. However, from the perspective of different industries alone, local government debt has a completely opposite crowding effect on real estate enterprises, which is also an innovation point found in this paper. Under the crowding out effect of local government debt on the overall market, the real estate industry alone presents the crowding in effect. Moreover, this paper will also study their effects on different properties, different scales and whether there is foreign investment.

The current leverage ratio of non-financial enterprises in China is extremely high, and the level of corporate debt will affect financial risk, and at the same time, as the external environment undergoes adverse changes, corporate operating

risk and credit risk will increase, which may lead to financial crisis. China's corporate leverage alert line of 90%, according to the data, which is pointed out in China Financial, China's non-financial enterprises of China's non-financial corporate leverage ratio of 152.9%, has exceeded the alert line by 62.9 percentage points. It is now a rapid economic recovery in the post-epidemic period, the overall economic recovery is slow, and in the context of China's economic restructuring, there is still some downward pressure on China's economy, and enterprises are facing a more unfavorable external environment for production and operation. In addition, the fiscal decentralization system and the Budget Law limit local government tax revenues. Local government financing platforms, which is referred local governments initiated the establishment, through allocating land, equity, fees, national bonds and other assets, quickly packaged a company whose assets and cash flow can meet the financing standards bear the burden of financing public projects; therefore, the security and liquidity of local government obligations are closely linked to local government fiscal policies and conditions (Ang et al., 2018). With a high government leverage ratio, maintaining stable economic growth is crucial to not incur systemic risks. Therefore, studying the impact of local debt level on corporate leverage is of great significance to solve the current problem.

The remaining sections of the paper are structured as follows. Section 2 critically analyzes the extensive current literature and formulates the corresponding hypotheses. Section III describes the sample, data collection, and research methodology used in this paper. Section IV reports the analysis of the empirical results of the fixed effects model, including the underlying regression results, robustness tests, heterogeneity analysis, and mechanism effects. Section V reports the regression results of the PVAR model, including the unit root test, cointegration test, determination of the lagged optimal order, impulse analysis, and variance decomposition. Section 6 reports the conclude.

2. Background

To "improve the financial supervision system and guard the bottom line of no systemic financial risks", which is the economic and financial development goal proposed by China

in The National Development and Reform Commission, the key issue to be addressed in the current economic development is to actively deal with the risk of local government debt and solve the fiscal deficit problem. Currently, with the economic development coupled with the impact of the three-year COVID-19, China's economy is facing the problem of large local government debt, which is a long-term and structural problem faced in the country's economic operation. Local governments announced a RMB 4 trillion stimulus package in 2008, which led to a rapid increase in bond issuance by local government financing platforms. Local governments absorbed three-quarters of the total funds, most of which were raised by local government financing platforms. Since 2015, the government has systematically opened up the local government's right to issue debt financing, and debt governance has begun to step into the stage of standardization, transparency and institutionalization, and the local government debt governance model has been transformed. Local government debt-related issues have received widespread attention (Zhang, 202; Graeve, 2023; Bo, 2018), however, the impact of government debt on corporate leverage has not been studied in depth. This paper investigates whether local debt has a crowding-out effect on corporate leverage.

The overall leverage ratio (government debt/GDP) of the Chinese government has a fluctuating upward trend, as shown in Figure 1 below, which shows the level of urban debt as well as the level of urban GDP from 2012 to 2018, and it is obvious from the figure that the two are positively correlated in the direction of development, with the level of urban debt and GDP increasing year by year, and from the actual situation, the overall leverage ratio of the Chinese economy is moderate and manageable of the Chinese economy, but the leverage structure of the Chinese economy is extremely unreasonable, and the impact of government debt on corporate leverage is a crowding-in or crowding-out effect that requires in-depth analysis. Figure 2 is a line graph of the overall debt level and overall GDP of the country, from which it can be seen that the overall government debt and GDP of the country are growing year by year, and the growth rate of GDP has accelerated after 2016, which is in line with the general trend of China's economy continuing to improve and the scale of government debt increasing year by year.



