

Article

Spatial Interaction of Local Government Debt: Evidence from China

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Abstract: The amount of local government debt has an important impact on the economic and social sustainability of a country. The rapid increase in local government debt in China over the past decade and the associated risks have profound implications for financial and economic sustainable development. While existing research has investigated governmental strategic interactions of tax and spending, little attention has been given to the spatial interaction of local government debt. This study employs Two-Regime Spatial Lag Models to investigate the spatial interaction of the debt among China's 332 prefectural-level local governments over the period of 2015 to 2019. The findings show significant interaction effects between neighbouring governments, both in the acquisition and utilisation of debt quotas, and the interaction during the acquisition process is higher than that during the utilisation process. In addition, the interaction between neighbouring governments within the same province is more pronounced than that between governments adjacent but located in different provinces. Furthermore, the interaction of special debt is more manifest than that of general debt. These findings pass various robustness tests. Additionally, the mechanism test shows that fiscal competition is one of the driving forces behind the observed interdependence of local governments' debt strategies.

Keywords: local government debt; China government debt; debt competition; fiscal competition; economic sustainability



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1. Introduction

The massive and rapid expansion of local government debt in China has attracted attention worldwide in recent years. Alshaib et al. (2023) [1] point out that governments' external debt obligation is an indicator of fiscal sustainability, which is essential for developing countries to achieve sustainable development. Having an appropriate amount of local government debt can provide funds to promote the sustainable development of the economy and society. Having an unreasonable amount of local government debt, however, can be risky and potentially restrict a country's sustainable development. According to the Ministry of Finance (MoF), China's local government debt outstanding balance increased from CNY 14.76 trillion in 2015 to CNY 25.66 trillion by the end of 2020, making a 73.89% increase. Table 1 shows the outstanding balance of China's total local government debt, general debt, and special debt in the years 2015 to 2022. As reported, the balance of total local government debt, general debt, and special debt gradually increased between the years 2015 and 2019. After 2019, the balance of various debts showed a rapid increase, with the amount of 25.66, 30.47, and 35.07 trillion in 2020, 2021, and 2022 and a growth rate significantly higher than that before 2020. This implies that the COVID-19 epidemic has significantly increased the outstanding balance of local government debt in China. The rapid urbanisation and expansion of infrastructure in China have resulted in large-scale and continuously increasing debt, which damages fiscal sustainability [2], capital accumulation [3,4], and economic growth [5]. Therefore, it is crucial to investigate the factors driving the expansion of local government debt and take necessary actions to control it.

Table 1. The outstanding balance of China’s local government debts between 2015 and 2022 (unit: CNY 100 million).

Year	Local Government Debt Balance	General Debt Balance	Special Debt Balance
2015	147,951.8	92,709.24	55,242.56
2016	153,164.01	97,867.78	55,296.23
2017	165,099.8	103,631.79	61,468.01
2018	184,618.67	110,484.51	74,134.16
2019	213,097.78	118,670.79	94,426.99
2020	256,610.77	127,393.40	129,217.37
2021	304,700.31	137,708.64	166,991.67
2022	350,652.91	143,961.67	206,691.24

Data source: 2015–2022 National financial accounts, China Local Debt Information Disclosure Platform.

Pan et al. (2017) [6] and Qu et al. [7] (2023) propose that the increasing growth in local debt could be driven by debt competition among local governments. If there is debt competition among local governments, they “mimic” or “target” the amount of debt of other governments, rather than borrowing based on their real needs, which can lead to unreasonable expansion of debt levels. However, while previous research has investigated tax and spending competition, very little is known about public debt competition [8,9]. Thus, this study aims to investigate the spatial interaction of local government debts to identify the existence of debt competition among local governments and explain the expansion of local government debt from the perspective of debt competition. This study contributes to the literature by investigating the interdependence of debt levels between China’s neighbouring governments in the same and different provinces during the process of “Acquisition of debt quota” and “Use of debt quota”. Additionally, the study differentiates between general debt and special debt to examine how different types of debt interact. Furthermore, this study not only explores the spatial interdependence of debt among local governments but also examines the underlying mechanisms driving this interaction.

Governments can interact with each other through three channels: spillover effect, fiscal competition, and yardstick competition. According to the spillover effect hypothesis, the benefits generated from a government’s expenditures can spill over into neighbouring regions [10]. For instance, public facilities like roads and museums built in one city can also be utilised by the residents of neighbouring cities. As governments frequently borrow debt from financial institutions to finance their public spending, the spillover effect should also be observed in debt borrowing.

The second theory argues that the interaction among local governments is a result of fiscal competition. The tax competition model proposed by Wildasin (1988) [11] suggests that, when a government reduces tax rates to attract more capital and increase the tax base, other jurisdictions tend to react by lowering their tax rates as well. The tax competition model can be further extended to debt borrowing; when local governments rely on both tax revenues and debt borrowing to finance their spending, their debt policies can affect the debt policies of other governments as well [12].

The third reason why governments interact is yardstick competition. According to Besley and Case (1995) [13], with the existence of information asymmetry between voters and politicians, voters use the performance of politicians in neighbouring jurisdictions to evaluate the performance of their local politicians. Similarly, Shleifer (1985) [14] suggests that market regulators use comparable firms’ costs as a benchmark to evaluate a firm’s acceptable cost level. In China, yardstick competition among local governments is more like a principal–agent relationship, with the central government acting as the principal and selecting the yardstick while local governments participate in the competition as agents. While revenue and expenditure are typically used as benchmarks, this study extends the literature by using debt as a benchmark.

To estimate two patterns of spatial interdependence (intra-province and inter-province) of debt among China's local governments, this study applies the Two-Regime Spatial Lag models and uses 332 prefectural-level governments from 2015 to 2019 as the sample. The findings show that local government debts interact in both the "Acquisition of debt quota" and "Use of debt quota" stages and interaction in the "Acquisition of debt quota" stage is higher than that in the "Use of debt quota" stage. Another finding is that the interaction between neighbouring governments within the same province is more pronounced than that observed between neighbouring governments in different provinces. In addition, the interaction is heightened for special debt compared to general debt. Importantly, these findings are robust when we change the sample, use alternative spatial weighting matrices, and use time-lagged control variables. Moreover, the mechanism test shows that fiscal competition is one factor contributing to the observed interaction of local government debt levels.

This paper contributes to the existing literature in three aspects. Firstly, it innovatively investigates two patterns of debt competition: inter-province adjacent local government debt competition and intra-province adjacent local government debt competition, which further examines the province effect on spatial interaction of local government debt in China. Secondly, the study is the first to separately analyse the interaction of local government debt in the "Acquisition of debt quota" and "Use of debt quota" process, which gives a more in-depth understanding of how local government debt interacts in different debt borrowing stages. Thirdly, this study is the first to differentiate the spatial interaction of general debt and special debt, which further analyses the effect of different debt characteristics on debt competition.

The rest of this paper is organised as follows: Section 2 introduces the institutional background of China's local government debt and reviews the relevant literature. Section 3 describes the empirical model and explains data collection and descriptive statistics. Section 4 shows results and Section 5 is the conclusion.

