



Article Land Finance, Real Estate Market, and Local Government Debt Risk: Evidence from China

Mengkai Chen ^{1,2}, Ting Chen ¹, Debao Ruan ¹ and Xiaowei Wang ^{3,*}

- ¹ School of Management Science and Engineering, Anhui University of Technology, Ma'anshan 243000, China; chenmk@ahut.edu.cn (M.C.); plutoyn@163.com (T.C.); ruandebao@126.com (D.R.)
- ² Key Laboratory of Multidisciplinary Management and Control of Complex Systems of Anhui Higher Education Institutes, Anhui University of Technology, Ma'anshan 243000, China
- ³ Department of Building and Real Estate, The Hong Kong Polytechnic University, Hong Kong 999077, China
- * Correspondence: xiaowwang@polyu.edu.hk

Abstract: The financing function of land in China has been extensively documented, but little research has explored the role of land finance in the real estate market affecting local government debt. In light of the recent simultaneous increase in China's real estate market risk and local government debt risk over the past two years, a pressing need to reevaluate the significance of land finance has arisen. Thus, this study explores the role of land finance in the relationship between the real estate market and local debt risk. The data were collected from 224 Chinese cities from 2010 to 2019. The study found that real estate market prosperity significantly promotes the expansion of local government debt. Land finance acts as a mediator and a moderator in this relationship. The study also found that during periods of real estate market booms, local governments tend to sell more land, which reinforces their debt-raising behavior and exacerbates the impact of the real estate market on local government debt, but the government debt repayment risk increases significantly. Furthermore, the amplifying effect of land finance is more pronounced in economically developed regions and cities with higher public budget revenues.

Keywords: land finance; real estate market; local government debt; debt repayment risk; China

1. Introduction

Addressing real estate risks has emerged as a critical global concern [1–3]. As the world's largest developing economy, China's real estate market has experienced unparalleled growth over the past three decades and has become a pivotal pillar of economic development [4]. However, in recent years, the Chinese real estate market has encountered a significant downturn. In 2022, commercial housing sales in China were worth CNY 13.33 trillion, reflecting a substantial year-on-year decline of 26.7%. This downturn presents a considerable challenge to the Chinese economy.

Along with real estate risks, local government debts have also increased. As of 2022, China's local debt balance is projected to reach CNY 35 trillion, which is 3.5 times higher than the amount in 2010. Especially for Chengtou bonds, the maturity scale is expected to reach CNY 5.7 trillion in 2023, a year-on-year increase of 52% ¹. Chengtou bond, an urban construction development bond, is one of several forms of financing infrastructure in China, falling under the broad category of local government or subsovereign debt compared to sovereign debt, such as centrally issued Chinese government bonds. The development of Chengtou bonds can be traced back to 1994, when China implemented tax-sharing system reform and reduced the financial resources available to local governments. However, the responsibility of local governments for economic development has remained unchanged [5]. With limited fiscal revenue, local governments have turned to borrowing for construction investments as a vital option to drive economic



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Copyright: © 2023 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https:// creativecommons.org/licenses/by/ 4.0/). growth. This trend became even more pronounced after the 2008 financial crisis, when the central government implemented a CNY 4 trillion economic stimulus plan, which placed a substantial burden on local governments to secure matching funds. In this context, local governments have increasingly relied on government credit as collateral to finance their projects through financing platforms [5]. Among them, Chengtou bonds have emerged as the most significant channel. Specifically, Chengtou bonds are officially issued by local government financing vehicles (LGFVs) with land-use rights as collateral to finance urban infrastructure construction [6]. While government debt provides a source of funding for urban construction, it also brings forth debt risks that cannot be overlooked.

The real estate market fluctuations will give rise to a spill-over effect on local government debt risks, which is an essential concern for the Chinese government in terms of systemic risk prevention. One perspective suggests that a thriving real estate market can enhance government revenue through taxes related to real estate transactions. This would result in more funds being available for local governments to invest in infrastructure. Assuming infrastructure spending remains unchanged, this could reduce the financing needs of local governments and consequently decrease local debt [7]. However, other studies indicate that increases in house prices can lead to a significant rise in government debt levels [8]. Housing price fluctuations can impact the cost of local government debt. When housing prices become unstable, lenders tend to raise lending rates to mitigate risks, thereby increasing the risk associated with local government debt [9–11].

Land plays a crucial role in China's real estate market. China's unique land finance system began after the tax-sharing reform in 1994. Since local governments hold a monopoly supply right in the primary land market, selling land-use rights has emerged as a significant avenue for local governments to generate fiscal revenue directly. In the past decades, more than 40% of local government fiscal revenue is derived from the sale of land-use rights. The act of obtaining financial revenue by selling land-use rights is also known as land finance [12]. In addition to the source of fiscal revenue, land also has a financial function due to the government's guarantee. Local governments can mortgage land to financing platform companies as financing guarantees and repayment sources. Consequently, land revenue not only serves as direct funding for urban infrastructure construction but also incentivizes local governments to issue debt backed by land as collateral for repayment [13].

Although existing studies have proven the importance of land in China's real estate market and highlighted the effect of land finance on local economic development, real estate bubble, and official promotion, investigations of the role of land finance in the real estate market affecting local government debt are still rare. This study suggests that local governments are more inclined to increase their debt levels by leveraging land during a booming real estate market due to the pressure of economic development assessments. Land finance might also accelerate debt issuance during a thriving real estate market due to the financial attribute of land. However, the potential risk associated with this phenomenon is that the solvency of local governments may decline and subsequently exacerbate government debt risks during a downturn in the real estate market.

Following the above analysis, this study empirically examines the role of land finance in the relationship between the real estate market and government debt. First, utilizing a panel fixed-effect model, the study reveals that the boom in the real estate market significantly promotes the expansion of local government debt. Second, employing intermediary and moderating effect models, this study demonstrates that land finance not only has an intermediary effect but also act as an amplifier in the relationship between the real estate market and government debt. Specifically, during a real estate market boom, local governments tend to increase their efforts to sell land, further exacerbating their borrowing behavior and amplifying the impact of the real estate market on government debt. Third, the results of heterogeneity analysis indicate that the effect of a real estate market boom on the expansion of local government debt is more pronounced in cities with higher public budget revenue and economically developed regions. More importantly, the research findings using a multi-period DID model suggest that government borrowing behavior decreases during the market downturn. However, there is a significant increase in the government's debt repayment risk, underscoring the fact that the government's reliance on the real estate market, particularly land, heightens its debt risk. Finally, we also discuss how macroeconomic trends affect the relationship between real estate market and local government debt.