Figure 1. Trend chart of local debt

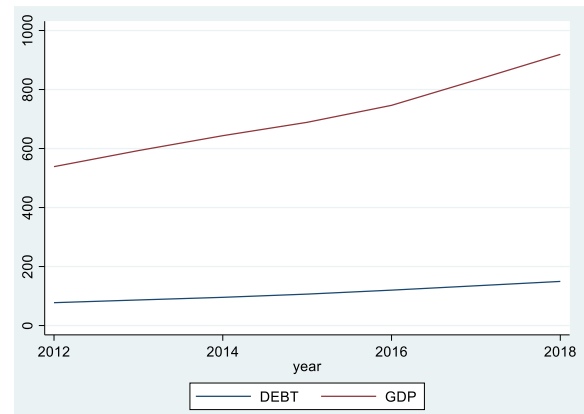


Figure 1. Trend chart of local debt

3. Literate Review and Hypothesis

First, our paper adds to the literature that Xiao et al. (2022) suggest that the trend of corporate leverage and macro leverage (which can be interpreted as the level of government debt) is the same before the current actual national situation in China, the level of both government leverage and corporate leverage is relatively high and shows an upward trend. Corporate financing and borrowing can cause changes in corporate leverage, which is affected by various factors. Liu (2023) argues that corporate financing is affected by its own financial characteristics, such as solvency and profitability, and also by macro-level effects, such as government financing behavior and economic growth conditions. Narayan et al. (2021), by studying the actual situation of corporate leverage in the U.S., point out that macroeconomic influences on corporate leverage are important. leverage in real terms, pointing out that macroeconomics affects important factors of corporate leverage, with positive correlation between short-term leverage and interest rates and negative correlation between long-term leverage and inflation, while the impact varies across periods of economic development. Jaffe (1978) shows that inflation affects corporate leverage by influencing interest rates and thus corporate leverage. Demirci et al. (2019) point out that when firms are financed through debt financing, there is often a tendency to hold relatively stable bond investments, so an increase in government debt increases the return to financiers on alternative bonds, thereby increasing the cost of financing. This informs our discussion of control variables when examining the benchmark model.

Second, many scholars have studied the relationship between government borrowing and corporate leverage in the past, and their conclusions have similarities and different aspects of the findings. We enrich the theory and propose our own hypothesis based on the theories of previous studies. Local governments have their own financing platforms, companies that are capitalized by local governments, with the purpose of financing not for profit but for building infrastructure and participating in public construction (Clarke and LU, 2017). Eberhardt and Predbitero (2015) examine the relationship between government debt problems and economic growth and find that there is a threshold for the positive effects of government debt. Zhang et al. (2014) study that local government debt was one of the most important forces driving the leverage boom and the surge in the shadow banking sector in China during the decade. On the one hand, expanding local government debt levels and increasing government leverage allow the government to have more funds to invest in infrastructure development, boost the

economy, and improve social development. Local governments tend to use increased local spending to increase GDP growth as a criterion for performance assessment (Mo, 2018). The first reflection of Chinese enterprises in financing will choose bank loans, and the choice between the interests of banks, government and enterprises will lead to that local governments will make the enterprise debt to be squeezed out through the constraints of enterprise loans (Badoer et al., 2016). In the short term, local issuance of debt is a response to the economic crisis, and in the long term, it can cause crowding out private investment. Local government borrowing has an impact on corporate financing in the case of increasing their own government leverage, which affects corporate leverage (Jong et al. 2008 and Fan et al. 2012). Krishnamurthy et al. (2012) point out that there is a substitution relationship between government debt and corporate leverage. Becker and Ivashina (2018) also concluded by studying the period of European debt crisis that government issuance of debt obligations led to a reduction in corporate debt, which resulted in a crowding out effect. There is a slight difference in the expected reporting of government debt in the short and long term, and firms respond in an elastic manner, suggesting that government debt influences firm debt choices (Greenwood et al., 2010). Firms with relatively unconstrained investment behavior bear higher interest rates and generate more pronounced crowding-out effects. Liang et al. (2017) conducted an empirical study on the impact of local government debt on corporate indebtedness using provincial and municipal-level data in China and found that local governments' preferential access to capital market financing worsens the allocative efficiency of capital markets and crowds out corporate debt. Hubbard (2012) demonstrates the impact of government debt on corporate finance by constructing a mathematical model in which the continued expansion of government debt raises the market interest rate, which in turn discourages corporate investment and thus reduces the level of corporate debt. Not only that, the increase in government bond holdings leads to a more pronounced crowding out effect on corporate lending, and studies have found that an increase in government bond holdings has a negative impact on private capital as a type of business (Becker and Ivashina, 2017). Friedman (1978) argues that in terms of the riskiness of investments, the government issues bonds, which are risk is less than that of corporate bonds, and the two become substitution, investors buying government bonds will reduce the purchase of corporate bonds, making corporate capital investment decrease and creating a crowding-out effect.

The increase in local government debt also makes the cost of financing and the cost of debt taxation increase, which leads to a decrease in corporate debt (McDonal, 1983). Taxes are the main melody of current life and investors must consider the tax situation, high tax investors represent a higher level of wealth and tend to hold equity, the increase in taxable income and equity causes an increase in tax costs, which leads to a decrease in corporate debt. Wu et al. (2015) state that local governments also indebtedness land supply, which results in land revenue. Under special circumstances, the government will provide land at low prices, offer tax incentives to enterprises, create a favorable financing environment, and enterprises receive incentives that reduce the financing costs they need to pay to purchase land. Man Zhang (2022) presents in more detail that central government debt has a security crowding out effect on enterprise debt and

local governments have a financial base effect on enterprise debt, in the original Greenwood et al. (2010) conclude that there is a negative relationship between government debt and firm debt maturity by studying the relationship between government debt maturity and firm debt maturity. The capital structure of firms also makes the effect of local government debt on firm leverage different, with the crowding-out effect of local government debt on firms being more pronounced in countries with larger and more liquid stock markets, where firms rely more on markets and less on banks for their financing sources, and thus have more flexibility to adjust their capital structure and thus have a more pronounced crowding-out effect (Demirci et al., 2019). In summary, the above study forms the main research hypothesis of this paper: under high local government leverage and high corporate leverage, local government debt raising causes a crowding-out effect on corporate leverage.