2. Literature Review and Hypothesis Development

This section provides a comprehensive overview of the institutional background of local government debt in China and discusses the theoretical hypothesis underlying the spatial interaction of local government debt in China.

2.1. Institutional Background

Before 1994, the Chinese governments were required to maintain a balanced budget under the 1994 Budget Law and they were prohibited from borrowing debt from capital markets to finance their expenditures. The development of local government debt in China can be traced back to the 1994 "tax sharing reform". The fiscal system in China was decentralised and, with the introduction of the "tax sharing system", tax income was divided into three parts: central government taxes, local government taxes, and shared taxes between the central and local governments [15]. Under this system, a large portion of local tax income was remitted to the central government, while local expenditures were still paid by local governments, which led to a significant asymmetry between revenue and expenditure [16]. As a response to the increasing financing demands, local governments established many locally controlled state-owned financial institutions, known as local government financial vehicles (LGFVs), to borrow funds from banks and other institutional investors for local infrastructure investments [17].

Local government debts dramatically increased with the implementation of the "four-trillion-yuan" stimulus plan after the 2008 Financial Crisis. To overcome the shock of the global financial crisis, the central government introduced a "four-trillion-yuan" fiscal stimulus package, with CNY 1.2 trillion provided by the central government and the rest taken by local governments. To enable the successful implementation of this policy, the central government relaxed the restrictions on government bonds and allowed local

governments to use debt instruments to borrow debts from capital markets, which resulted in a significant increase in local government debts [7,17].

Nonetheless, the significant increase in local government debt also led to increasing risks. Recognising increasing risks, the central government has gradually strengthened the regulation of local government debts. In August 2014, the central government amended the 1994 Budget law to stipulate that local governments can only borrow debts through the local government bond market. A month later, the State Council published “Opinions on Strengthening the Administration of Local Government Debts”, which further clarified regulations regarding local government debt. This regulation classified local government debt into two categories: general debt and special debt. General debt is issued for non-profit projects and repaid through the general public budget. Special debt is issued for profitable projects and repaid by government-managed funds or project returns. In December 2015, the MoF published “Opinions on the Implementation of Quota Management for Local Government Debt”, which established a debt quota management system aimed at controlling local government debt limits [7]. These opinions aimed to further standardise the management of local government debt, strengthen the positive effect of government debt on economic and social development, and prevent and reduce fiscal and financial risks. The regulation stipulates, first, effectively strengthen the management of local government debt limits. Debt limit should be allocated according to debt risk, financial status, national macro-control policy, and construction and investment needs of regions. Second, establish a government debt risk prevention system. Third, manage outstanding debt appropriately. Local governments should effectively take responsibility for paying debt and handling outstanding debt legally. Table 2 shows the debt limit (including general debt limit and special debt limit) of China’s local governments between the years 2015 and 2022. As can be seen, the total local government debt limit, general debt limit, and special debt limit maintained an increasing trend in these years. For EU countries, the constraints on government borrowing behaviours are mainly reflected in fiscal rules, especially debt rules. Debt rules set clear limitations and target indicators (such as debt-to-GDP ratio) to control government debts. For example, in 2021 EU fiscal rules committed to reduce the percentage of public debt to GDP to a threshold of 60%; if a member country’s public debt exceeded 60% of GDP, the country had obligations to reduce public debt by 20% per year in the next three years. Overall, the debt limit system in China is similar to the fiscal rules in EU countries, but China emphasises the absolute amount of the limit, while the EU emphasises the relative value. The last column of Table 2 reports the ratio of general government gross debt to the GDP of EU 27 countries from 2015 to 2022. As it shows, the debt ratio of EU countries kept a decreasing trend from 2015 to 2019, it peaked with the COVID-19 outbreak in 2020, and then reduced gradually.

Recently, the COVID-19 pandemic has had a great influence on the worldwide economy, and researchers have been interested in the effect of the COVID-19 pandemic on local government debt. Huo et al. (2023) [16] point out that, to mitigate the negative effect of the COVID-19 pandemic on the economy, the Chinese government increased the scale of debt issuance to stabilise economic growth expectations. Auerbach et al. (2020) [18] examine the effect of COVID-19 on US local government budgets and document that the economic downturn caused by the COVID-19 pandemic and resulting legislation raise debt permanently. Briceño and Perote (2020) [19] report that the Eurozone countries most recently affected by the COVID-19 pandemic, such as Spain, Italy, and France, dramatically increased their public debts, making their public debts unsustainable. Della Posta et al. (2022) [20], Della Posta and Morroni (2022) [21] point out that the COVID-19 pandemic made public debt unsustainable; the policy response adopted by European institutions like monetary policy “Pandemic Emergency Purchase Program” and fiscal policy “Next Generation EU” can improve public debt sustainability, especially in the high-indebted country Italy. Zaremba et al. (2021) [22] also find that the COVID-19 pandemic increased the volatility of local sovereign bonds of different global regions and suggest that effective

policy responses such as containment and closure regulations, economic support, and health system interventions can reduce the volatility.

Table 2. Debt limit of China’s local governments and debt ratio of EU member countries in years 2015–2022 (unit: CNY 100 million).

Year	China Local Government Debt Limit	China General Debt Limit	China Special Debt Limit	Debt Ratio of the EU
2015	160,074	99,272	60,802	85.1
2016	171,874	107,159	64,716	84.3
2017	188,174	115,478	72,696	81.9
2018	209,974	123,789	86,185	79.8
2019	240,774	133,089	107,685	77.7
2020	288,074	142,889	145,185	90
2021	332,774	151,089	181,685	87.4
2022	376,474	158,289	218,185	83.5

Data source: 1. 2015–2022 National financial accounts, China Local Debt Information Disclosure Platform. 2. Eurostat: https://ec.europa.eu/eurostat/databrowser/view/sdg_17_40/default/table (accessed on 20 February 2024).

2.2. Spatial Interaction of Local Government Debt

The existing literature on the spatial interaction of government strategy mainly focuses on tax and spending. However, there is little literature on the spatial interaction of local government debt. Borck et al. (2015) [9] examine the spatial interdependence of public debt among German municipalities and find significant and robust interaction effects between debt levels of neighbouring municipalities. However, the literature on the spatial interaction of local government debts in China is very rare.

The literature suggests that governments can interact through three theoretical mechanisms: yardstick competition, fiscal competition, and spillover effect. These mechanisms can also be applied to the interaction of local government debt levels.

The yardstick competition theory introduced by Shleifer (1985) [14], Besley and Case (1995) [13] suggests that, with the existence of information asymmetry between regulators and regulated firms, regulators can use the costs of comparable firms as a reference to the regulated firms’ acceptable cost level. Besley and Case (1995) [13] introduce yardstick competition in the setting with asymmetric information between voters and politicians, where voters can use the performance of neighbour jurisdictions as a benchmark to evaluate the performance of their own jurisdictions. The yardstick competition among local governments in China is more like a principal–agent relationship; the central government acts as the principal to set the yardstick and local governments are agents engaging in yardstick competition. China’s local officials are appointed and promoted by upper governments and, with the presence of information asymmetry, it is difficult for the upper government to obtain a whole picture of local governments’ performance. To address this issue, the higher-level government sets a benchmark to compare the performance of all subordinate governments. This helps the higher-level government to better understand the performance of the lower-level governments. Consequently, local governments have incentives to imitate the strategies of other governments at the same level in order to meet the set standards.