This study introduces several notable innovations. First, we empirically test the role of land finance in the real estate market affecting local government debt, which broadens the knowledge of existing studies that highlighted the effect of land finance on local economic development [9] and official promotion [14]. The findings contribute to our understanding of the inner reason of local governments' excessive borrowing behavior during real estate market booms. Second, this study not only demonstrates that the real estate market presents substantial hidden risks to the expansion of government debt but also highlights the interconnected influence between these two significant risk factors. The results of this study broaden the previous studies that have predominantly focused on risks arising from fluctuations in the real estate market, such as deficit risk [15], financial risk [16], and corporate risk [17]. Third, the findings of this study provide insights into the factors contributing to the current downturn in China's real estate market and the increased risks associated with local government debt repayment. They are of great significance for effectively preventing real estate risks and local debt risks in China.

The subsequent sections of this paper are as follows. Section 2 provides the institutional background and literature review. Section 3 introduces the research design. Section 4 analyzes the empirical results. Sections 5 and 6 provide extended analysis, and Section 7 highlights the conclusion and policy implications.

2. Institutional Background and Literature Review

2.1. Local Government Debt and Chengtou Bonds

The tax-sharing reform introduced in 1994 is considered to be an node in the increase in local government debt [18]. Before 1994, China adopted a financial management model under which the central government and local governments distributed income according to a certain proportion, resulting in insufficient fiscal revenue for the central government [19]. In 1994, the reform of the tax-sharing system in China redefined the financial power relationship between the central and local governments, leading to a trend in fiscal decentralization characterized by the devolution of administrative powers and an upward transfer of financial powers. This reform granted local governments increased economic freedom, but it also resulted in significant financial pressure on them as the central government retained control over relevant fiscal revenues. Additionally, the central government imposed strict regulations prohibiting local governments from issuing local government bonds and limited their access to loans from commercial banks. This mismatch between administrative power and financial power compelled local governments to seek balance through means such as direct budget transfers from the central government or by generating additional income through land transfers and other channels [20]. Furthermore, as economic development serves as a primary indicator of officials' performance evaluation, local governments are compelled to explore alternative avenues for financing urban construction to achieve rapid economic growth [21].

In this scenario, local governments have resorted to raising funds by establishing Chengtou companies [22]. These companies serve as financing platforms dedicated to securing funding and can apply for bank loans and issue corporate bonds. Unlike bonds issued by regular enterprises, the bonds issued by Chengtou companies are primarily utilized for urban construction purposes and are commonly referred to as Chengtou bonds. Following the global financial crisis in 2008, the Chinese government implemented a fiscal stimulus plan amounting to CNY 4 trillion. However, only CNY 1.18 trillion was provided directly by the central government, while the remainder had to be shouldered by local governments [23]. This situation has significantly expanded China's Chengtou bonds, with over CNY 160 billion issued in 2009 alone.

Chengtou bonds issued through financing platforms have effectively addressed the financing needs of local governments, alleviating their financial pressures and playing a vital role in promoting China's infrastructure development and economic growth [24]. However, it is crucial to carefully consider the credit risk associated with these bonds and the potential hidden risks of local government debt. Studies have highlighted that excessive government debt can hinder capital accumulation, productivity improvement, and sustained economic growth [25]. The presence of soft budget constraints further contributes to the expansion of government debt. Local governments often perceive the central government as the ultimate backstop for their debts, while financing platform companies may rely on local government finances to cover their own debt obligations, further incentivizing bond issuance [26,27]. Additionally, the performance appraisal system for local officials is considered a significant factor in the growing debt risk [28]. Typically, local government debt spans the tenure of multiple officials. Due to the fact that the central government's assessment of local officials mainly depends on GDP, local officials have a strong incentive to borrow money for economic development to enhance their performance [14]. This kind of GDP competition may lead to severe debt problems [29].

2.2. Land Finance, Real Estate Market and Local Government Debt Risk

As a pillar industry of the Chinese economy, the relationship between the real estate market and local government debt has attracted widespread attention. Some studies suggested that the rapid increase in housing prices contributes to the expansion of local government debt [8,30]. Wang and Zhang [11] found a significant positive correlation between various real estate variables in China and Chengtou bonds, indicating that a thriving real estate market stimulates the issuance of Chengtou bonds. Fluctuations in house prices can lead to higher borrowing rates, thereby increasing the risk of government debt [31]. Furthermore, there is an intertwined effect between the real estate market and the risk of local government debt. Specifically, rising house prices stimulate local government debt issuance, while the widening debt gap has the reverse effect of reinforcing local governments' incentives to maintain a booming real estate market [32]. Local governments heavily borrow for infrastructure investment, which may also elevate the risk of rapid increases in urban house prices [33]. Therefore, we propose the first research hypothesis as follows:

H1: The boom of real estate market has a positive effect on local government debt.

However, previous studies mainly focus on the relationship between the real estate market and local government debt; very few studies have directly explored the specific mechanism of how real estate market affects local government debt, especially for land, which is a unique asset of local governments and has a strong connection to the development of the real estate market. Since local governments possess land-use rights, selling the use rights of lands has become a crucial means for local governments to generate direct fiscal revenue [34,35]. In recent decades, more than 40% of local government fiscal revenue has been derived from the sale of land-use rights [36]. Previous studies highlighted that overreliance on land finance may led to land misallocation and social unrest. Some scholars also criticized that China's unique land finance causes housing bubbles, which stimulate the real estate market and further push up property prices [37,38]. Therefore, local governments could use the money from selling land-use rights to repay government debt [39].Mo [40] found that the higher proportion of land transfer revenue to total fiscal revenue can bring about a lower debt cost. In addition, studies have shown that land values increase significantly during real estate market booms, which can stimulate the willingness of local governments to sell land [41]. In this case, a booming real estate market always could further raise the government's expectations of future solvency, thereby stimulating the issuance of Chengtou bonds [42].