In contrast, SOEs have easier access to development funds, i.e., credit resources are disproportionately allocated to operationally inefficient firms, a phenomenon This explains to some extent the resource distortion effect of land finance (Hu and Qian, 2017). This is because SOEs often act as instruments for local governments to implement policies and they operate not following market laws but policy guidelines (Tang et al., 2019). Ayturk (2017) argues that large reputable and financially sound firms are more sensitive to local government debt than smaller firms with poorer finances. The larger the size of the firm, the greater the ability of the firm to finance itself in general, producing a more pronounced crowding-out effect (Demirci et al., 2019). The degree of financial openness also affects the crowding out effect of local government debt on firm leverage, and foreigners financing firms will, to some extent, reduce firms' reliance on the local interest rate sector, thus mitigating the crowding out effect (Demirci et al., 2019)

Firms are affected differently by local government debt depending on their ownership structure, their size and the industry they are in. Differences in GDP growth have a significant differential impact on local government debt across regions, with local governments tending to issue more local debt in regions with GDP growth compared to other regions (Qu et al., 2023). Thus, government leverage tends to be higher in lagging regions and the crowding out effect on firm leverage is more pronounced.

Finally, referring to the above literature, the research contribution of this paper lies in We refer to this literature and put heterogeneity analysis in this paper's study, classifying firms according to ownership, firm size, and the presence of foreign investment input or not, and then derive the corresponding results as an extension to enrich the impact of local debt on different firms. And furthermore, we classify the firms according to the type of industry they are in, trying to see if the level of local government debt differs across industries for firms in different industries.

4. Data and Empirical Strategy

4.1. Data

In this paper, 1288 A-share listed non-financial enterprises from 2012-2018 are selected because listed non-financial enterprises can better reflect the current leverage problem of Chinese non-financial enterprises as a whole, while we identify 128 prefecture-level cities with a total of 9016 observations in this dataset. The main corporate data are

obtained from CSMAR, and government debt balances and municipal investment debt balances are obtained from Wind Information financial database and the National Bureau of Statistics. According to the availability and completeness of the data, the sample is processed as follows: firstly, the enterprises with financial category, abnormal financial data and serious missing data are excluded; secondly, the listed enterprises with special treatment of ST and *ST are excluded.

4.2. Empirical Strategy

In this paper, with reference to Demirci (2019), we want to study whether local government debt will have a crowding-in or crowding-out effect on corporate leverage output in the current economic context of China, with high local government leverage and high corporate leverage, and set up the model of equation (1) and use it for the benchmark regression. The Hausman test is conducted and the original hypothesis of a random effect is rejected at the 1% significance level. The following fixed effects model is developed in this paper:

$$\text{Leverage}_{i,t} = \alpha_0 + \beta_0 \text{gov_debt}_{c,t-1} + \beta_1 X_{i,t-1} + \beta_2 Y_{i,t-1} + \eta_i + \delta_t + \varepsilon_{i,t} \quad (1)$$

In equation (1), leverage is firm leverage, gov_debt is the size of local government liabilities, which we follow Admati et al (2012) and Badoer and James (2016) and lag all independent to safeguard against endogeneity, X is the firm-level control variable, which includes firm size (size), firm profitability (net_pro), and firm's guarantee capacity (tangibility), Y is the government-level control variable, which includes per capita gross domestic product (per_gdp), consumer price index (CPI), and unemployment rate (unemployment). i and t denote firm and year, respectively, and t-1 denotes a lagged period. We choose a lagged period to enter the regression equation is mainly because the business activities of firms have a certain lag in response to government policies, and the setting of lagged variables can address certain endogeneity (Irem Demirci, et, 2019). and represent city and time fixed effects, respectively. is the error term.

In addition, according to the previous theoretical analysis, local government debt will affect corporate government debt through the balance of cash equivalents at the end of the period cash thus affecting corporate leverage, corporate funds are represented by cash, the level of cash holdings is equal to money funds/total assets, the greater the amount of cash, indicating that the internal funds of the firm are sufficient and more secure debt service (Xiao et al., 2022). Therefore, we introduce intermediation effects to test the mechanism according to the way proposed by Baron and Kenny (1986).

$$\text{Cash}_{i,t} = \alpha_0 + \beta_0 \text{gov_debt}_{i,t-1} + \beta_1 X_{i,t-1} + \beta_2 Y_{i,t-1} + \eta_i + \delta_t + \varepsilon_{i,t} \quad (2)$$

$$\text{Leverage}_{i,t} = \alpha_0 + \beta_0 \text{gov_debt}_{i,t-1} + \beta_1 \text{cash}_{i,t-1} + \beta_2 X_{i,t-1} + \beta_3 Y_{i,t-1} + \eta_i + \delta_t + \varepsilon_{i,t} \quad (3)$$

4.3. Variable Selection

Regarding the dependent variable: leverage is corporate leverage, according to most scholars (Irem Demirci, et, 2019; Yusuf Ayturk, 2017), corporate leverage is usually measured using the corporate gearing ratio, i.e., gearing ratio = total liabilities/total assets, and we also use this measure in this paper for the benchmark regression, which is the traditional

way of measuring corporate leverage.

Regarding the independent variable: gov_debt is the size of local government debt and is measured using local government debt/GDP (Rangarajan & Srivastava, 2005). A possible concern with using the government debt/GDP ratio to measure the size of local government debt is that the relationship between corporate leverage and government debt may be driven by changes in GDP rather than changes in outstanding government debt.

