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LAND-LEASING BEHAVIOR, LOCAL OFFICIALS' PROMOTIONS, AND CHINESE CITIES' DEBT RISKS

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Abstract. This study first analyzes how local governments' land-leasing behaviors affect Chinese cities' debt risk then examines the impact of officials' promotion mechanisms on debt risk in China's urban land bank system. The land-leasing behavior is reflected through three indicators, namely, land-leasing revenue, land-leasing scale, and land financial dependence level. Two new indicators are constructed to measure the local government' debt risk from the perspective of debt scale and debt repayment: the debt scale risk and debt burden risk. Empirical analyses are based on the data of 281 prefecture-level cities from 2006–2015. The main findings are twofold. First, the debt scale risk is positively affected by the land-leasing revenue, and officials' promotion pressure. The debt burden risk is positively affected by the land financial dependence and officials' promotion pressure. Second, the officials' promotion pressure significantly enhances the positive effect of land-leasing revenue on the debt scale risk. Local officials, who are under promotion pressure, are inclined to expand the size of urban investment bonds, which increases debt scale risk.

Keywords: land leasing, urban investment bonds, debt risk, officials' promotion, China.

Introduction

Toward the end of 2017, the outstanding balance of Chinese local governments' debt was RMB 16.47 trillion. By the end of 2018, the total debt of local governments in China reached RMB 18.4 trillion, which is approached the ceiling of RMB 18.82 trillion of local governments' debt approved by the National People's Congress in 2017. However, the debt ratio (the ratio of the debt to GDP) is lower than the internationally accepted 100–120% warning line. Considering the hidden debts of local regions, local debts have potential risks. The rapid growth of cities' debt is derived from China's unique land finance (*tudi caizheng*), that is, to expand cities' revenue by land lease, land mortgage loans, and bonds (Wu et al., 2015; Cheng et al., 2018; Gao et al., 2019; Zhang et al., 2019b).

In 1994, the central and local governments implemented the tax-sharing system (*fenshuizhi*). The liabilities and responsibilities of urban development were decentralized, while the power of tax revenue collection was recentralized (Mello, 2000; Liu & Lin, 2014; Cao et al., 2019). Local governments' tax revenue depleted and needed new funds sources to promote cities' economic development plans (Ho & Lin, 2003; Cai et al., 2019; Zhang et al., 2019a; Narbón-Perpiñá et al., 2020). Meanwhile, the land bank system and bidding, auction, and transferring methods were established in the form of laws and regulations. Land became an important source of income and high-quality financing collateral for local governments. Urban land supply is monopolized by local governments through bidding, auction, and listing system. With the land transferring, the revenue is distributed between the central and local governments. Local governments would dominate over 90% of the earnings. Local governments can obtain financial resources through three means, namely, land-leasing revenue, land loans, and urban investment bonds (*chengtouzhai*) (Tsui, 2011; Wang et al., 2018). 2003 to 2015 was the critical period of Chinese urbanization development. Local governments require substantial funds to construct urban infrastructure. Only 10% of the local governments' total investment in infrastructure comes from the fiscal budget; the remaining 90% is provided by land-leasing revenue and urban investment bonds (Wen et al., 2018). Local governments issue urban investment bonds to finance urban infrastructure construction. Land-leasing revenue must be repaid when the bonds are due. According to *National Development and Research Center* report, from 1999–2003, total investment

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of the infrastructure construction of local governments was RMB 232.27 billion, of which the land-leasing revenue was RMB 33.75 billion, which accounted for 14.3%, land mortgage loans and urban investment bonds reached RMB 170 billion, which accounted for 72.88%. Analyzing China's land-driven infrastructure construction mode reveals that land has become a tool for local governments to profit and leverage for financing (Zheng et al., 2014; Zhang et al., 2017; Xu, 2019).

Land-leasing revenue is the source for local governments to address the debt repayment risk. According to the data released by the *National Audit Office* in 2013, the proportion of Chinese cities' debt committed to repay by land-leasing revenue reached 54.6% in 2012. A total of 80% of the local governments promised to repay over 30% of the debt by land-leasing revenue. It points out that two opposing views exist on the effect on the total amount of bonds (city's bonds issued scale). One is the land-leasing revenues and debt financing, which are important sources of funding municipal infrastructure construction, when land-leasing revenues rise; local governments will reduce the need for debt financing (Homburg, 2014; Wu et al., 2016b; Huang & Chan, 2018). The second view is that when land-leasing revenues increase, local governments may overestimate the expected solvency, which will increase the issued scales of urban investment bonds. Land-leasing behavior directly affects the risk of local governments' debt, and studying the mechanism and risk of land financing is necessary.