The second reason for the existence of spatial interaction among local governments is fiscal competition. The tax competition model developed by Wildasin (1988) [11] demonstrates that each jurisdiction sets its tax rate based on the tax rates of other jurisdictions. The increase in the tax rate of a jurisdiction can lead to a reduction in the tax rates of its neighbours. This is because the increase in tax rate makes the jurisdiction less attractive for capital, which can lead to the outflow of capital into neighbouring jurisdictions and

subsequently give those jurisdictions higher tax bases. This tax competition model can be extended to debt borrowing when jurisdictions finance their spending with tax income and debt; Jensen and Toma (1991) [12] and Borck et al. (2015) [9] show that, in the fiscal competition framework with debt financing, a local government's debt level can impact the debt levels of its neighbours.

The third reason for the interdependence of government policy is the spillover effect. This theory argues that the benefits generated from fiscal expenditure can spill over to neighbouring governments [10]. They find that, with the presence of a spillover effect, a government's expenditure on public goods depends on the expenditures of its neighbours. Borck et al. (2015) [9] find that, when a government increases its debt levels to finance the expenditure on public goods whose benefits can spill over into other jurisdictions, its neighbours will react by adjusting their debt levels.

In China, local governments are considered as the agency of the central government, exercising the power given by the central government. Under the official promotion scheme, government officials are promoted and rewarded for their performance in economic and infrastructure development. This gives local governments an incentive to compete for economic and infrastructure development, which often requires debt financing, leading to debt competition among them. According to Pan et al. (2017) [6], the accumulation of local government debt is driven by inter-jurisdictional competition. He and Jia (2020) [23] suggest that the growth in local government debt is due to the yardstick set for local officials' promotion competition. Huo et al. (2023) [16] find that inter-governmental competition is one of the drivers of local government debt risk and is also a driver of the debt risk of neighbouring cities or cities with similar economic levels.

To sum up, existing studies on the interaction of governments' strategies mainly focus on tax competition and spending competition and the literature on debt competition among local governments is very rare. Although there is research on the debt interaction of German government debt, the empirical research on the interaction of Chinese local government debt is very limited. The governmental borrowing behaviours of developing countries should be different from the behaviours of developed countries. In addition, the existing study on the debt interaction of China's governments is very initial, either investigating the interaction among different regions (northeast, middle, and west) or provincial governments. This study fills this knowledge gap in the following ways: first, the study investigates the debt interaction of China's adjacent prefectural-level governments in the same and different provinces; second, this study examines the interaction of China's local government debts in "Acquisition of Debt Quota" and "Use of Debt Quota" stages separately, which is more in line with China's specific national conditions; third, the study tests the interaction of general debt and special debt separately and further explores the effect of different debt characteristics on debt competition in China.

From the above discussion, debt levels of local governments can spatially interact through three mechanisms: fiscal competition, yardstick competition, and spillover effect. Fiscal competition theory suggests that governments compete for investment in public goods as citizens "vote with their feet" for governments with optimal public services [24]. If there is an asymmetry between fiscal revenue and fiscal expenditure, governments are likely to issue debt to finance the spending. Therefore, the fiscal competition of governments can result in positive debt competition. Yardstick competition theory suggests that, in a setting with information asymmetry, higher-level governments set a benchmark to compare the performance of all subordinate governments. This motivates local governments to imitate the strategies of other governments at the same level to meet the set standards. Therefore, the yardstick competition also results in positive debt competition between adjacent governments. Spillover effect theory, however, implies a negative interaction of neighbouring governments' debt levels. The benefits of a government's public goods investment can spill over to its neighbours, making neighbouring governments have less incentives to issue debt to investment in similar public goods. Among these three mechanisms, the competition incentive is dominant and the accumulated effect of fiscal

competition and yardstick competition should exceed the effect of the spillover effect; therefore, we hypothesise that:

Hypothesis 1. *In China, a local government's debt level positively interacts with the debt level of its neighbouring governments.*

3. Materials and Methods

This section will introduce the empirical model and data collection of this study.

3.1. Empirical Model

The purpose of this study is to examine the spatial interdependence among Chinese prefectural-level governments' debt; thus, following Elhorst and Fréret (2009) [25], Bordinon et al. (2003) [26], Borck et al. (2015) [9], and Qu et al. (2023) [7], a spatial lag model designed to test the degree of interaction between regimes is applied. The definitions of variables used in the model are listed in Table 3.

Table 3. Definition of variables in the estimation.

Variable	Definition	Unit
$\Delta quota_{it}^{gen}$	Annual change in general debt quota	CNY 100 million
$\Delta quota_{it}^{spe}$	Annual change in special debt quota	CNY 100 million
z_{ij}	Indicator variable with value of 1 if governments i and j are in the same province, 0 otherwise	0/1
w_{ij}	Coefficient of the matrix W^{adj} , 1 if i and j are adjacent prefectural-level governments, 0 otherwise	0/1
$fiscal_{it-1}^{gen}$	Comprehensive financial capacity of general public budget	CNY 100 million
$fiscal_{it-1}^{spe}$	Comprehensive financial capacity of government-managed fund	CNY 100 million
$debt_rat_{it-1}^{gen}$	$\frac{\text{year-end general debt balance}}{\text{comprehensive financial capacity of general public budget}}$	%
$debt_rat_{it-1}^{spe}$	$\frac{\text{year-end special debt balance}}{\text{comprehensive financial capacity of government-managed fund}}$	%
$rate_{it}^{gen}$	$\frac{\text{actual general debt scale}}{\text{general debt quota}}$	%
$rate_{it}^{spe}$	$\frac{\text{actual special debt scale}}{\text{special debt quota}}$	%
$revu_{it}^{gen}$	General public budget revenue	CNY 100 million
$revu_{it}^{spe}$	Government-managed fund revenue	CNY 100 million
$ssra_{it}$	$\frac{\text{sum of general public budget revenue and government-managed fund revenue}}{\text{sum of general public budget expenditure and government-managed fund expenditure}}$	%
$loan_dpst_{it}$	$\frac{\text{loan balance of financial institutions}}{\text{deposit balance of financial institutions}}$	%
$\ln gdp_{it}$	Logarithm of GDP	CNY 100 million
$popu_{it}$	Average annual resident population	10,000 people
inv_{it}	Total investment in fixed assets divided by GDP	%
$sale_{it}$	Total retail sales of consumer goods divided by GDP	%

The reason this study applies the annual change in debt quota $\Delta quota_{it}$ and the ratio of debt quota used $rate_{it}$ as dependent variables is to examine the interaction of China's local government debts in different borrowing stages. Since the publication of the "Opinions on the Implementation of Quota Management for Local Government Debt" (hereafter, opinion 1) by MoF in December 2015, local governments in China have been following a two-step process to borrow debt. The first step is to apply for a new debt quota from the higher government, which is known as the "Acquisition of debt quota". After the debt quota is issued and allocated, the second step is to borrow the debt from capital markets within the new debt quota, which is referred to as the "Use of debt quota". This study uses the dependent variable $\Delta quota_{it}$ to reflect the "Acquisition of debt quota" process and $rate_{it}$ to reflect the "Use of debt quota" process.