Regarding the control variables: the control variables in the paper include government level and firm level. For the selection of macro-level control variables, we mainly refer to relevant studies by Narayan (2021), including per_gdp (per capita gross regional product) which using is used logarithmic form in the text, inflation is measured by the consumer price index (CPI), and unemployment is derived from the unemployment registration rate of urban residents. The micro-level control variables refer to relevant studies by Baker and Wurgler, 2002; Frank and Goyal, 2003; Lemmon et al., 2008 and others are including firm's guarantee capacity (tangibility), which is used to guarantee the firm's ability to secure itself after borrowing, using the net value of firm's fixed assets over total assets; firm's size (size), which is expressed in terms of the firm's total assets; and the firm's profitability, which we use the gross operating margin to express.

Table 1. Variable definition

Variables	Symbol	Definition
Corporate Leverage	leverage	total debt/total asset
Government Debt	gov_debt	government debt/GDP
Corporate Size	size	corporate asset
Tangible Asset	tangibility	net fixed assets/total assets
Return on Asset	net_pro	Profit/sales revenue
Inflation	CPI	resident consumption index
Unemployment	unemployment	Unemployment rate
GDP per capita	Lnper_gdp	GDP/total population

Note: Standard errors in parentheses. *, **, ***.

4.4. Descriptive Statistics

Table 2. Descriptive statistics.

	(1)	(2)	(3)	(4)	(5)
Variables	obs.	Mean	S.D.	Min	Max
leverage	9,016	0.448	0.301	-0.19000	11.510
gov_debt	9,016	0.137	0.109	0.00530	0.734
size	9,016	2.470	9.562	0.00100	230.7
tangibility	9,016	0.210	0.168	0.00001	0.948
net_pro	9,016	0.278	0.180	-1.01100	1.154
CPI	9,016	102.300	0.987	95.00000	113.3
unemployment	9,016	2.782	0.770	0.90000	4.900
Lnper_gdp	9,016	2.168	0.579	0.00896	3.845

Table 2 below displays the descriptive statistics. The total sample size is 9016. The average ration leverage in our sample is 0.448, standard deviation of leverage is 0.301, and the maximum value is 11.51, which the minimum value is -0.19. The average gov_debt each city is 0.137, which standard

deviation is 0.109. The maximum value is 0.734, and the minimum value is 0.0053. On average, the size of each company is 2.47 billion. The standard deviation of size is 9.562. The maximum value is 230.7 billion. The minimum value is 0.001 billion. The average tangibility is 0.21, the standard deviation of tangibility is 0.168. And the maximum tangibility value is 0.948, which the minimum value is 0.00001. The average net_pro is 0.278. The standard deviation of net_pro is 0.18. The maximum value of net_pro is 1.154, and the minimum value is -1.011. The average level of CPI is 102.3, which the standard deviation is 0.987. The maximum value of CPI is 113.3, and the minimum value of it is 95. Moreover, the average of unemployment is 2.782. The standard deviation of the unemployment is 0.77, which the maximum value is 4.9 and the minimum value is 0.9. Finally, the average Lnper_gdp is 2.168. The standard deviation of it is 0.579. The maximum value of Lnper_gdp is 3.845, and the minimum value is 0.00896.

5. Empirical Results

5.1. Main Results

In this paper, we want to study the impact effect of high government leverage and high corporate leverage, and use a double fixed effects template for regression estimation according to equation 1, and analyze the regression results by observing corporate leverage to determine whether there is a crowding-in or crowding-out effect between high government leverage and high corporate leverage.

Table 3. Benchmark results

	(1)	(2)	(3)
	leverage	leverage	leverage
gov_debt (t-1)	-0.136**	-0.149***	-0.150***
	(0.056)	(0.053)	(0.054)
tangibility (t-1)		-0.113***	-0.113***
		(0.016)	(0.016)
size (t-1)		0.004***	0.004***
		(0.000)	(0.000)
net_pro (t-1)		-0.418***	-0.418***
		(0.015)	(0.015)
Lnper_gdp (t-1)			-0.002
			(0.012)
unemployment (t-1)			-0.004
			(0.009)
cpi (t-1)			-0.002
			(0.002)
_cons	0.461***	0.593***	0.794***
	(0.007)	(0.009)	(0.251)
Individual FE	YES	YES	YES
Time FE	YES	YES	YES
N	7728	7728	7728
r2	0.101	0.245	0.245
F	5.850	258.065	150.503

Note: Standard errors in parentheses. *, **, ***.

Table 3 reports the regression results of the data on the

effect of local government debt on corporate leverage: column 1 is the regression result without adding control variables, and we can see that the coefficient -0.136 is significant at the 5% level, concluding that the relationship between local government debt and corporate leverage is negative and generates a crowding-out effect, with each percentage point increase in local government debt decreasing corporate leverage by 13.6%. Column 2 adds micro firm-level control variables, and the final regression comes out to be significant at 1% with a coefficient of -0.149, where each percentage point increase in local government debt decreases firm leverage by 14.9%, and the crowding out effect is even more pronounced. Column 3 adds the macro-level control variables and the estimated coefficient is 15%, again significant at the 1% level, and for every one percentage point increase, the corporate market leverage decreases by 15%. This indicates that the larger the size of government debt, the lower the market leverage of firms, i.e., government debt has crowding-out effect on the market leverage of firms, validating the previous hypothesis.