In addition to being affected by the land-leasing behavior, Chinese cities' debt risk is related to the promotion pressure of local officials. The promotion opportunities of local officials are basing on economic indicators, which include the construction of local infrastructure and economic development (Li & Zhou, 2015; Wu et al., 2016a; Lu et al., 2019; Huang et al., 2020). Under the pressure of performance evaluation, local officials are inclined to issue bonds to support urban development. Investing in the infrastructure and urban development can increase the cities' GDP so officials can gain greater promotion opportunities. Therefore, the officials' promotion pressure is related to Chinese cities' debt risk (Cai et al., 2011). Previous studies on political cycles pointed out that the local official's promotion pressure varies at different stages of their career (Guo, 2009). The closer they are to retirement the greater promotion pressure they have, and the high likeliness of issuing bonds to develop the local economy. Moreover, the competition between local governments caused by the promotion pressure has also increased the issued scale of local governments' debt, which will increase the debt risk (Wang & Hui, 2017).

Since April 2008, three urban investment bonds overdue payment has occurred when the bonds are expired (Qian, 2018). With the default of some urban investment bonds, regulators have been increasingly focusing on Chinese cities' debt risk. Existing studies mainly measure the local debt risk through the debt scale. However, we find the debt scale of the cities with default of urban investment bonds is not large， For example, the urban investment bonds in Yiyang and Huhhot cities. Yiyang is a municipal city in Hunan province, and Huhhot is the capital city of Inner Mongolia Autonomous Region in China. The urban investment bonds defaulted in 2018, because the government didn't have enough funds to pay the remaining principle of RMB 640 million. The urban investment bonds in Huhhot city defaulted twice, in 2019 and 2012, respectively. Compared to the coastal cities of East China, the debt scale of Yiyang and Huhhot is not large. From the perspective of government investment and asset accumulation, not all local government' debt created equal (Peppel-Srebrny, 2021). The local government debt in different cities has different effect on the city's infrastructure construction and economic growth, which results in the cities' different repayment ability. Therefore, the local government's debt risk mainly depends on the city's debt repayment ability.

This study aims to find the relationship of local governments' land-leasing behavior, local cities' debt risk and officials' promotion pressure. Land-leasing behavior is measured by three indicators, namely, land-leasing revenue, land-leasing scale, and land financial dependence. To analyze the effect of land-leasing behavior and officials' promotion pressure on the local governments' debt risk. We need to measure the local governments' debt risk accurately and reasonably. The local government' debt risk is measured from the respects of the debt scale and the debt repayment, and two new indicators: debt scale risk and debt burden risk are constructed. Promotion pressures are measured according to the municipal officials' age. Officials with ages between 55–58 years old are at the last tenure term and have greater promotion pressure. They are more probable to issue urban investment bonds to stimulate the local economy than younger officials.

Compared with the existing research, this study has two contributions. First, this study subdivides the local governments' debt risk into debt scale risk and debt burden risk, and first quantifies the risk of urban investment bonds from the point of local governments' debt repayment ability. The two indicators can assess the risk of urban investment bonds systematically, and the debt burden risk is more accurate to measure the local governments' debt risk. Existing studies are mainly on the debt scale, and few are quantitative studies on the debt risk of urban investment bonds. Second, this study analyzes the impact of officials' promotion pressure on the local governments' debt risk. The promotion of Chinese officials implements top-down mechanism. Cities officials' career is predicted on fulfilling a range of mandates and satisfying their superiors (Pan et al., 2017). Generally, officials with shorter tenures are more incentivized to promote economic performance due to their larger probability to be promoted than leaders with longer tenures. Therefore, officials at the age of 55–60 have the greatest promotion pressure, and the inter-jurisdictional competition could be a driving force for the excessive borrowing by local governments, which requires the local governments obtain large scale

land-leasing revenue to repay debt (Baldacci et al., 2011; Pan et al., 2017; Popescu & Turcu, 2017). Therefore, local governments' land financing has been caught in a vicious circle. This study assesses how officials' promotion pressure impacts on local governments' debt risk through the land-leasing behavior.