Since the fiscal expenditure of local governments often depends on the fiscal revenue, certain studies argue that a thriving real estate market can increase local governments' fiscal revenue, potentially reducing their need for financing and decreasing the issuance

of Chengtou bonds [7,42]. However, we argue that the nature of the relationship between the real estate market and land finance largely depends on the specific requirements of local urban construction funds. In China, one of the key bases for the promotion of local government officials is GDP growth [43], which leads to government officials having sufficient incentives to develop the economy. As a result, local governments increase land supply to obtain funds for debt servicing during periods of real estate market boom [44]. Therefore, we propose the second research hypothesis as follows:

H2: Land finance serves as the channel through which local government debt is expansed during the real estate boom.

In addition to discussions of land finance, which serves as a source of local government' direct fiscal revenue, the financing attribute of land has also attracted scholars' attention. Due to the government guarantee, land is also considered high-quality collateral that has a leverage effect when local governments issue debts [45]. This gives rise to the fundamental model of local governments repaying debts with land mortgages, effectively endowing land with financing attributes [13,43]. Especially during a booming real estate market, the appreciation of land value as collateral enhances the credit worthiness of financing platforms, enabling local governments to have stronger financing capabilities [46,47]. Therefore, we suggest that the borrowing behavior of local governments may be highly dependent on the real estate market mainly because of the financing attribute of land. Specifically, land finance may further amplify the debt issuance of local governments during a booming real estate market. We propose the third research hypothesis as follows:

H3: *Land finance acts as an amplifier of real estate market boom and promotes local government debt issuance.*

A natural question is, what would happen if real estate market cooling down? According to the above hypotheses, local government debt is highly related to the real estate market through land finance. Since the cooling down real estate market results in a decrease in land value, local governments may face challenges in repaying their debts. In this case, local government fiscal revenue may not be sufficient to serve as a reliable source for repaying large-scale borrowing that occurs during the real estate market boom. This, in turn, can intensify the debt repayment pressure on local governments and exacerbate the debt risks of local governments. Therefore, we also propose an additional hypothesis, H4. If this assumption holds true, it can not only serve as a robustness test for the above hypotheses, but also explain the simultaneous increase in the current downturn of China's real estate market and the rising risks associated with local government debt repayment.

H4: The government's debt repayment risk would increase given a downturn in the real estate market.

3. Methodology

3.1. Description of Variables and Descriptive Statistics

This study employs Chengtou bonds as a metric for measuring local government debt [48], with data sourced from the WIND database. The WIND database encompasses financial data from global markets, encompassing securities, futures, foreign exchange, funds, bonds, macroeconomics, and other related fields. It is widely utilized in economic research. Our sample period spans from 2010 to 2019. First, there is a significant amount of missing data on Chengtou bonds after 2020. Second, we stop the sample in 2019 to avoid overlapping with the COVID-19 pandemic, which had major effects on global capital markets and global policy responses [49]. The primary independent variable is the prosperity of the real estate market, which is quantified by the sales area of commercial housing in cities. This variable provides a more tangible reflection of real estate market fluctuations compared to housing prices [9]. Land finance is measured by the city's land income through selling land-use rights for the given year. After eliminating outliers and blank values, the sample for this study comprises 224 cities, including cities where the issuing entity is a municipality.

This study incorporates control variables such as urban economy, population, and industrial structure to enhance the accuracy of estimating the influence of the real estate market on government debt [20]. The data are collected from the China Land and Resources Yearbook, prefecture-level city Statistical Yearbook, and WIND database. All data are logarithmically transformed to eliminate heteroscedasticity.

Table 1 shows variable definitions and descriptive statistics.

Table 1. Descriptive statistics of the variables.

Variables	Quantitative Index	Obs	Mean	Std. Dev.	Min	Max
Local government debt	Chengtou bonds	2240	3.901	1.839	0	8.456
Real estate market	Commercial housing sales area	2240	5.896	0.909	1.275	8.812
Land finance	Land sale revenue	2240	13.45	1.331	6.77	17.157
Economic growth	Per GDP	2240	55.101	14.835	22.28	100
Capital input	Fixed investments/GDP	2240	5.925	0.813	2.277	7.923
Regional total population	Regional total population	2240	10.975	0.571	9.076	13.885
Industrial structure	Tertiary industry production value/GDP	2240	6.031	0.634	3.784	8.067
Urbanization rate	Urban population/total population	2240	46.48	11.102	14.01	82
Population density	Population density	2240	0.052	0.149	0.002	1.25
Local government competition	General public budget expenditure/GDP	2240	0.164	0.098	0.011	2.702

3.2. Model Development

First, we build a fixed-effect model to test the impact of the real estate market and local government debt. The baseline regression model is as follows:

$$debt_{i,t} = \alpha_1 + \alpha_2 sale_{i,t} + \sum \alpha_i Control_{i,t} + \mu_i + \mu_t + \varepsilon_{i,t}$$
(1)

where *i* and *t* represent city and year, respectively. *debt*_{*i*,*t*} represents the local government debt, while *sale*_{*i*,*t*} represents the real estate market. *Control*_{*i*,*t*} represents control variables. μ_i and μ_t represent city and year fixed effects, respectively. $\varepsilon_{i,t}$ is random error term. The significantly positive of α_2 suggests a positive correlation between the real estate market and local government debt.

Second, as the hypotheses proposed above, we suggest that land finance not only serves as the channel through which local government debt expansion during the real estate boom, but also act as an amplifier of the real estate market boom, promoting local government debt issuance. Therefore, we construct the moderated mediation model as follows:

$$lf_{i,t} = \beta_1 + \beta_2 sale_{i,t} + \sum \beta_i Control_{i,t} + \mu_i + \mu_t + \varepsilon_{i,t}$$
⁽²⁾

$$debt_{i,t} = \gamma_1 + \gamma_2 lf_{i,t} + \sum \gamma_i Control_{i,t} + \mu_i + \mu_t + \varepsilon_{i,t}$$
(3)

$$debt_{i,t} = \phi_1 + \phi_2 lf_{i,t} + \phi_3 sale_{i,t} + \sum \phi_i Control_{i,t} + \mu_i + \mu_t + \varepsilon_{i,t}$$
(4)

$$debt_{i,t} = \phi_4 + \phi_5 lf_{i,t} + \phi_6 sale_{i,t} + \phi_7 sale \times lf_{i,t} + \sum \phi_i Control_{i,t} + \mu_i + \mu_t + \varepsilon_{i,t}$$
(5)

where $lf_{i,t}$ refers to land finance. If γ_2 , ϕ_2 , and ϕ_3 are all positive and significant, the real estate market affects local government debt through the intermediary effect of land finance. In Equation (5), if ϕ_7 is positive and significant, we can conclude that land finance has a moderating effect on the influence of the real estate market on local government debt.