In addition, dependent variables are divided into general debt ($\Delta quota_{it}^{gen}$ and $rate_{it}^{gen}$) and special debt ($\Delta quota_{it}^{spe}$ and $rate_{it}^{spe}$) to achieve the objective of testing the interaction of different types of government debts. The "Opinions on Strengthening the Administration of Local Government Debts" (hereafter, opinion 2) published by the State Council categorises local government debt into two categories: general debt and special debt. The different natures and characteristics of these two types of government debt, such as target project, regulation methods, repayment source, and deficit definition, can affect the interaction of these two types of government debt.

This study firstly examines the spatial interaction of debt in the first step “Acquisition of debt quota”. It will investigate the interaction of debt between adjacent governments, including those in the same province and different provinces. The “Interim Measures for the Administration of the Allocation of New Local Government Debt Limits” (Measure 1 hereafter), issued by MoF in March 2017, states that the allocation of debt limits should consider the financial status and debt risk of each region. Therefore, the Two-Regime Model of Debt Quota Acquisition is presented as follows:

$$\Delta quota_{it} = \rho_1 \sum_{j=1}^N z_{ij} w_{ij} \Delta quota_{jt} + \rho_2 \sum_{j=1}^N (1 - z_{ij}) w_{ij} \Delta quota_{jt} + \beta_1 fiscal_{it-1} + \beta_2 debt_rat_{it-1} + \mu_i + \varepsilon_{it} \quad (1)$$

where $quota_{it}$ refers to debt quota and the dependent variable $\Delta quota_{it}$ is the annual change in debt quota for prefectural-level government i in the year t , i.e., $\Delta quota_{it} = quota_{it} - quota_{it-1}$. Furthermore, to investigate the spatial interaction of different types of local government debts, $\Delta quota_{it}$ is divided into annual changes in the quota of general debt $\Delta quota_{it}^{gen}$ and annual changes in the quota of special debt $\Delta quota_{it}^{spe}$ to investigate the spatial interaction of different types of local government debts.

The variable $\Delta quota_{jt}$ represents the annual change in the debt quota of neighbouring governments. To examine spatial interaction between debt levels of neighbouring governments in the same province and different provinces, this study employs variables z_{ij} and w_{ij} . z_{ij} is an indicator variable that equals 1 if governments i and j are in the same province and 0 otherwise. w_{ij} stands for the coefficient of the matrix w^{adj} , which is a geospatial weight matrix structured by the location of prefectural-level governments i and j . If governments i and j are adjacent, the coefficient w_{ij} will be assigned the value of 1; otherwise, it will be assigned the value of 0. In this way, the variable $\sum_{j=1}^N z_{ij} w_{ij} \Delta quota_{jt}$ captures the annual change

in the debt quota of intra-province neighbours and the variable $\sum_{j=1}^N (1 - z_{ij}) w_{ij} \Delta quota_{jt}$ captures the annual change in the debt of inter-province neighbours. If prefectural-level governments i and j are adjacent and in the same province, the interaction of debt change can be captured by the coefficient ρ_1 . If governments i and j are adjacent but in different provinces, the interaction of local government debt can be captured by the coefficient ρ_2 .

According to “Interim Measures for the Administration of the Allocation of New Local Government Debt Limits”, the allocation of debt quota is influenced by the financial status and debt risks of each region; therefore, these factors should be controlled in the model. The financial status of governments is controlled by the government’s comprehensive financial capacity level $fiscal_{it-1}$. It is based on the repayment sources of general debt and specific debt. General debt is repaid by the general public budget and specific debt is repaid by government-managed funds. Therefore, when the dependent variable is the change in the quota of general debt $\Delta quota_{it}^{gen}$, $fiscal_{it-1}$ refers to the comprehensive financial capacity of the general public budget $fiscal_{it-1}^{gen}$; when the dependent variable is the change in the quota of specific debt $\Delta quota_{it}^{spe}$, it refers to the comprehensive financial capacity of government-managed fund $fiscal_{it-1}^{spe}$. The debt risk of governments is controlled by the local debt ratio $debt_rat_{it-1}$. It is also divided into general debt ratio $debt_rat_{it-1}^{gen}$ and special debt ratio $debt_rat_{it-1}^{spe}$. The new debt quota for each government is decided at the beginning of the year; therefore, we use the lagged value of comprehensive financial capacity level and local debt ratio. In addition, the use of lagged values can mitigate the potential endogeneity issue of the model. μ_i controls individual fixed effects and ε_{it} is the error term.

This study then examines the interaction of debt in the second step “Use of debt quota”. After the debt quota is issued and allocated, local governments will borrow debts within

the debt limit. To examine the spatial interaction of debt in this process, the following model is built:

$$rate_{it} = \lambda_1 \sum_{j=1}^N z_{ij} w_{ij} rate_{jt} + \lambda_2 \sum_{j=1}^N (1 - z_{ij}) w_{ij} rate_{jt} + \theta_k \sum_{k=1}^K X_{it,k} + u_i + \varepsilon_{it} \quad (2)$$

The variable $rate_{it}$ refers to the proportion of debt quota used, which reflects to what extent a government uses its debt quota. It is measured as the rate of local governments' actual debt scale to the debt quota allocated. The use of debt quota is divided into the use of general debt quota $rate_{it}^{gen}$ and the use of special debt quota $rate_{it}^{spe}$.

The variable $rate_{jt}$ represents the proportion of debt quota used by neighbouring governments and z_{ij} and w_{ij} have the same definition as those in model (1). To avoid the change in the ratio of debt quota use being confounded by other variables, the "Use of debt quota" model (i.e., model 2) includes a group of control variables ($X_{it,k}$) that affect the scale of local government debts. Based on China's specific national conditions, the first effect to be controlled is the repayment sources of general debt and special debt, including general public budget revenue $revu_{it}^{gen}$ and government-managed fund revenue $revu_{it}^{spe}$. The second effect to be controlled is debt risk, measured by the general debt ratio $debt_rat_{it-1}^{gen}$ and special debt ratio $debt_rat_{it-1}^{spe}$; the definition is the same as those in model (1). Other factors that should be controlled include local financial self-sufficiency rate $ssra_{it}$, loan-to-deposit ratio of financial institutions $loan_dpst_{it}$, logarithm of regional GDP $\ln gdp_{it}$, average resident population $popu_{it}$, investment level $invst_{it}$, and consumption level $sale_{it}$. The other variables have the same meanings as in Equation (1).

To address the potential endogeneity issue in our models, we use the feasible generalised 2SLS (2SLS) method as proposed by Kelejian and Prucha (1998) [27] to estimate variables and use spatially lagged independent variables as instrumental variables. In addition, we control for fixed effects of the province to mitigate the endogenous problem caused by omitted variables. Specifically, the least square dummy variable model (LSDV) is adopted to estimate the fixed effect.