The reminder of this paper is organized as follows. The next section introduces the spatial and temporal distribution of local governments' debt in China. The second section is the data and variables. The third section presents econometric models. The fourth section presents the empirical results, and last section is the conclusions.

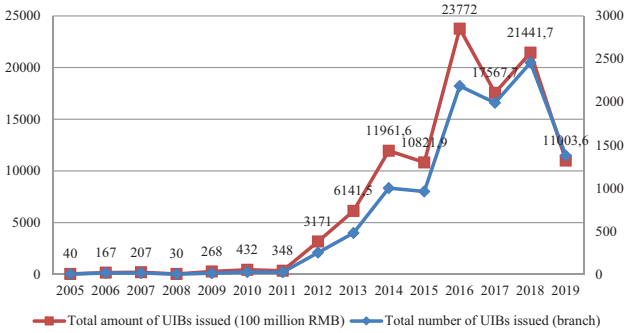
1. Spatial and temporal distribution of local debt risk

1.1. Local government debt distribution

According to the No. 32 announcement of *The Audit Commission*, toward the end of June 2013, the total debt of the national government was RMB 30.27 trillion. Compared with 2010, and 2012, it grew by 73.27% and 9.02%, respectively. After the tax-sharing reforms in 1994 and 2002, more fiscal revenue had been diverted from the local to the central government, and in return local governments have been entitled to obtain revenue from urban land leasehold. State-owned enterprises are established as local financing platforms (LFPs). LFPs have been persistently responsible for financing local governments. The debt financing mode of local governments is popular. Since 2005, LFPs have been established at the provincial, prefecture-level cities, and counties. By the end of March 2019, only 2,264 of the 1,002 LFPs are provincial credits (including provincial capitals and single-city municipalities), accounting for less than 20%, while the prefecture-level cities' credit accounted for about 56%, and over 20% was county-level credit. Zhejiang Province ranked first with 1,490 financing platforms, followed by Sichuan Province with 780, and Jiangsu Province and Guangdong Province ranked third and fourth with 750 and 710, respectively.

LFPs obtain funds from the market mainly through three means: land mortgage loans, urban investment bonds, and capital market financing, such as financial leasing and trust private placement. Urban investment bonds account for the largest proportion of these three financing means, and data on urban investment bonds are publicly available (Wang et al., 2015; Liu et al., 2016).

This study uses urban investment bonds to represent local governments' debt. Data comes from the *China Wind Database*. Figure 1 shows the number and sizes of urban investment bonds issued during 2005–2019; data comes from the *China Wind Database*. Until 2011 the number of bonds issued by local governments is not beyond 30, the total amount of issued bonds were lower than RMB 450 billion. From 2008–2012, the amount of local governments' debt had been kept steady growth, but the growth rate was low. Since 2012, the number and the total amount of urban investment bonds issued



Notes: Data on urban investment bonds are collected from *China WIND Database*.

Figure 1. Amount of China's Urban Investment Bonds issued during 2005–2019

have shown a substantial rise. In 2014 the national total amount of Chinese cities' debts was over one trillion RMB. From 2014–2018, the number and amount of local governments' debt issued across the country had shown two drops in 2015 and 2017, but the total amount of local governments' debt had still been maintained at over one trillion RMB. The total amount in 2016 and 2018 even reached RMB 2 trillion, which shows that the scale of local governments' debt in China is sizeable. If including other hidden debts of local governments, the total debt has reached a high level. To promote stable economic development, focusing on the research of local governments' debt risk is important (Mendonça & Nunes, 2011; Tsui, 2011; Tu & Padovani, 2018).

1.2. Local government debt risk measure and distribution

The local governments' debt risk is affected by the utilization efficiency and sustainability of fiscal revenues (Selow, 1997). Some researches proposed a fiscal risk matrix to quantify the risk of local governments' debts. In addition, debts sensitivity to the fiscal conditions, fiscal short-term repayment ability, unreasonable debt ratio and other indicators are used to measure local governments' debt risk. Baldacci et al. (2011) proposed two indicators of debt burden ratio and comprehensive burden ratio to measure the fiscal risk. The debt burden ratio is the proportion of city's debt amount to its GDP, which applies the amount of city's debt and GDP to reflect the degree of the debt risk, the higher the debt burden ratio, the greater the city's debt risk. However, the local governments' expected repayment ability depends on its fiscal revenue, not GDP, so the ratio of local debt amount to local fiscal revenue is included to reflect the local debt burden level.