4. Empirical Results

4.1. Basic Results

The results of the influence of the real estate market on local government debt are shown in Table 2 and column (1), displays the results of Equation (1). The coefficient of the sales area of commercial housing is 0.422, p < 0.01, which means that local governments are more likely to issue Chengtou bonds as the sales area of commercial housing increases. The result in column (2) shows that the coefficient of land finance is 0.125, p < 0.01, which means that land finance income can significantly stimulate the expansion of government debt. The result in column (3) displays that the coefficient of the sales area of commercial housing is 0.385, p < 0.01, which means that the sales area of commercial housing positively impacts the land market. There may be two reasons for this result. The first reason is that intensified competition among real estate companies during the boom period of the real estate market will lead to an increase in land prices. The other is that local governments tend to increase land supply during the real estate market boom, increasing land income. The results in column (4) show that the coefficient of land finance is 0.0851, p < 0.01, indicating that land acts as a mediating variable. Specifically, the real estate market boom will increase the government's land incomes, thereby stimulating the expansion of government debt. Column (5) highlights the moderating role of land finance. The results indicate that the coefficient of the interaction term between land finance and the real estate market is 0.0378, p < 0.01. This suggests that land finance not only serves as a mediator, but also has an amplifying effect. To elaborate, during a period of real estate market boom, the increase in land finance contributed to the expansion of government debt.

Variables	(1) Local Government Debt	(2) Local Government Debt	(3) Land Finance	(4) Local Government Debt	(5) Local Government Debt
Real estate market	0.422 ***		0.385 ***	0.390 ***	0.407 ***
	(0.0518)		(0.0428)	(0.0527)	(0.0534)
Land finance		0.125 ***		0.0851 ***	0.0811 ***
		(0.0268)		(0.0270)	(0.0271)
Real estate market $ imes$ land finance					0.0378 **
					(0.0190)
Urbanization rate	0.0145 **	0.0221 ***	-0.018 ***	0.0161 ***	0.0169 ***
	(0.00615)	(0.00618)	(0.00508)	(0.00615)	(0.00616)
Population density	-0.299	-0.481	1.803 ***	-0.452	-0.485
	(0.436)	(0.443)	(0.360)	(0.437)	(0.437)
Economic growth	0.252 ***	0.451 ***	0.214 ***	0.234 **	0.250 ***
	(0.0960)	(0.0926)	(0.0793)	(0.0959)	(0.0962)
Regional total population	0.418	0.797 **	-0.343	0.447	0.400
	(0.329)	(0.330)	(0.272)	(0.329)	(0.329)
Industrial structure	0.00254	0.00256	0.274	0.00322	-0.621 **
	(0.00421)	(0.00426)	(0.221)	(0.00420)	(0.267)
Capital input	-0.586 **	-0.515 *	-0.008 **	-0.609 **	0.00309
	(0.268)	(0.270)	(0.00348)	(0.267)	(0.00420)
Local government competition	-0.483 **	-0.551 **	-0.0503	-0.479 **	-0.488 **
	(0.214)	(0.216)	(0.177)	(0.213)	(0.213)
Constant	-5.175 **	-8.414 ***	3.051	-5.435 **	-5.268 **
	(2.544)	(2.541)	(2.102)	(2.540)	(2.539)
Year	Control	Control	Control	Control	Control
City	Control	Control	Control	Control	Control
Observations	2240	2240	2240	2240	2240

Table 2. Baseline results.

*** p < 0.01, ** p < 0.05, * p < 0.1.

The above empirical results verify the conjecture of this study and reveal the reasons for the increase in government debt during the boom period of the real estate market. On the one hand, a thriving real estate market results in higher real estate taxes and land revenues, thereby boosting the government's confidence in debt repayment and prompting increased debt. On the other hand, the financial aspect of land enables local governments to issue bonds, amplifying the bond issuance behavior as a result of land finance.

4.2. Robustness Test

We control for possible confounding factors and find that the results are still robust. The results are shown in Table 3.

	(1)	(2)	(3)	(4)
Variables	Local Government Debt	Local Government Debt	Local Government Debt	Local Government Debt
Real estate market	0 385 ***	0 305 ***		0 390 ***
Real estate market	(0.0573)	(0.0608)		(0.0528)
Land finance	0.140 ***	(0.0000)	0.121 ***	0.0851 ***
	(0.0336)		(0.0271)	(0.0270)
Land finance (through bidding, auction, and listing)		0.266 ***		
udenon, and noting)		(0.0435)		
Undue Chengtou bonds			0.000160	
C C			(0.000153)	
High growth pressure				0.000133
				(0.00296)
Control variables	Control	Control	Control	Control
Constant	-3.989	-15.66 ***	-8.049 ***	-5.426 **
	(2.892)	(1.113)	(2.565)	(2.548)
Year	Control	Control	Control	Control
City	Control	Control	Control	Control
Observations	1890	2240	2240	2240

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Table 3. Robustness test.
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*** p < 0.01, ** p < 0.05.

First, the study excludes some provincial capital cities. A provincial capital city is often the political and economic center, which undertakes the task of driving the development of other cities in the province. Therefore, the bonds issued by some provincial capital cities are sometimes not limited to internal use within the city, which may affect our identification of the impact of the housing market on government debt. We deleted the provincial capital cities, and the regression results are shown in column (1) of Table 3. We find that the prosperity of the real estate market also promotes the expansion of government debt.

Second, the study replaces the land finance variable. Since the reform of the land-use system in China, land, as a special commodity, has gradually transitioned from being accessible for an unlimited period to being paid for a limited period. In China, the ways of selling land-use rights by local governments mainly include bidding, auction, listing, and agreement transfer. The first three methods are mainly for the supply of residential land, and the latter is mainly for industrial land. To eliminate the influence of different land supply methods on the result of regression, we replace the total land income in the baseline regression with the land income obtained through bidding, auction, and listing. The results shown in column (2) of Table 3 support the robustness.