Moreover, different industries are affected by government debt raising differently depending on the nature of the environment they are in, policies, and industry characteristics. We divide the industries in which the enterprises are located according to 2012 Edition SEC Industry Classification in CSMAR, excluding financial enterprises in the sample screening, so the industries involved in the sample are the public utilities sector, the real estate sector, the industrial sector, the commercial sector, and the Conglomerates sector, and we divide the sample into five groups to conduct regressions separately to obtain Table 4. Table 4 Column 1 in order is Public Utilities, Column 2 is Real Estate, Column 3 is Comprehensive Industry, Column 4 is Industrial sector, and Column 5 is Business2 regression results. The results reported that: the local government debt has the most significant crowding out effect on the enterprises in the industrial sector, the reason is that industrial enterprises will undertake more research and development, the most important material production sector, providing material products for the life of the population and economic activities of various industries, this important role is irreplaceable by any other industrial sector. Industry is the industrial sector with the most R&D investment, the most active technological innovation, and the strongest radiation drive, so the relationship between enterprises in the industrial sector and government debt is the closest, and the issuance of government debt will often become the main influence of the industrial sector, so the crowding out effect is the most obvious. The regression results for the real estate sector appear in column 2 of Table 4 are opposite to those for other industry types. We believe the reason for this is that: this in turn may trigger potential risks such as market volatility and credit rating downgrades, curbing financing channels and raising funding costs for local governments and real estate enterprises, thereby exacerbating the latter's leverage levels. Additionally, the larger debt issuance may also shift the investment focus of banks and other financial institutions towards real estate and property developers as their preferred lending targets, potentially lifting the leverage ratio of the real estate industry.

Table 4. Benchmark resultII

	Public Utilities sector	Real Estate sector	Comprehensive sector	Industrial sector	Business
gov_debt (t-1)	-0.075	2.878***	0.676	-0.423**	-0.196
	(0.174)	(0.975)	(0.477)	(0.193)	(0.409)
tangibility (t-1)	-0.355*	0.166	-0.333***	-0.254***	-0.124
	(0.191)	(0.251)	(0.104)	(0.069)	(0.172)
size (t-1)	0.002	0.239***	0.108*	0.002***	0.000
	(0.002)	(0.062)	(0.056)	(0.001)	(0.005)
net_pro (t-1)	-0.409***	-2.593***	-0.313***	-0.551***	-0.478***
	(0.100)	(0.413)	(0.065)	(0.078)	(0.125)
Lnper_gdp (t-1)	-0.008	-0.016	0.010	0.023	0.036
	(0.065)	(0.131)	(0.082)	(0.036)	(0.056)
unemployment (t-1)	-0.079	-0.869***	-0.239*	-0.091***	-0.086
	(0.049)	(0.285)	(0.135)	(0.035)	(0.099)
cpi (t-1)	0.012	0.007	0.005	-0.008	-0.040
	(0.011)	(0.010)	(0.013)	(0.008)	(0.024)
_cons	-0.303	2.253*	0.530	1.759**	4.804*
	(1.147)	(1.088)	(1.253)	(0.876)	(2.477)
Individual FE	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES
N	144	36	78	612	66
r2	0.674	0.719	0.650	0.333	0.911
F	4.223	12.347	5.657	20.770	3.674

Note: Standard errors in parentheses. *, **, ***.

5.2. Heterogeneity Analysis

5.2.1. Corporate ownership structure

Table 5. Heterogeneity: corporate ownership structure

	NON—SOE	SOE	NON—FC	FC
	leverage	leverage	leverage	leverage
gov_debt (t-1)	-0.189**	-0.056	-0.153***	0.020
	(0.075)	(0.076)	(0.055)	(0.262)
tangibility (t-1)	-0.094***	-0.146***	-0.116***	-0.072
	(0.023)	(0.022)	(0.016)	(0.066)
size (t-1)	0.007***	0.003***	0.004***	0.003***
	(0.001)	(0.000)	(0.000)	(0.001)
net_pro (t-1)	-0.382***	-0.396***	-0.420***	-0.384***
	(0.019)	(0.028)	(0.016)	(0.056)
Lnper_gdp (t-1)	0.001	-0.001	-0.004	0.043
	(0.014)	(0.023)	(0.013)	(0.045)
unemployment (t-1)	-0.008	0.004	-0.004	-0.010
	(0.012)	(0.012)	(0.009)	(0.039)
cpi (t-1)	-0.002	-0.002	-0.002	0.004
	(0.003)	(0.003)	(0.002)	(0.009)
_cons	0.749**	0.862**	0.831***	0.023
	(0.343)	(0.346)	(0.256)	(0.958)
Individual FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
N	4920	2808	7212	516
r2	0.257	0.263	0.246	0.385
F	75.860	46.533	136.792	16.250

Note: Standard errors in parentheses. *, **, ***.