This study presents two indicators: debt scale risk and debt burden risk to measure local governments' debt risk.

Debt scale risk:

$$debt\ scale\ risk = debt(1 + r_d)^t / gdp / (1 + r_g)^t. \quad (1)$$

The *debt* represents the total amount of the city's debt per year, and *gdp* is the city's annual GDP, r_d represents the

annual growth rate of the city's urban investment bonds, r_g represents the annual nominal *gdp* growth rate, and t represents the time (year).

Debt burden risk:

$$debt\ burden\ risk = debt(1 + r_d)^t / revenue\ (1 + r_{fr})^t. \quad (2)$$

The *debt* represents the total amount of the city's debt per year, *revenue* is the city's annual revenue, r_d represents the annual growth rate of the city's urban investment bonds, r_{fr} represents the annual growth rate of the city's annual fiscal revenue, and t represents the time.

Debt scale risk reflects the debt size and is used to the debt risk comparison between different cities. Debt burden risk is focused on the city's repayment ability and debt burden ratio, which is measured by the ratio of the city's annual debt amount to the city's annual fiscal revenue (Gao, 2019). Given that the city's fiscal revenue is the main resource to repay the city's debt, the debt burden risk reflects the city's debt risk, the higher value the indicator has the greater risk the city's debt has.

To better reflect the debt risk' changes with space and time, the prefecture-level cities' burden risk values are calculated on the basis of the data from 2006–2015 (Cao et al., 2014; Mao & Huang, 2018). Figures 2 and 3 are the spatial distribution of cities' debt burden risk in 2009 and 2015, respectively. Comparing the two figures, it shows that the debt burden level of prefecture-level cities increases sharply from 2009 to 2015, especially in the central and eastern regions. The overall debt issuing probability and the debt scale increased. The reason is urban investment bonds are mainly used to urban development and infrastructure construction. The economy in the central and eastern regions is better than the economy in the western regions so they are more inclined to issue bonds to develop local economy and improve infrastructure construction.

2. Research ideas and data

2.1. Research ideas

Land-leasing behavior is reflected by three indicators: land-leasing revenue, land-leasing scale, and land financial dependence. This study first analyzes how these three indicators and the officials' promotion pressure affect the local governments' debt risk by taking these three indicators and the officials' promotion pressure as explanatory variables to construct the first econometric model to conduct the empirical study. Then we consider the effects of the officials' promotion pressure on the local governments' debt risk through the land-leasing behavior and analyze whether the officials' promotion pressure enlarge the effects of land-leasing behavior to the local governments' debt risk. Thus, the interactive variables of the land transfer behavior and officials' promotion pressure are added to the econometric model to construct the second econometric model.

2.2. Data description

We construct a prefecture-level dataset with 281 Chinese cities from 2006–2015. The prefecture-level data is used because the land supply decision is made by the municipal government. The timespan of study is from 2006–2015 given that data on urban investment bonds of the prefecture-level area are only publicly available during this period. The prefecture-level data mainly comes from official Chinese publications; urban investment debt data comes from the *China Wind Database*. Data on land-leasing revenue and land-leasing scale of prefecture-level cities are from China Land and Resources Statistical Yearbooks (2007–2016); values for prefecture-level cities' GDP, built-up area, fiscal revenue, and the total population come from the China City Statistical Yearbooks.