3.2. Data Collection and Descriptive Statistics

In this section, we will introduce the sources of data required for the study and conduct descriptive statistics to verify data validity.

3.2.1. Data Source

In China, there are 333 prefectural-level governments, including 293 cities, 7 regions, 30 autonomous prefectures, and 3 leagues; they are at equivalent administrative levels. The city Sansha is excluded from the sample due to a lack of data. In total, the sample consists of 332 prefectural-level governments in the period of 2015–2019. We chose this period because the New Budget Law was implemented in 2015, which formally allowed governments to issue bonds to borrow debt from capital markets. The period ends in 2019 because this is the latest year for which we have data available. Figure 1 shows the ratio of local government debt to GDP in China, the United Kingdom, France, Germany, and the United States in the years 1950 to 2022. As shown in the chart, during the period of 2015–2019, while the other countries showed a decreasing trend in the ratio of local government debt to GDP, China showed a continuing increase. From 2019 to 2020, all of these countries increased the percentage of local government debt to GDP. After 2020, suffering from the impact of the COVID-19 pandemic, other countries reduced the ratio of government debt to GDP but China still exhibited an increase in the percentage of government debt to GDP. Nevertheless, the amount of debt issued by local governments as a share of GDP in China has been lower than that in other countries (except Germany) since 1995.



Figure 1. The ratio of local government debt to GDP in China, UK, France, Germany, and US in the years 1950–2022. Source: International Monetary Fund Global Debt Database (September 2023) https://www.imf.org/external/datamapper/GG_DEBT_GdDP@GDD/CHN/GBR/FRA/DEU/USA (accessed on 20 February 2024).

According to the central government’s requirements for information disclosure, local governments have an obligation to disclose debt levels to the public. Therefore, data for local debt, fiscal revenue, and fiscal expenditure are collected from the fiscal budget and final accounts reports published on each government’s official website. However, not all governments strictly comply with the requirement to regularly disclose the reports. For the governments that do not provide the reports, this study follows the process introduced by Qu et al. (2023) [7] to manually collect government debt data. For the data still missing, the study estimates them by aggregating data from districts and counties under their jurisdictions. Other economic data are collected from the National Economic and Social Development Statistical Bulletin disclosed on each government’s official website and the China City Statistical Yearbook and Statistical Yearbook of Provinces downloaded from the Wind database.

3.2.2. Descriptive Statistics

The descriptive statistics of the variables used in this study are presented in Table 4. As shown in the table, the total number of observations of the study is 1660. According to the descriptive statistics for the variable $\Delta quota_{it}^{gen}$, the change in the sample’s general debt quota ranges from −16 billion to 59.95 billion. On average, the general debt quota allocated to the governments in the current year is 1.572 billion higher than the previous year. The descriptive statistic for the variable $\Delta quota_{it}^{spe}$ shows that the change in the special debt quota ranges from −9.3 billion to 105.64 billion. On average, the special debt quota allocated to prefectural-level governments has a yearly increase of 3.953 billion. This suggests that the increase in the special debt quota is greater than that of the general debt quota. The descriptive statistics for variables $rate_{it}^{gen}$ and $rate_{it}^{spe}$ show that the sample governments use, on average, 90.25% of the general debt quota and 89.34% of the special debt quota. According to the descriptive statistics of the variables, the data collected are valid.

Table 4. Descriptive statistics of variables.

Variable	Obs	Mean	Std. Dev	Min	Max
$\Delta quota_{it}^{gen}$	1660	15.7237	27.1181	−159.9500	599.5440
$\Delta quota_{it}^{spe}$	1660	39.5329	64.4186	−92.9900	1056.3651
$fiscal_{it-1}^{gen}$	1660	392.2763	365.8458	24.2744	4594.7000
$fiscal_{it-1}^{spe}$	1660	143.3043	272.7120	0.0026	3191.9280
$debt_rat_{it-1}^{gen}$	1660	0.6383	0.4181	0.0049	4.1850
$debt_rat_{it-1}^{spe}$	1660	2.0555	2.2189	0.0000	27.3224
$rate_{it}^{gen}$	1660	90.2542	8.9815	19.9248	114.9585
$rate_{it}^{spe}$	1660	89.3429	14.7585	0.0000	129.3616
$revu_{it}^{gen}$	1660	201.3066	330.6048	1.8919	3857.5000
$revu_{it}^{spe}$	1660	174.0800	320.3397	0.0026	3690.4500
$ssra_{it}$	1660	0.4647	0.2258	0.0141	1.1264
$loan_dpst_{it}$	1660	71.8369	19.6099	14.5130	163.9147
$\ln gdp_{it}$	1660	10.8183	0.4928	9.2338	12.2718
$popu_{it}$	1660	389.3659	294.5017	11.2155	2093.7757
inv_{it}	1660	93.1484	39.3712	12.1710	286.4502
$sale_{it}$	1660	40.2466	13.4296	6.5676	103.4445

4. Results and Discussions

This section will begin by presenting the primary findings of the study on the spatial interaction of neighbouring governments, including intra-province neighbouring governments and inter-province neighbouring governments. The study will explore the interaction of general debt and special debt during the “Acquisition of debt quota” and “Use of debt quota” stages. Then, the study will test the robustness of the findings and examine the underlying mechanism that drives the observed interactions.

4.1. Main Results

The results of the Two-Regime Spatial Lag models (1) and (2) are reported in Table 5. The results for the process of “Debt Quota Acquisition” (i.e., acquisition of debt quota) are shown in columns (1) and (2), where column (1) reports the results for general debt and column (2) reports the results for special debt. According to R^2 , the models explain 10.45% of the variance in the annual change in general debt quota and 38.75% of the variance in the annual change in special debt quota. Columns (3) and (4) of Table 5 display the results of the regression analysis conducted for the process of “Debt Quota Use” (i.e., use of debt quota). Column (3) represents the use of general debt, while column (4) represents the use of special debt.

The results of Table 5 show that local governments’ general debt quota and special debt quota acquisition significantly interact with their intra-province neighbours; the interaction of special debt quota is stronger than that of general debt quota. In addition, local governments’ use of general debt quota interacts with their intra- and inter-province neighbours. Their use of special debt, however, is only influenced by their intra-province neighbours. The interaction of special debt use between intra-province neighbours is stronger than the use of general debt quota. In addition, comparing the interaction of general debt and special debt in different stages, the spatial interaction of general debt and special debt quota acquisition is higher than the interaction of debt quota use.

With detailed analysis, for general debt, the coefficient ρ_1 is 0.3673, which is statistically significant at the 1% level. This shows that there is a significant interaction of general debt quota between the prefectural-level governments and their intra-province neighbours. Specifically, a prefectural-level government’s general debt quota will increase by an average of 36.73 million if its intra-province adjacent governments’ general debt quota increases by 100 million. However, the general debt quota of adjacent governments in different provinces does not interact, as indicated by the coefficient ρ_2 .

Table 5. Estimation results for Two-Regime Spatial Lag Models (1) and (2).