Third, the study controls for the undue Chengtou bonds. One of the motivations for local government financing may be to repay existing debts. Following the research of Zhang et al. [44], we calculate the undue Chengtou bonds in each city and add it as an additional control variable to the model. We find that the coefficient of undue Chengtou bonds is not significant, and the coefficient of land finance is still positively significant with little change. The above results show in column (3) of Table 3 that the debt repayment

pressure faced by local governments does not affect the promotion effect of land finance on debt issuance.

Fourth, the study controls for the pressure of urban economic growth. Economic growth is one of the central government's main assessment indicators for local governments. Cities with higher growth pressures are more likely to issue debt to develop their economies. Although we control for the fixed effects of cities and years in the model, it is still difficult to separate the influence of economic development motivation on Chengtou bond issuance. Therefore, referring to the practice of Yang and Yang [50], we define a dummy variable of economic growth pressure. We define economic growth pressure as 1 if a city's GDP growth rate in the current year is less than that in the previous year; otherwise, it is 0. We control for the dummy variable of economic growth pressure in the model, and the results are shown in column (4) of Table 3. We find that the coefficient of economic growth pressure is not significant. This indicates that local governments, regardless of whether they are under economic growth pressure, are willing to increase debt issuance during a real estate market boom.

4.3. Heterogeneity Test

The above regression results provide evidence that the real estate market positively affects local government debt. As discussed above, Chengtou bonds issued by local governments are mainly used for infrastructure investment to develop the economy, while the development of the regional economy symbolizes the local government's ability to repay and issue debt [51]. One may wonder what kind of cities will rely more on this model and how to specifically prevent the corresponding risks. In this study, we conduct heterogeneity tests in two aspects. First, we divide the sample into five categories according to city economic development level, namely first-tier, second-tier, third-tier, fourth-tier and fifth-tier cities. The grouping criteria is from First Financial Weekly in China, and first-tier cities are highly developed. Second, since the issuance of Chengtou bonds is related to the government's income level, we divide the sample into two groups according to the urban general public budgeting income. We define cities with higher than median urban general public budgeting revenue as the high-income group and vice versa. In general, cities with higher general public budgeting revenue are economically developed; the regressions of the above two aspects can therefore mutually verify the robustness of heterogeneity. The results are presented in Table 4.

		Local General Public Budget Revenue					
	Tier-1 City	Tier-2 City	High Income	Low Income			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	Local Government Debt	Local Government Debt	Local Government Debt	Local Government Debt	Local Government Debt	Local Government Debt	Local Government Debt
Real estate market	1.377 ***	0.741 ***	0.422 ***	0.389 ***	0.231 **	0.411 ***	0.309 ***
	(0.203)	(0.194)	(0.122)	(0.116)	(0.0962)	(0.0895)	(0.0857)
Land finance	0.260 ***	0.296 **	0.256 ***	0.0439	0.0408	0.243 ***	0.0187
	(0.0861)	(0.138)	(0.0656)	(0.0596)	(0.0562)	(0.0501)	(0.0458)
Control variables	Control	Control	Control	Control	Control	Control	Control
Constant	-34.77 ***	-30.69 ***	-21.16 ***	-19.94 ***	-12.05 ***	-14.12 ***	-13.28 ***
Year	Control	Control	Control	Control	Control	Control	Control
City	Control	Control	Control	Control	Control	Control	Control
Observations	190	300	650	680	420	1120	1120

Table 4. Heterogeneity test.

*** p < 0.01, ** p < 0.05.

As shown in columns (1)–(5), we find that the impact of the real estate market on Chengtou bonds issuance increases with the level of urban economic development, and the coefficient of real estate sales area is 1.377, p < 0.01 in first-tier cities, but only 0.231, p < 0.01 in fifth-tier cities. In addition, the effects of land finance on Chengtou debt issuance are insignificant among fourth and fifth-tier cities with less economic development. The results in columns (6)–(7) suggest that the impact of real estate market boom on Chengtou bonds issuance is more significant in high-income cities, and the coefficient is 0.411. Although the coefficient of the real estate market is significant in both the high- and low-income groups, the sensitivity of government debt issuance to the real estate market is higher in the high-income group. Moreover, the effect of land finance on debt issuance is not significant in the low-income group. This is similar to the results of grouping regression by level of economic development.

The above results suggest that cities with higher economic development and more public budget revenue are more inclined to expand debt issuance through land finance during the real estate boom. A possible reason for this is that economically developed cities are generally accompanied by a booming real estate market, resulting in higher land values. Since land income can be used as a source of debt service, and land can also be used as collateral for government debt issuance, high-value land further amplifies government debt issuance.

4.4. Endogeneity Test

The relationship between the real estate market and local government debt may be endogenous. Chengtou bonds supplement the infrastructure construction funds of local governments and promote the economic development of cities. Meanwhile, the improvement of urban infrastructure construction helps to enhance the attraction of the population, thus promoting the prosperity of the real estate market [33]. In order to avoid the estimation bias caused by the endogeneity problem, we adopt the system-generalized method of moments (SYS-GMM) for empirical testing.

When variables in the model are endogenous, the ordinary panel regression results are biased, while the dynamic panel model can eliminate the endogenous bias of the model and obtain a more effective estimate. The dynamic panel model needs to introduce the lag term of the explanatory variable into the regression model as an explanatory variable to make the model have dynamic explanatory capabilities. SYS-GMM is suitable for not knowing whether there are endogenous variables, but it can also solve the problem of potential endogenous variables. In this study, we construct a SYS-GMM model as follows:

$$lf_{i,t} = \theta_1 + \theta_2 lf_{i,t-1} + \theta_3 sale_{i,t} + \sum \theta_i Control_{i,t} + \mu_i + \mu_t + \varepsilon_{i,t}$$
(6)

$$debt_{i,t} = \vartheta_1 + \vartheta_2 debt_{i,t-1} + \vartheta_3 lf_{i,t} + \vartheta_4 sale_{i,t} + \sum \vartheta_i Control_{i,t} + \mu_i + \mu_t + \varepsilon_{i,t}$$
(7)

The results of SYS-GMM are presented in Table 5. The *p*-value for the AR (1) test is less than 0.05, while the *p*-value for the AR (2) test is greater than 0.05. This implies that there is autocorrelation in the first-order difference of the disturbance term, but no autocorrelation exists in the second-order difference sequence, suggesting that the instrumental variable is exogenous. The results of the instrumental variable correlation tests demonstrate the exogeneity and effectiveness of the instrumental variables. The findings consistently show a significant positive impact of the real estate market on local government debt. Specifically, as the sales area of commercial housing increases, there is a greater likelihood of local governments issuing bonds. This indicates that the prosperity of the real estate market plays a role in promoting the issuance of Chengtou bonds. Moreover, this effect is mediated through the intermediary impact of land finance. During the boom period of the real estate market, land finance further exacerbates the government debt.