Figure 2. Debt burden risk at prefecture-level in 2009

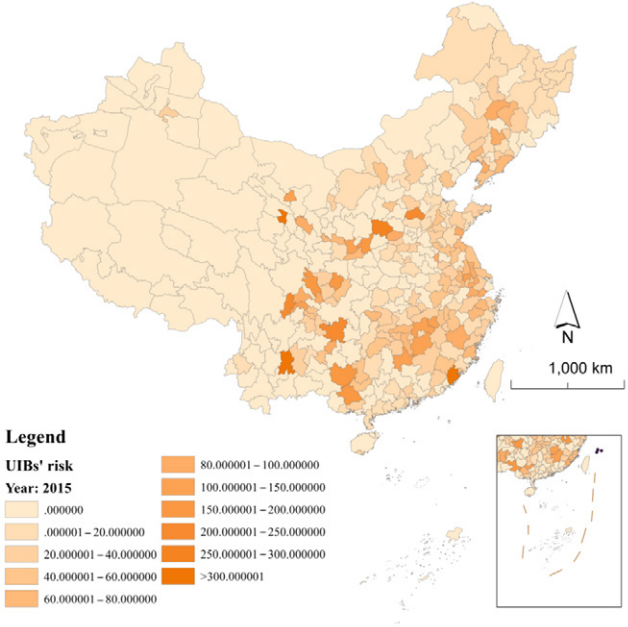


Figure 3. Debt burden risk at prefecture-level in 2015

To test city leaders' career incentives, we also compile data on the city leaders in office; mainly collect the age data of Municipal Party Secretaries from government websites and bulletins. China's basic political system is a multi-party cooperation and political consultation system under the leadership of the Communist Party of China. Government institutions are set up under the leadership of the Communist Party of China. When the mayor and municipal party secretary have different opinions, the municipal party secretary is on the higher power level than mayor. So this paper focuses on the municipal party secretary's promotion stress.

2.2.1. Dependent variable: urban investment bonds risk

The researchers collected the data of LFPs and bonds to construct a new database, which contains 2,419 LFPs and 13,926 urban investment bonds from 2006 to 2015. Based on the new database, we analyze the urban investment bonds risk. The unit of urban investment bond issuance is RMB 100 million, and the unit of debt scale risk ratio is the percentage. According to Meng et al. (2011), the firm's performance was measured through three indicators. This paper measures the risk of urban investment bonds through four indicators: the probability of issuing debt, total amount of debt, debt scale risk and debt burden risk. The probability of issuing debt (*debt*1) set a dummy variable of 0 and 1, if an issue urban investment bond, the value is 1, otherwise 0. The total amount of debt (*debt*2) is the scale debt, adding 1 to the logarithmic process, or 0 if no debt issuing exists. The debt scale risk (*risk*1) is measured by the proportion of debt issuance to GDP. And the debt burden risk (*risk*2) is the proportion of the issued debt amount to the prefecture-level cities' fiscal revenue. These four indicators represent the frequency of issuing debt, the total amount of debt, the proportion of debt scale in GDP and the pressure of debt repayment, respectively.

2.2.2. Independent variables

Land-leasing revenue (*L.landrevenue*): the land-leasing revenue of different prefecture- level cities is measured by the proportion of land-leasing revenue to their GDP. Data are from Land and Resources Statistical Yearbooks and China City Statistical Yearbooks. To alleviate the endogenous problem, it is lagged by one year.

Land-leasing scale (*L.landscale*): this variable is measured by the ratio of the land-leasing scale to the cities' built-up areas to reduce the effect of cities' differences. The data are from Statistical Yearbooks of Land and Resources and China City Statistical Yearbooks. To alleviate the endogenous problem, it is lagged by one year.

Land financial dependence (*L.dependence*): this factor is measured by the ratio of the city's land-leasing revenue to its fiscal revenue. It may affect the scale of local governments' debt issuance. The data are from Statistical Yearbooks of Land and Resources, and China City Statistical Yearbooks. To alleviate the endogenous problem, it is lagged by one year.

Official promotion stress (*stress*): based on the existing research, the official promotion stress is measured through the ages of the municipal leaders and is represented as a dummy variable in the econometric model. The municipal leaders with ages between 55 and 58 have greater promotion pressure, and the variable value is taken 1, otherwise 0. The researchers manually collected the data from the information of government websites and bulletins.

2.2.3. Control variables

Fiscal Gap (*auto*): measured by the ratio of the difference of financial income and expenditure to the total financial income. Similar to the fiscal self-sufficiency rate, Fiscal Gap may also affect the cities' issued scale of urban investment bond, and is added to the econometric models as a control variable. The data is from China City Statistical Yearbooks.