	Acquisition of Debt Quota (Model 1)		Use of Debt Quota (Model 2)	
	General Debt	Special Debt	General Debt	Special Debt
	(1)	(2)	(3)	(4)
ρ_1	0.3673 *** [0.1232]	0.4104 *** [0.0391]		
ρ_2	0.0862 [0.0610]	−0.0265 [0.0410]		
λ_1			0.1823 *** [0.0285]	0.3437 *** [0.0456]
λ_2			0.0089 * [0.0045]	0.0115 [0.0080]
$fiscal_{it-1}$	0.0149 *** [0.0018]	0.1362 *** [0.0049]		
$debt_rat_{it-1}$	−5.5743 *** [1.8871]	−0.1371 [0.5576]	2.7677 *** [0.6205]	0.9448 *** [0.1502]
$revu_{it}$			−0.0140 *** [0.0010]	−0.0038 ** [0.0016]
$ssra_{it}$			−8.2385 *** [1.6677]	−7.0664 *** [2.7041]
$popu_{it}$			0.0081 *** [0.0011]	−0.0006 [0.0018]
$invt_{it}$			0.0082 [0.0061]	−0.0098 [0.0107]
$sale_{it}$			0.0911 *** [0.0196]	0.2323 *** [0.0323]
$loan_dpst_{it}$			−0.0194 * [0.0117]	0.1007 *** [0.0203]
$\ln gdp_{it}$			6.5371 *** [0.2817]	4.3486 *** [0.4781]
Province fixed effect	✓	✓	✓	✓
No. of regions	332	332	332	332
No. of observations	1660	1660	1660	1660
R ²	0.1045	0.3875	0.4482	0.2605

Note: clustering robust standard errors are reported in parentheses; test statistics are significant at * $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$.

The findings regarding special debt show that the allocation of special debt among intra-province governments is spatially dependent. The coefficient ρ_1 is 0.4104 and statistically significant at the 1% level. This means that, if the special debt quota of an intra-province adjacent government increases by 100 million, the sample government's special debt quota will increase by 41.04 million. Such spatial interaction, however, does not exist between adjacent governments in different provinces. Furthermore, the higher coefficient for special debt indicates that the spatial interaction of special debt among governments is stronger than that of general debt.

The coefficients for $fiscal_{it-1}^{gen}$ and $fiscal_{it-1}^{spe}$ are significantly positive, indicating that the stronger the comprehensive financial capacity a government has, the more debt quota will be allocated. In contrast, the significantly negative coefficient for $debt_rat_{it-1}^{gen}$ reflects that the quota allocated to general debt is sensitive to debt risk; the higher debt risks a government has, the less general debt quota will be assigned. The findings are consistent with our expectations.

Regarding the use of debt quota, the analysis shows that the coefficient for the general debt in the "Acquisition of debt quota" process (0.3673) is higher than that for the general debt in the "Use of debt quota" process (0.1823). Similarly, the coefficient for the special debt in the "Acquisition of debt quota" process (0.4104) is also higher than that for the special debt in the "Use of debt quota" process (0.3437). This suggests that the interaction of local government debt in the process of acquiring debt quota, no matter general debt or special debt, is higher than the interaction in the process of using debt quota.

For general debt, coefficients λ_1 (0.1823) and λ_2 (0.0089) are all significantly positive, which indicates a significant spatial interdependence in the use of general debt quota between prefectural-level governments and their neighbours, including both intra-province

and inter-province neighbours. The higher and more significant value of λ_1 implies that the interaction of intra-province neighbouring governments is more pronounced than that of inter-province neighbouring governments. For special debt, the significant positive λ_1 suggests that governments' use of special debt quota is influenced by their intra-province neighbours. If the use of special debt quota by intra-province neighbours increases by 100 million, then the governments will correspondingly increase their use of special debt by 34.37 million.

In terms of spatial interdependence heterogeneity, in both processes, the coefficient of special debt is larger than that of general debt. This shows that governments are more influenced by their neighbours' acquisition and use of special debt quota compared to the general debt quota. This might be because general debts are primarily used to invest in projects without returns and are repaid by regional fiscal revenue, while special debts are mainly invested in projects with returns and are repaid by government-managed funds or revenue from relevant projects. As special debt is revenue-based, the projects funded by it have opportunities to gain capital gains, which are essential for effective investment and economic development. Therefore, local governments have more incentives to acquire more debt quota and increase debt utilisation. Additionally, the scale of special debt is generally larger than general debt because it has a higher debt quota limitation. This means that, when neighbouring governments expand the scale of special debt, local governments have a more sufficient special debt balance.

The coefficients of control variables generally align with theoretical expectations. Lagged debt ratio, consumption level, and logarithm of GDP are positively associated with the use of both general debt and special debt. On the other hand, general public revenue and government-managed revenue are negatively associated with the use of general and special debt quota, which means that the higher the general public revenue and government-managed revenue a government has, the less likely for the government to use debt quota. The financial self-sufficiency rate is also negatively related to the use of debt quota, meaning that a higher financial self-sufficiency rate is associated with less need for government debt.

4.2. Robustness Tests

In this section, the study tests the robustness of the results to different research samples, different spatial weighting matrices, and different statuses of control variables.

4.2.1. Change in Sample

As mentioned earlier, the research sample consists of 332 administrative regions at the prefectural level, which includes 292 prefectural-level cities, 7 regions, 30 autonomous prefectures, and 3 leagues. Although these regions are at an equivalent administrative level, their economic development levels vary significantly. There is a considerable gap between the economic development level of prefectural-level cities and the economic levels of regions, leagues, and autonomous prefectures. This gap has the potential to impact the accuracy of the empirical results. To test the robustness of the results for economic development levels, the study removes all regions, leagues, and autonomous prefectures from the sample, retaining only the 292 prefectural-level cities. In addition, among these 292 prefectural-level cities, 7 cities have transferred from regions or county-level cities to prefectural-level cities. To maintain consistency and coherence in the definition of prefectural-level cities, these 7 cities are also excluded from the final sample of 285 prefectural-level cities.

Table 6 shows that our findings are robust to the economic development levels of local governments. Columns (1) and (2) report the interdependence of general debt and special debt in the process of "Acquisition of debt quota" and columns (3) and (4) show the interaction of general debt and special debt in the process of "Use of debt quota". The study confirms that the spatial interaction of debt among neighbouring governments persists in both processes, with a greater interaction observed among intra-province neighbours

compared to inter-province neighbours. In addition, the spatial interaction of general and special debt in the process of acquiring debt quota is higher than that in the process of using debt quota. Furthermore, this study finds that the interaction of special debt is stronger than that of general debt.

Table 6. Robustness test: change in sample.