	(1)	(2)
Variables	Land Finance	Local Government Debt
L. local government debt		0.729 ***
		(0.0339)
L. land finance	0.650 ***	
	(0.0284)	
Land finance		0.0987 *
		(0.0541)
Real estate market	0.143 ***	0.0506 **
	(0.0422)	(0.0249)
AR (1)	0.000	0.000
AR (2)	0.066	0.588
Hansen	0.956	0.953
Control variables	Control	Control
Constant	-1.110	-2.447 ***
	(0.708)	(0.790)
Year	Control	Control
City	Control	Control
Observations	2016	2016

Table 5. Endogeneity test.

*** p < 0.01, ** p < 0.05, * p < 0.1.

5. Real Estate Market Downturn and Local Government Debt Repayment Risk

Based on the previous findings, it is evident that a thriving real estate market significantly promotes the issuance of Chengtou bonds. A critical follow-up question is what happens when the real estate market experiences adverse conditions. Specifically, why does the local government's debt repayment risk significantly increase during a severe downturn in China's real estate market? To investigate the impact of a sluggish real estate market on the scale of local government debt, we utilize the housing purchase restriction policy as a measure. We focus on examining the changes in the solvency of local governments when the market faces a downturn. This analysis provides a robustness test for the conclusions above from an alternative perspective.

The housing purchase restriction policy serves as a tool to control the qualifications and quantity of commercial housing purchases. It was initially introduced in 2010 during a period of a booming real estate market and has since become a crucial measure for regulating the real estate market in many cities. The policy is widely recognized as an effective tool to mitigate the overheating of the real estate market [52]. This provides us with an important opportunity to examine the relationship between a downturn in the real estate market and the risk of local government debt repayment. In our sample period, 65 cities implemented purchase restriction policies. Since these policies were introduced at different times in each city, we employed a multi-period difference-in-difference (DID) model for empirical testing. The constructed model is as follows:

$$sale_{i,t} = \partial_0 + \partial_1 D_{i,t} + \sum \theta_i Control_{i,t} + \mu_i + \mu_t + \varepsilon_{i,t}$$
(8)

$$lf_{i,t} = \partial_2 + \partial_3 D_{i,t} + \sum \theta_i Control_{i,t} + \mu_i + \mu_t + \varepsilon_{i,t}$$
(9)

$$DEBT_{i,t-1} = \partial_4 + \partial_5 D_{i,t} + \sum \theta_i Control_{i,t} + \mu_i + \mu_t + \varepsilon_{i,t}$$
(10)

$$debt \ ratio_{i,t} = \partial_6 + \partial_7 D_{i,t} + \sum \theta_i Control_{i,t} + \mu_i + \mu_t + \varepsilon_{i,t}$$
(11)

where $DEBT_{i,t-1}$ represents local government debt with a lag of one period. Considering that the Chengtou bonds have a lagging effect, we use local government debt with a lag of one period in our calculations. We adopt the *debt ratio*_{i,t} as a measure of the local government's debt repayment risk. The debt ratio is calculated as the debt balance at the

end of the year divided by the comprehensive financial resources of the year. This ratio provides an indication of the overall solvency of a government. A decrease in the debt ratio signifies a higher debt-paying capacity of the government, while an increase in the debt ratio indicates a lower debt-paying capacity of the government. $D_{i,t}$ represents the interaction between the policy dummy variable (P) and the time dummy variable (T), that is, $D_{i,t} = P \times T$. μ_t is the year fixed effect and μ_i is the city fixed effect, which excludes the impact of time trends or policy changes, as this can be confused with the impact of housing purchase restrictions.

The results from column (1) to column (3) in Table 6 demonstrate that the implementation of real estate purchase restriction policies effectively reduces the transaction volume in the real estate market and decreases the finance income received by local governments. Meanwhile, the purchase restriction policy has also reduced the issuance of Chengtou bonds, indicating that the pre-cooling of the real estate market will significantly inhibit the expansion of local government debt. More importantly, the coefficient of the purchase restriction policy in column (4) on the debt service risk of local governments is significantly positive, indicating that the impact of the purchase restriction policy will significantly increase the debt ratio of local governments. This means that the debt repayment risk of local governments will increase significantly when the real estate market goes down. This finding supports the hypothesis of this study.

Tal	ble	6.	Regression resul	ts.
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	(1) (2)		(3)	(4)	(5)
Variables	Real Estate Market	Land Finance	Local Government Debt	Debt Ratio	Local Government Debt
$P \times T$	-0.158 ***	-0.277 ***	-0.139 *	21.29 *	-0.120
	(0.0296)	(0.0579)	(0.0764)	(11.64)	(0.0768)
Land finance					0.0646 **
					(0.0288)
Control variables	Control	Control	Control	Control	Control
Constant	-8.220 ***	-0.911	-7.099 ***	-666.2 ***	-7.209 ***
Year	Control	Control	Control	Control	Control
City	Control	Control	Control	Control	Control
Observations	2240	2240	2240	2240	2240
R ²	0.395	0.251	0.467	0.406	0.699

*** p < 0.01, ** p < 0.05, * p < 0.1.

The assumption of using the purchase restriction impact to identify the impact of the real estate market on local debt is that the purchase restriction policy has no other impact on the local debt except land finance. This assumption is theoretically untestable. Therefore, to further test the robustness of the above results, we make some rough judgments by adding land finance into Equation (10). If the purchase restriction policy is no longer significant after land finance is added, other channels of the impact of purchase restriction on local debt can be excluded to a certain extent. When we add purchase restriction and land finance in column (5) of Table 6, we found that the impact of purchase restriction is no longer significant, while the impact of land finance is still significant, and the coefficient is not much different from that in the basic regression.