Ownership attributes are actually a standard, exogenous division based on financing constraints. We classify firms into state-owned and non-state-owned enterprises based on their ownership structure, making state-owned enterprises 1 and non-state-owned enterprises 0. We conduct a heterogeneity analysis of firm ownership, as shown in Table 5, column 1, column 2. According to the results reported in Table 5, column 1, column 2, the estimated coefficient of non-state-

owned enterprises is -0.189, which is significant at the 5% level, while the estimated coefficient of state-owned enterprises is -0.056, and the crowding out of non-state-owned enterprises the crowding out effect of non-SOEs is more significant than that of SOEs. The reason is that, on the one hand, the main shareholder of SOEs is the government, and government intervention makes SOEs have policy advantages in terms of credit, and high-quality resource factors tend to flow to SOEs, forming a soft budget constraint,

resulting in a significantly weaker financing constraint for SOEs than for non-SOEs, and the crowding-out effect is less pronounced. On the other hand, non-state-owned enterprises are mainly subject to market allocation of resources, and their operating conditions are influenced by the market. They tend to choose their financing structure according to the local government's debt raising, and when the government's debt raising scale is larger, the interest rate rises, and the enterprise's comprehensive financing cost and return risk, etc. will reduce the enterprise's debt and lower the enterprise's leverage, so the crowding out effect is more obvious.

In the enterprise ownership structure, we also divided the enterprises with foreign investment and without foreign investment, as shown in Table 5 column 3 and column 4. when foreign participation in enterprise investment, no foreign participation in investment enterprises with financial openness than with foreign participation will be lower, more dependent on local government debt, that is, more significantly affected by the negative impact of local government debt, that is, column 3 is more significant, the crowding out effect is more obvious.

5.2.2. Firm size

Table 6. Heterogeneity: firm size

	S	M	L
	leverage	leverage	leverage
gov_debt (t-1)	-0.153*	-0.186**	-0.117
	(0.079)	(0.088)	(0.078)
tangibility (t-1)	0.054**	-0.087**	-0.231***
	(0.025)	(0.038)	(0.022)
size (t-1)	0.043***	0.014***	0.002***
	(0.008)	(0.004)	(0.000)
net_pro (t-1)	-0.399***	-0.355***	-0.362***
	(0.019)	(0.031)	(0.032)
Lnper_gdp (t-1)	-0.000	-0.001	-0.005
	(0.019)	(0.020)	(0.018)
unemployment (t-1)	0.006	-0.010	-0.015
	(0.012)	(0.015)	(0.014)
cpi (t-1)	-0.001	-0.005	-0.001
	(0.004)	(0.004)	(0.003)
_cons	0.580	1.107**	0.822***
	(0.366)	(0.454)	(0.303)
N	3348	1650	2730
r2	0.259	0.264	0.293
F	79.189	27.133	49.957

Note: Standard errors in parentheses. *, **, ***.

The total sample was divided into three subsamples and regressed separately. The classification criteria were as follows: according to the total assets of enterprises in 2018, enterprises with total assets less than 500 million yuan were classified as small-scale enterprises, enterprises with total assets greater than 1 billion yuan were classified as large-scale enterprises, and the rest were classified as medium-sized enterprises. According to the size of enterprises, the regressions were grouped for the sample of enterprises, and the results are shown in Table 6 columns 1 to 3 are small, medium and large enterprises, respectively, and it can be concluded that the crowding-out effect is most obvious for small and medium enterprises, while large enterprises are not significant instead. The reasons are: first, large enterprises have more financing options compared to small-scale enterprises, and these enterprises rely on their own strength tend to issue their own bonds for financing, so the default cost

is lower and they are less likely to be replaced by government bonds. Secondly, the financing structure of large enterprises will be more complex than that of small and medium-sized enterprises, with their own financial strength, they will consider using internal funds first before using external funds. Considering the high cost of external financing, large enterprises tend to consider internal financing first, so large enterprises are less sensitive to the expansion of government debt scale. In summary, the crowding-out effect is more significant for small and medium-sized enterprises than for large-scale enterprises.

6. Robustness Checks

Although we include explanatory variables, explained variables, and six micro- and macro-level control variables in our baseline regression model, the estimation results of the model may still be affected by model setup, omitted variables, and differences in sample background, making the results unconvincing and robust. Therefore, we include robustness tests to remove the interference of other factors to the model as much as possible through various ways.

Table 7. Robustness checks

	(1)	(2)	(3)
province_debt (t-1)	-0.154***		
	(0.055)		
gov_debt (t-1)		-0.153***	-6.123**
		(0.057)	(2.745)
tangibility (t-1)	-0.113***	-0.091***	-8.139***
	(0.016)	(0.018)	(0.753)
size (t-1)	0.004***	0.008***	0.365***
	(0.000)	(0.001)	(0.043)
net_pro (t-1)	-0.418***	-0.425***	-6.597***
	(0.015)	(0.015)	(0.558)
Lnper_gdp (t-1)	-0.002	0.001	-0.161
	(0.012)	(0.013)	(0.416)
unemployment (t-1)	-0.004	-0.005	0.076
	(0.009)	(0.009)	(0.265)
cpi	-0.002	-0.003	-0.083
	(0.002)	(0.002)	(0.099)
_cons	0.794***	0.889***	17.638*
	(0.251)	(0.257)	(10.085)
Individual FE	YES	YES	YES
Time FE	YES	YES	YES
N	7728	6174	7728
r2	0.245	0.273	0.238
F	150.547	129.694	43.032

Note: Standard errors in parentheses. *, **, ***.