	Acquisition of Debt Quota (Model 1)		Use of Debt Quota (Model 2)	
	General Debt	Special Debt	General Debt	Special Debt
	(1)	(2)	(3)	(4)
ρ_1	0.2849 ** [0.1340]	0.3945 *** [0.0418]		
ρ_2	0.1204 * [0.0701]	−0.0212 [0.0435]		
λ_1			0.0598 *** [0.0156]	0.0861 *** [0.0212]
λ_2			0.0116 ** [0.0045]	0.0247 *** [0.0062]
$fiscal_{it-1}$	0.0154 *** [0.0024]	0.1357 *** [0.0053]		
$debt_rat_{it-1}$	−5.1301 ** [2.1254]	−0.2442 [0.8081]	2.8787 *** [0.6123]	0.5054 *** [0.1525]
$revu_{it}$			−0.0138 *** [0.0009]	−0.0009 [0.0012]
$ssra_{it}$			−8.7190 *** [1.6924]	−13.3607 *** [2.2098]
$popu_{it}$			0.0072 *** [0.0011]	−0.0028 ** [0.0014]
inv_{it}			−0.0005 [0.0067]	−0.0054 [0.0093]
$sale_{it}$			0.1323 *** [0.0201]	0.2449 *** [0.0261]
$loan_dpst_{it}$			−0.0170 [0.0123]	0.0535 *** [0.0169]
$\ln gdp_{it}$			7.5036 *** [0.2024]	7.1148 *** [0.2879]
Province fixed effect	√	√	√	√
No. of regions	258	258	258	258
No. of observations	1425	1425	1425	1425
R ²	0.0884	0.4386	0.4532	0.2423

Note: clustering robust standard errors are reported in parentheses and test statistics are significant at * $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$.

4.2.2. Different Spatial Weighting Matrices

The location of regions is not the only factor that determines spatial correlations; the economic activities of regions can also reflect the level of spatial correlation. Based on this theory, a new matrix, denoted as W^{aeco} , is introduced to indicate spatial correlations. This matrix takes into account both the geographical location and economic level of regions. Specifically, $W^{aeco} = W^{adj} \times W^{eco}$, where W^{adj} is the geospatial weight matrix defined previously and W^{eco} represents an economic spatial weight matrix. The coefficient w_{ijt} of W^{eco} is assigned as the reciprocal of the absolute difference in per capita GDP between regions i and j in year t . In other words, $w_{ijt} = 1/|GDP_ca_{it} - GDP_ca_{jt}|$, where GDP_ca_{it} and GDP_ca_{jt} are per capita GDP of prefectural-level governments i and j in the year t . The smaller the difference between GDP_ca_{it} and GDP_ca_{jt} , the higher the value of w_{ijt} and, hence, the stronger the correlation between governments i and j . The results of the Two-Regime Spatial Lag Model based on the matrix W^{aeco} are presented in Table 7.

Table 7. Robustness test: different spatial weighting matrices.

	Acquisition of Debt Quota		Use of Debt Quota	
	General Debt	Special Debt	General Debt	Special Debt
	(1)	(2)	(3)	(4)
ρ_1	0.4034 *** [0.1217]	0.4140 *** [0.0447]		
ρ_2	0.1242 ** [0.0620]	−0.0050 [0.0415]		
λ_1			0.1601 *** [0.0274]	0.3031 *** [0.0425]
λ_2			0.0090 ** [0.0045]	0.0099 [0.0081]
$fiscal_{it-1}$	0.0150 *** [0.0023]	0.1329 *** [0.0050]		
$debt_rat_{it-1}$	−5.9695 *** [1.8996]	−0.1910 [0.5500]	2.7535 *** [0.6207]	0.9679 *** [0.1505]
$revu_{it}$			−0.0139 *** [0.0010]	−0.0038 ** [0.0016]
$ssra_{it}$			−8.6327 *** [1.6618]	−7.6131 *** [2.7036]
$popu_{it}$			0.0081 *** [0.0011]	−0.0002 [0.0018]
$invt_{it}$			0.0076 [0.0061]	−0.0086 [0.0108]
$sale_{it}$			0.0943 *** [0.0196]	0.2394 *** [0.0322]
$loan_dpst_{it}$			−0.0207 * [0.0117]	0.0989 *** [0.0203]
$\ln gdp_{it}$			6.7306 *** [0.2734]	4.6413 *** [0.4628]
Province fixed effect	1660	1660	1660	1660
No. of regions	332	332	332	332
No. of observations	1660	1660	1660	1660
R ²	0.0901	0.4368	0.3857	0.2615

Note: clustering robust standard errors are reported in parentheses and test statistics are significant at * $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$.

Table 7 shows the results of the Two-Regime Spatial Lag Model based on the matrix W^{aeco} . The results are consistent with previous findings, meaning that the results are robust to different types of spatial weighting matrices. We find that the acquisition and use of debt quota by the governments at the prefectural level, regardless of whether it is general debt or special debt, is influenced by neighbouring governments in the same province. The influence is higher in the debt quota acquisition process than in the debt quota use process. There is also interaction in terms of general debt between adjacent governments across provinces, although this interaction is weaker compared to those within the same province. The interaction of special debt is found to be more pronounced than that of general debt.

4.2.3. Lagged Control Variables

In model (2), most of the control variables are contemporaneous with the dependent variables, which can lead to endogeneity issues caused by causal relationships or interaction effects of variables. To address this issue, we follow the approach of Borck et al. (2015) [9] and use one-year-lagged control variables to estimate the model.

The results are presented in Table 8 and are consistent with our previous findings, indicating that our findings are robust to different types of control variables. We find that the governments' use of special debt quota interacts with adjacent governments within the same province. While the use of general debt quota interacts with both intra- and inter-province adjacent governments, the interaction among governments in the same province is higher than that of governments in different provinces. In addition, the interaction in the use of special debt quota is higher than that of general debt.

Table 8. Robustness test: using time-lagged control variables.

	Use of Debt Quota General Debt	Use of Debt Quota Special Debt
	(1)	(2)
λ_1	0.1897 *** [0.0284]	0.2805 *** [0.0480]
λ_2	0.0094 ** [0.0045]	0.0050 [0.0082]
$revu_{it-1}$	-0.0202 *** [0.0019]	0.0010 [0.0026]
$debt_rat_{it-1}$	2.8737 *** [0.6175]	0.9628 *** [0.1526]
$ssra_{it-1}$	-7.6731 *** [1.6228]	-1.4573 [2.6878]
$popu_{it-1}$	0.0105 *** [0.0014]	0.0019 [0.0024]
inv_{it-1}	-0.0010 *** [0.0002]	-0.0002 [0.0004]
$sale_{it-1}$	0.0724 *** [0.0198]	0.2593 *** [0.0326]
$loan_dpst_{it-1}$	0.0004 *** [0.0001]	-0.0004 ** [0.0001]
$\ln gdp_{it-1}$	6.6114 *** [0.2651]	5.1205 *** [0.4687]
Province fixed effect	√	√
No. of regions	332	332
No. of observations	1660	1660
R ²	0.3861	0.2552

Note: clustering robust standard errors are reported in parentheses and test statistics are significant at ** $p < 0.05$, and *** $p < 0.01$.

4.3. Mechanism Test

The empirical results provide evidence of interaction among local government debts and the results are robust. This section further explores the mechanism underlying the spatial interdependence of local government debts. According to the literature, governments can interact through three theoretical mechanisms: yardstick competition, fiscal competition, and spillover effect. However, due to the lack of a valid model to test yardstick competition and spillover effects, this study focuses on testing the effect of fiscal competition.