To overcome endogeneity concerns, we further estimate parametric bounds to omitted correlated variables following the methodology proposed by Oster [53] and Dantas et al. [54]. As Oster [53] proposed, when there may be unobservable missing variables in the model, the estimator $\beta^* = \beta^*(R_{max}, \delta)$ can be used to obtain a consistent estimate of the true coefficient. This estimator requires setting two parameters: δ and R_{max} , where δ is the degree of proportionality between selection on unobservable and selection on observables. We assume that the unobserved variable has at least the same effect on the explained variable as the observed variable (including fixed effects) (i.e., $\delta = 1$), which entails making

an assumption about the maximum possible R^2 of the regression. We follow the calibration proposed by Oster [53], which sets $R^2_{max} = \min(1, \Pi * \tilde{R}^2)$ and $\Pi = 1.3$ as the benchmark. We also consider the conservative value of $\Pi = 2.0$ for robustness purposes. The bounding value of the DID estimate (β^*) is defined as $\beta^* = \tilde{\beta} - \frac{(\dot{\beta} - \tilde{\beta})(R^2_{max} - \tilde{R}^2)}{\tilde{R}^2 - \dot{R}^2}$, where $\dot{\beta}$ and \dot{R}^2 are the point estimate and R-squared, respectively. $\tilde{\beta}$ and \tilde{R}^2 are the analogue values from the regression with all controls.

The results are shown in Table 7. The Oster bounds interval of models (8)–(11) does not contain 0 and falls within the 95% confidence interval of the estimated parameter. These results meet the robustness standard proposed by Oster [53] and pass the robustness test.

Table 7. Bounds for robustness for proportional selection on unobservable variable.

	Baseline	e Model	All DID	All DID Controls		nax	Bounding Values	
Panel A: DID with real estat	e market							
Outcome DID smoothing coefficient Oster bounds ($\tilde{\beta}, \beta^*$) 95% confidence interval Excludes 0	$\dot{\beta}$ -0.1360	[.] ² 0.3650	\widetilde{eta} -0.1580	\widetilde{R}^2 0.3950 [-0.1627 [-0.2455 Y	$\Pi = 1.3 \\ 0.5135 \\ 7, -0.0129 \\ 7, -0.0800 \\ 7 \\ 6s$	$\Pi = 2.0$ 0.7900	$eta_{\Pi=1.3}^{*} \\ -0.2449$	$eta_{\Pi=2.0}^{*} \ -0.4480$
Panel B: DID with land finar	nce							
Outcome DID smoothing coefficient Oster bounds ($\tilde{\beta}, \beta^*$) 95% confidence interval Excludes 0	β -0.1690	Ŕ ² 0.3610	\widetilde{eta} -0.2770	\widetilde{R}^2 0.2510 [-0.2545 [-0.4281 Y	$\Pi = 1.3$ 0.3263 5, -0.1298] , -0.0809] Kes	$\Pi = 2.0$ 0.5020	$eta_{\Pi=1.3}^{*} \\ -0.0061$	$eta_{\Pi=2.0}^{*} \ -0.1956$
Panel C: DID with local gov	ernment deb	t						
Outcome DID smoothing coefficient Oster bounds ($\tilde{\beta}, \beta^*$) 95% confidence interval Excludes 0	$\dot{\beta}$ -0.385	Ř ² 0.5355	\widetilde{eta} -0.1390	\widetilde{R}^2 0.4673 [-0.4978 [-0.7522	$\Pi = 1.3 \\ 0.6075 \\ 5, -0.3339] \\ 5, -0.2435] \\ \text{(es)}$	$\Pi = 2.0$ 0.9346	$egin{array}{c} eta^{*}_{\Pi=1.3} \ -0.6446 \end{array}$	$eta_{\Pi=2.0}^{*} \ -1.8246$
Panel D: DID with debt ratio)							
Outcome DID smoothing coefficient Oster bounds ($\tilde{\beta}, \beta^*$) 95% confidence interval Excludes 0	β 43.8000	Ŕ ² 0.5470	β̃ 21.2900	\$\tilde{R}^2\$ 0.4060 [107.2019 [50.0461,	Π = 1.3 0.5278 (113.2455] 184.4442] ζes	$\Pi = 2.0$ 0.8120	$eta_{\Pi=1.3}^{*}$ 55.4998	$eta^*_{\Pi=2.0}$ 86.1060

6. Further Discussion: Considering Macroeconomic Trends

China's real estate boom is particularly unique in that it relates to specific economic features of China's development model [55,56]. Moreover, China's real estate bubble possibly coincided with important global economic developments [49]. To account for these confounding macroeconomic trends, in this section, we further discuss how macroeconomic trends affect the relationship between the real estate market and local government debt issuance regarding the following aspects.

The first is monetary expansions. In response to the subprime and Eurozone crises, several central banks of developed nations engaged in massive rounds of quantitative easing [49]. These policies distort international capital flows and reduce the cost of capital in emerging market economies, such as China, leading to credit booms [57] and asset price bubbles that cannot be detected by traditional risk-management techniques [58]. In turn, quantitative easing policies not only may feed real estate bubbles but also affect the price of

Chinese government bonds. In this paper, we choose broad money supply (M2) to reflect China's monetary expansion under the fluctuating external economic environment.

The second is deficits and fiscal multipliers. During financial crises, implicit government guarantees are critically relevant to ensure the stability of the banking sector and capital availability for real estate financing. Because the sample period comprises the subprime and Eurozone crises, increasing deficits and debt-to-GDP ratios due to fiscal stimuli may have weakened implicit guarantees and fiscal multipliers [56,59]. Although these crises have not affected the Chinese market directly, there are several indirect effects given the interconnectedness of the global banking sector [60]. In this study, we adopt fiscal pressure as the proxy variable of fiscal deficit, which can be defined as follows:

deficits = (general public budget expenditure – general public budget revenue)/general public budget revenue

The third is geopolitical uncertainty. The sample period in question is characterized by rising policy uncertainty due to events such as the Brexit referendum and the 2016 US election [61,62]. Such events may have helped generate abnormal capital flows to China given its relative political stability. We chose the 2016 US election as a proxy variable to examine the impact of geopolitical uncertainty. To test the role of the above factors on the relationship between real estate market and local government debt issuance, we conduct the following regression models:

$$debt_{i,t} = \lambda_1 + \lambda_2 sale_{i,t} + \lambda_3 monetary_{i,t} + \lambda_4 sale \times monetary_{i,t} + \sum \lambda_i Control_{i,t} + \mu_i + \mu_t + \varepsilon_{i,t}$$
(12)

$$debt_{i,t} = \lambda_5 + \lambda_6 sale_{i,t} + \lambda_7 deficits_{i,t} + \lambda_8 sale \times deficits_{i,t} + \sum \lambda_i Control_{i,t} + \mu_i + \mu_t + \varepsilon_{i,t}$$
(13)

$$debt_{i,t} = \lambda_9 + \lambda_{10} sale_{i,t} + \lambda_{11} politics_{i,t} + \lambda_{12} sale \times politics_{i,t} + \sum \lambda_i Control_{i,t} + \mu_i + \mu_t + \varepsilon_{i,t}$$
(14)

where *monetary*_{*i*,*t*}, *deficits*_{*i*,*t*}, and *politics*_{*i*,*t*} represent monetary expansions, deficits, and geopolitical uncertainty, respectively. To test the robustness of the above interaction terms, we also conduct grouping regressions.