In the baseline regression model of equation 1, we use local debt data of prefecture-level municipalities for our sample data, and to test the robustness of the regression results, we use provincial-level debt data for the regression. The relevant estimates are shown in column 1 of Table 7. the regression results using the provincial sample can be found: the coefficients are very similar to the baseline regression results; the estimated coefficients differ by 0.003, the results are very small, and the robust standard errors are also very close, indicating the robustness of the estimation results in this paper. Due to the special political and economic factors of Direct-administered municipalities of China, local government debt

tends to be different from that of ordinary prefecture-level cities, which will have an impact on the results when considered. To test the robustness of the regression results, we exclude the data of municipalities directly under the central government and use the data of the remaining prefecture-level cities for the regression. The results in column 2 of Table 7 show that the estimated coefficients and robust standard errors are very similar. Therefore, the results of the benchmark regression model are still significant and robust in terms of robustness tests. In the benchmark regression model, we use total liabilities/total assets (gearing ratio) to measure firm leverage, and based on the related literature by Greenwood (2015), Irem Demirci (2019), we use the market leverage ratio of liabilities/market value added instead of the original indicator of firm leverage, and the results are presented in column 3 of Table 7. Although the estimated coefficients and robustness criteria are in error with the coefficients in Table 3, the results are still significant, implying that to some extent, the results of the benchmark regression model are still robust and local government debt still has a crowding-out effect on corporate leverage.

Table 8. Robustness checks: endogeneity

	Basic	IV
	leverage	leverage
gov_debt (t-1)	-0.150*** (0.054)	-0.685*** (0.235)
tangibility (t-1)	-0.113*** (0.016)	0.046** (0.021)
size (t-1)	0.004*** (0.000)	0.002*** (0.000)
net_pro (t-1)	-0.418*** (0.015)	-0.212*** (0.018)
Lnper_gdp (t-1)	-0.002 (0.012)	0.020 (0.013)
unemployment (t-1)	-0.004 (0.009)	-0.007 (0.005)
cpi (t-1)	-0.002 (0.002)	-0.003** (0.002)
_cons	0.794*** (0.251)	0.819*** (0.159)
Individual FE	YES	YES
Time FE	YES	YES
N	7728	7728
r2	0.245	
F	150.503	
Underidentification test		490.713
Weak identification test		530.611
Sargan statistic		0.000

Note: Standard errors in parentheses. *, **, ***.

We next use the instrumental variable approach to deal with endogeneity, referring to Irem Demirci et al. (2019) who use defense spending as an instrumental variable for local government debt, and in this paper, we use the sum of defense spending and health spending. In terms of the choice of instrumental variables, defense spending and health care spending are closely related to local fiscal spending, and defense spending and health care spending are basic livelihood spending, which are less affected by macroeconomic influences and are relatively fixed expenditures in government finance, and can be considered as exogenous variables with weak correlation with the economic influences on corporate leverage. We use IV estimation method for regression, as shown in column 2 of Table 8, and

the results show that the results are significant at 1%, indicating that the instrumental variables are valid, and we conduct Underidentification test, Weak identification test, and Sargan statistic, and the results are 490.713, 530.611 and 0.000, from which we can conclude that there is and our baseline regression results are robust between corporate leverage and instrumental government debt.

The trend of mass data in power system provides a basis for load characteristic analysis and prediction model establishment, but the classical load forecasting method can not afford such a huge time and computing resource consumption. The problem of over fitting in large sample set will affect the prediction accuracy. In this paper, a power load forecasting model is built by using the BP neural network model, making full use of the powerful data processing function of Clementine and preventing the over fitting function. The experimental results show that the BP neural network model has good predictability and robustness, and has a certain practical application value.

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References

- [1] Admati, A.R., DeMarzo, P.M. Hellwig, M.F. & Pfleiderer, P.C., 2012. Debt Overhang and Capital Regulation., Rock Center for Corporate Governance at Stanford University, Working Paper, No. 114.
- [2] Ang, A., Bai, J., & Zhou, H., 2018. The Great Wall of Debt: Real Estate, Political Risk, and Chinese Local Government Financing Cost, Georgetown McDonough School of Business Research Paper, PBCSF-NIFR Research Paper No. 15– 02.
- [3] Badoer, D.C., James, C.M., 2016. The determinants of long-term corporate debt issuances, *Journal of Finance*, 71 (1), 457–492.
- [4] Baker, M., Wurgler, J., 2002. Market Timing and Capital Structure. *Journal of Finance*, 57, 1–32.
- [5] Baron R M, Kenny D A., 1986. The Moderator-mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations. *Journal of Personality and Social Psychology*, 51(6).
- [6] Bo Becker, Victoria Ivashina, 2018. Financial Repression in the European Sovereign Debt Crisis. *Review of Finance*, 83–115
- [7] Clarke, D., Lu, F., 2017. The Law of China’s Local Government Debt: Local Government Financing Vehicles and their Bonds. *Am. J. Comp. Law* 65 (4), 751–798.
- [8] De Jong, A., Kabir, R. & Nguyen, T.T., 2008. Capital Structure Around the World: the Roles of Firm-and Country-specific Determinants. *J. Bank. Finance* 32 (9), 1954–1969.
- [9] Demirci, I., Huang, J. & Sialm, C., 2019. Government Debt and Corporate Leverage: International Evidence, *Journal of Financial Economic*, 133(2), 337–356.
- [10] Eberhardt, M., A.F. 2015. Presbitero, Public Debt and Growth: Heterogeneity and Non-Linearity. *Journal of International Economics*, 97(1):45—58.
- [11] Fan, J.P., Titman, S., & Twite, G., 2012. An International Comparison of Capital Structure and Debt Maturity Choices. *Journal of Financial and Quantitative Analysis* 47 (01), 23–56.