As previously mentioned, the fiscal competition between governments can lead to a competition for local government debt. The spatial interdependence of local government fiscal behaviours results from the need to compete for flowing resources or tax resources and it can be classified into two types: competition for fiscal revenue and competition for fiscal expenditure. This study aims to examine the competition between adjacent governments in the same province and across provinces in terms of fiscal revenue and expenditure to analyse the impact of fiscal competition. In order to ensure that the results are comparable, we will use the same control variables used in the Two-Regime Model of Debt Quota Use but we will change the dependent variables to fiscal revenue increment and fiscal expenditure increment.

The results can be found in Table 9, which shows a significant spatial interaction of fiscal revenue increment and fiscal expenditure increment between adjacent governments within the same province. Column (1) displays the results for fiscal revenue and column (2) shows the results for fiscal expenditure. The coefficient λ_1 is significantly positive, suggesting that there is significant fiscal revenue competition and fiscal expenditure competition between neighbouring governments in the same province. This aligns with the findings on local government debt, supporting the conjecture that the spatial interaction of the debt levels of adjacent governments in the same province is probably due to fiscal competition.

Table 9. Mechanism test: fiscal competition.

	Fiscal Revenue	Fiscal Expenditure
	(1)	(2)
λ_1	0.1960 *** [0.0653]	0.1867 *** [0.0629]
λ_2	−0.0656 [0.0629]	−0.0664 [0.0508]
$debt_rat_{it-1}$	−11.7086 [7.7744]	−7.2442 [7.9302]
$ssra_{it}$	188.8325 *** [21.4476]	61.6088 *** [21.5866]
$popu_{it}$	0.1272 *** [0.0113]	0.2130 *** [0.0115]
$invt_{it}$	0.0224 [0.0844]	−0.0538 [0.0861]
$sale_{it}$	−0.3072 [0.2461]	−0.5039 ** [0.2513]
$loan_dpst_{it}$	−0.2525 [0.1587]	0.3219 ** [0.1606]
$\ln gdp_{it}$	−8.3909 *** [2.0683]	−4.4259 ** [2.1336]
Province fixed effect	√	√
No. of regions	332	332
No. of observations	1660	1660
R ²	0.3097	0.3678

Note: clustering robust standard errors are reported in parentheses and test statistics are significant at ** $p < 0.05$, and *** $p < 0.01$.

In summary, the results of our research are consistent with the results reported by Borck et al. (2015) [9], Liu et al. (2022) [24], and Pan et al. (2017) [6]. Borck et al. (2015) [9] find a significant positive interaction effect between debt levels of neighbouring municipalities in Germany. Similarly, we find a significant positive interaction effect between the debt levels of neighbouring governments in China. Liu et al. (2022) [24] report that China's provincial neighbouring governments show positive strategic interactions in their local public debts. Our study further finds that this positive strategic interaction also exists among prefectural-level governments. The study of Pan et al. (2017) [6] suggests that debt accumulation in China is driven by inter-jurisdictional competition; our results also support this conclusion. In addition to these studies, our research has further findings that contribute to the knowledge in the local government debt research field. For example, our study finds that the spatial interaction of adjacent governments in the same province is more significant than the governments in different provinces. The spatial interaction of special debt is stronger than that of general debt. The interaction of neighbouring governments' debt levels in the process of debt quota acquisition is higher than that in the debt quota use process.

5. Conclusions

Taking China's prefectural-level governments as the research sample, this study investigates the spatial interaction of local government debts in China. We find that there is significant interdependence among local governments' debt, both in the process of acquiring and using debt quota. The spatial interaction in the process of acquiring debt quota is higher than that in the process of using debt quota. Additionally, the study takes province effect into account and investigates the interaction among intra-province and inter-province adjacent governments.

This study finds that the strategic interaction among prefectural-level governments in the same province is more pronounced than that of adjacent governments in different provinces. In terms of different types of debt, the result shows that the spatial interaction

of special debt is significantly higher than that of general debt. The results are robust when we change samples, use time-lagged instead of contemporaneous control variables, and apply different spatial weighting matrices.

Furthermore, we analyse the internal mechanism driving spatial interdependence in the acquisition and use of local government debt quota. Our investigation identifies fiscal competition as a key factor. By issuing debt to finance public spending, local governments strategically gain advantages in tax and expenditure competitions. Thus, fiscal revenue competition and fiscal expenditure competition promote governments' debt competition.

This study contributes to the theory in the following ways. First, the results contribute to the theory of government strategy interaction. Previous literature mainly focuses on the interaction of governments' tax and spending strategies, this study contributes to the theory of government strategy interaction by investigating the interaction of debt strategy. In addition, the literature hypothesises that the interaction of government strategy is caused by fiscal competition, yardstick competition, and spillover effect; this study supports fiscal competition theory based on the evidence of China. Second, the study contributes to the theory about local government debts. Previous literature conjectures that the increase in local government debt could be driven by debt competition. This study supports this theory by providing evidence of spatial interaction between debt levels of neighbouring governments.

The contribution of this study to society is to provide suggestions for policymakers, help regulators strengthen the management of government debt behaviours, control governments' excessive borrowing behaviours, optimise the government debt system, reduce debt risks, and promote the sustainable development of local debt and economy. The findings of this study have the following policy implications. First, the evidence of positive spatial interaction among neighbouring governments' debt levels implies the existence of debt competition among local governments; that is, the increase in local government debt may not be driven by governments' real needs but just competition with their neighbouring governments. In addition, the study finds that such interaction is more significant in the debt quota acquisition process and special debt issuance. These findings suggest that regulators should strengthen the management of local government debt (especially special debt) to control excessive debt issuance and debt risks. Practical approaches include introducing more market-based pricing in debt issuance, establishing an early alert system, improving debt quota setting mechanism, depending on governments' debt repayment ability and debt risk rather than their borrowing willingness to set debt limit, and implementing flexible debt quota allocations to curb debt limits for excessively indebted governments. Second, the reason local governments engage in debt competition is the current promotion scheme. Under the official promotion scheme, government officials are promoted and rewarded for their performance in economic (e.g., GDP) and infrastructure development. The improvement in such performance often requires debt financing, resulting in debt competition and unreasonable debt issuance. Therefore, policymakers are suggested to adjust the official promotion scheme and select other indicators (e.g., medical benefit or environmental quality) to evaluate the performance of officials.

The authors acknowledge that this study has limitations. First, the study only explores the spatial interaction of China's local government debt; the findings, therefore, are only applicable to the specific institutional context of China. Whether the findings can be generalised to other countries, especially developing countries, is uncertain. Second, although the literature suggests three mechanisms of debt competition (yardstick competition, fiscal competition, and spillover effect), this study only tests fiscal competition due to the lack of a valid theoretical model. Whether other mechanisms also contribute to the spatial interaction of local government debt levels is unclear.

The research can be continued in the following directions. Future research can assess the impact of the practical approaches mentioned above on spatial debt interaction and their effectiveness in limiting excessive local government debt growth. In addition, since debt competition is argued as a driving force of increasing debt risks, it is suggested to

conduct a quantitative investigation to measure the effect of spatial interaction of local government debt on their debt risks in future studies. In addition, future research can explore valid models to test the effects of yardstick competition and spillover effect on debt competition, providing a deeper understanding of the mechanisms influencing local government debt levels.

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