The results are shown in Table 8. In column (1), the coefficient of the interaction term of real estate market and monetary expansions is 0.423, with significance at a 1% level, suggesting that monetary expansions would exacerbate the positive impact of the real estate market on local government debt. In columns (2)–(3), we divide the full sample into a tightening period and a slack period following the method of Zhao [63]. The results also show that the coefficient of the real estate market is significant only in the slack period.

Column (4) lists the impact of deficits. The coefficient of the interaction term of real estate market and fiscal pressure is -0.994 with significance at a 1% level, suggesting that fiscal pressure negatively moderates the impact of the real estate market on local government debt. We also divide the sample into high-stress and low-stress groups based on the median, and the grouping regression results are shown in columns (5)–(6). We also find that debt issuance in cities with less fiscal stress is more sensitive to the real estate market boom.

Columns (7)–(9) report the potential impact of geopolitical uncertainty. The results of both interactive regression and grouping regression show that geopolitical uncertainty would restrain debt issuance and weaken the dependence of local government debt on real estate.

	Monetary Expansions				Deficits	Geopolitics Uncertainty			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Full Sample	Tightening Period	Slack Period	Full Sample	High Deficits	Low Deficits	Full Sample	Before 2016	After 2016
Real estate market	0.432 ***	-0.326	0.428 ***	0.331 ***	0.387 ***	0.580 **	0.328 ***	0.160 **	-0.0245
Monetary expansions	0.0653 **	0.623 **	(0.0350) (0.202 *** (0.0420)	(0.0011)	(0.0001)	(0.0040)	(0.0000)	(0.0050)	(0.140)
Deficits	(0.020))	(0.2)1)	(0.0120)	-0.209 *** (0.0374)	-0.0978 **	0.672 ***			
Geopolitics uncertainty				(0.007 1)	(0.0000)	(0.172)	0.904 ***		
Real estate market \times monetary expansions	0.0765 ***						(0.232)		
Real estate market \times deficits	(0.0216)			-0.0944 *** (0.0263)					
Real estate market × geopolitics uncertainty							0.246 ***		
Control variables Constant Year City Observations	Control -5.450 ** Control Control 2240	Control -42.16 ** Control Control 448	Control -22.63 *** Control Control 1792	Control -32.01 *** Control Control 2240	Control -22.77 *** Control Control 1120	Control -25.47 *** Control Control 1120	(0.0378) Control 0.53 Control Control 2240	Control 5.653 Control Control 1568	Control -2.622 Control Control 672

Table 8. The impacts of macroeconomic trends.

*** p < 0.01, ** p < 0.05.

7. Conclusions

In recent years, China's local government debt risk and the downturn in the real estate market have caused widespread concerns. Some studies have focused on the spillover effect of real estate market risks on local government debt issuance [64]. However, as the direct source of local government's financial revenue, the role of land finance lacks in-depth discussion. In this paper, we examine the relationship between the real estate market and local government debt and emphasize the mediating and moderating effects of land finance. We first take Chengtou bonds, which are issued by local governments through platform companies, as a proxy variable for local government debt. We then construct panel data from 224 prefecture-level cities spanning from 2010 to 2019 to conduct our empirical study. The main findings can be summarized as follows.

First, we find that a booming real estate market exacerbates the growth of local government debt by employing the fixed-effect model. Second, we find that local governments would increase debt issuance during the real estate market boom by increasing land finance. More importantly, land finance also acts as an amplifier, which positively moderates the impact of the real estate market on local government debt. Third, the influence of a booming real estate market on local government debt is more pronounced in economically developed regions. Finally, we highlight the possible consequences of a downturn in the real estate market. By utilizing the multi-period DID model, we find that although a sluggish real estate market can restrain the expansion of local government debt, it also increases the government's debt repayment risk due to the decline in income associated with the real estate market, leading to simultaneous debt risks. Moreover, we also discuss the potential impacts of macroeconomic trends, such as monetary expansions, deficits, and geopolitical uncertainty.

Different from previous studies of real estate market risk and local government debt, we focus on the role of land finance and explore the mechanism therein. We highlight that land finance has both mediating and moderating effects, which helps us understand the reasons for the increase in local government debt. Importantly, we find that due to the decline in land income and mortgage capacity, the solvency of local governments has severely decreased and led to an increase in debt service risk.

According to the above findings, we propose recommendations to guard against systemic risks. First, we suggest that the central government implement strict regulations on the operations of local financing platforms, including setting clear upper limits on debt scales, restraining the increase in local government debt, and preventing excessive borrowing by local governments. Second, it is important to gradually reduce the reliance of local government's revenue on land. We propose to advance the reform of the real estate tax and land tax systems. Third, we suggest that local governments can try to use healthier and sustainable financial tools to broaden financing channels. For example, local governments could increase the issuance of publicly funded real estate investment trusts (REITs), which have both fixed income attributes and equity financing, to expand the financial sources of local governments. We also emphasize the importance of differentiated regulations based on the type of city. For example, cities with higher economic development and lower fiscal pressure generally have a flourishing housing market and high land values. The central government should strengthen the supervision of these cities and maintain the stability of regulatory policies to the interaction between real estate market risks and government debt risks.

Despite the valuable benefits and contributions of this study, the study has some limitations. Due to insufficient data feasibility, we use Chengtou debt as a representation of local government debt. In fact, there are other sources of local government debt, including bank loans and project financing. Therefore, how to comprehensively evaluate the impact of the real estate market on local government debt risk is still worth exploring.

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Notes

¹ Data sources: wind database, https://www.wind.com.cn/ (accessed on 12 May 2022).

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