- [12] Ferre De Graeve, Giulio Mazzolini, 2023. The Maturity Composition of Government Debt: A Comprehensive Database, *European Economic Review*, Volume 154.
- [13] Frank, M.Z., Goyal, V.K., 2003. Testing the Pecking Order Theory of Capital Structure. *Journal of Financial Economics*, 67, 217–248
- [14] Friedman, B. M., 1978. Crowding Out or Crowding In: Economic Consequences of Financing
- [15] Government Deficit, *Brookings Papers on Economic Activity*, 9(3), 593-641.
- [16] Graham, M.T. Leary, M.R. Roberts., 2014. How does Government Borrowing Affect Corporate Financing and Investment? *J. R.*
- [17] Greenwood, S. Hanson, J.C. Stein., 2010. A Gap-Filling Theory of Corporate Debt Maturity Choice. *The Journal of Finance*, 65 (3), 993-1028.
- [18] Hailian Xiao, Ying Zhao, & Meihua Zhou, Can Financial Factors Affect Corporate Debt Leverage Convergence? *Pacific-Basin Finance Journal*, 72 (2022) 101728.
- [19] Jaffe, J.F, 1978. A Note on Taxation and Investment. *Journal of Finance*, 33, 1439-1445.
- [20] Keefe, M.O.C., Yaghoubi, M., 2016. The Influence of Cash Flow Volatility on Capital Structure and the Use of Debt of Different Maturities. *Journal of Corporate Finance*, 38, 18–36.
- [21] Krishnamurthy, Vissing-Jorgensen., 2012. The Aggregate Demand for Treasury Debt. *Journal of Political Economy*, 20 (2): 233-267.
- [22] Lemmon, M.L., Roberts, M.R. & Zender, J.F., 2008. Back To The Beginning: Persistence and the Cross-section of Corporate Capital Structure. *Journal of Finance*, 63, 1575–1608.
- [23] Liang, Y, K. Shi & L. Wang, 2017. Local Government Debt and Firm Leverage: Evident from China. *Asian Economic Policy Review*, 12(2):210—232
- [24] Man Zhang, Oscar T. Brookins & Xiaowei Huang, 2022. The Crowding Out Effect of Central Versus Local Government Debt: Evidence from China. *Pacific-Basin Finance Journal*, 72.101707.
- [25] McDonald, R. L. 1983. Government Debt and Private Leverage: An Extension of the Miller
- [26] Theorem. *Journal of Public Economics*, 22(3), 303-325.
- [27] Mengtao Zhang, Wenchuan Chen, Aidi Kou & Yanjun Wu, 2023. Promotion Incentives, Tenure Uncertainty, and Local Government Debt Risk, *Finance Research Letters*, Volume 56.104136.
- [28] Mo, J., 2018. Land Financing and Economic Growth: Evidence from Chinese Counties, *China Economic Review*, 50, 218-239.
- [29] Qiongzhi Liu, Yun Bai, Hexin Song., 2023. The Crowding Out Effect of Government Debt on Corporate Financing: Firm-level Evidence from China, *Structural Change and Economic Dynamics*.
- [30] Rangarajan C, Srivastava D K., 2005. Fiscal Deficits and Government Debt: Implications for Growth and Stabilisation. *Economic & Political Weekly*, 40(27):2919-2934
- [31] Robin Greenwood, Samuel Hanson, & Jeremy C. Stein, 2010. A Gap-Filling Theory of Corporate Debt Maturity Choice. *The Journal of Finance*. Volume 60, No. 3.
- [32] Seema Narayan, Minh Ngoc Thi Bui, Yishuai Ren & Chaoqun Ma., 2021. Macroeconomic Determinants of US Corporate Leverage, *Economic Modelling*, 104 105646.
- [33] Tang, P., Shi, X., Gao, J. Feng, S. & Qu, F., 2019. Demystifying the Key for Intoxicating Land Finance in China: An Empirical Study through the Lens of Government Expenditure, *Land Use Policy*, 85, 302-209.
- [34] Wu, Q., Li, Y., & Yan, S. 2015. The Incentives of China's Urban Land Finance, *Land Use Policy*, 42, 432-442.
- [35] Xi Qu, Zhiwei Xu, Jinxiang Yu & Jun Zhu, 2023. Understanding Local Government Debt in China: A Regional Competition Perspective, *Regional Science and Urban Economics*, Volume 98, 103859.
- [36] Yusuf Ayturk. 2017. The Effects of Government Borrowing on Corporate Financing: Evidence from Europe, *Finance Research Letters* 20 (2017) 96–103
- [37] Zhang, Yuanyan Sophia & Barnett, Steven, 2014. Fiscal Vulnerabilities and Risks from Local Government Finance in China, *IMF Working Paper*.