Table 1. Descriptive statistics of variables

Variable	*N*	Mean	Standard error	Min	Max	P50
*debt*1	2830	0.380	0.486	0.000	1.000	0.000
*debt*2	2830	1.155	1.612	0.000	6.656	0.000
*risk*1	2806	3.521	9.005	0.000	124.0	0.000
*risk*2	2825	17.66	42.26	0.000	678.1	0.000
L.landrevenue	2782	0.041	0.035	0.000	0.425	0.032
L.landscale	2830	0.008	0.013	0.000	0.171	0.004
L.dependence	2825	1.803	3.136	0.006	64.66	1.100
stress	2830	0.322	0.467	0.000	1.000	0.000
*auto*2	2804	1.759	1.907	–0.351	17.40	1.220
Ln.realgdppc	2806	10.07	0.669	7.926	12.85	10.05
Ln.popden	2807	5.711	0.912	1.548	7.882	5.840

Notes: Data on urban investment bonds are collected from *China WIND Database*. Data on the land-leasing revenue and land-leasing scale of prefecture-level cities are taken from the *China Land and Resources Statistical Yearbooks* (2007–2016). Data on per capita GDP, population density, and local fiscal revenue and expenditure of prefecture-level cities are obtained from the *China City Statistical Yearbooks* (2007–2016).

GDP per capita (*pcgdp*): this variable reflects the level of prefecture-level cities' economic development, and has an impact on the issued scale of urban investment bonds. It is set as a control variable in the econometric models of this study.

Population density (*popden*): this variable is measured by the proportion of the cities' total population to their total land area. To control the effects of the population size on the urban investment bond issued size, population density is added in the econometric models as a control variable. To eliminate the impact of price changes, all variables measured in the name of currency are converted into actual values discounted by the consumer price index (set the value as 1 in 2006). Table 1 exhibits the descriptive statistics of each variable where *pcgdp* and *popden* are logarithmic values of the real data.

3. Econometric model

3.1. Theoretical framework

This section aims to explain the mechanism of local governments' land financing, and analyze the influence relationship among land-leasing behavior, debt issuance behavior and officials' promotion pressure. In order to foster local economic, local governments issue urban investment bonds by land mortgage to obtain funds for city construction. The main fund to repay the urban investment bonds comes from the land-leasing revenue. When the land-leasing revenue is insufficient to repay the debt, the repayment will be made through local fiscal revenue. And the local economic development and infrastructure construction determine the promotion of local officials. The more promotion stress of the local officials, the more local debt they issued. So, debt issuance probability and debt risk are affected not only by the land-leasing revenue, but also by the officials' promotion pressure. Premised on the finding in the literature of Chen and Kung (2016), we hypothesize that local governments' land-leasing behavior and officials' promotion stress may increase the local governments' debt issuance scale and debt risk.

To measure the local governments' debt risk accurately, we construct two indicators: debt scale risk and debt burden risk. Through these two indicators, we aim to find out how the land-leasing behavior and officials' promotion pressure affect the local governments' debt risk. The promotion pressure prompts local officials to issue more debt, and more land-leasing revenue is required to repay the debt. The more funds are invested in the local economic and infrastructure construction, the more probable the officials get promoted. Local governments' land financing has been caught in a vicious circle. The officials' promotion stress may be a catalyst, and change the relationship of the local governments' land-leasing behavior and debt risk. To illustrate this, we will analyze how the officials' promotion stress increases the local debt risk in the next section.

3.2. Model selection

The debt risk is measured by four indicators: the probability of issuing debt (*debt*1), the amount of issued debt (*debt*2), the debt scale risk of (*risk*1), and the debt burden risk (*risk*2). When these four indictors are the explanatory variables, we choose the econometric model between the fixed-effects and mixed-effects models. Setting the null hypothesis is to support the mixed-effects model, and the alternative hypothesis is to support the fixed-effects model. *F* test, seeing Table 2 shows that the *P*-values of the four models are 0.000, and the null hypothesis is rejected at a significance level of 1%, so the results of *F* test support the fixed-effects model.

The Hausman test is done to choose a better one between a random effects model and a fixed-effects model. The null hypothesis is to support a random effects model, and the alternative hypothesis is to support a fixed-effects model. If the Chi-square statistical value is greater than the critical value of 10% reject the null hypothesis and accept the alternative hypothesis, that is, a fixed-effects model should be used. Otherwise, a random effects model should be used. Table 2 displays the results of the Hausman test. The *P*-values of Models 1, 2, and 3 are less than 0.01, which reject the null hypothesis on the significance level of 1%. The *P*-value of Model 4 is less than 0.05, and the null hypothesis will be rejected at a significance level of 5%. Therefore, the Hausman test results of the four models indicate that the panel fixed-effects model is suitable for empirical models.

3.3. Fixed-effects model

On the basis of the analysis of Section 3.2, we construct a dual fixed-effects model to analyze the impact of land-leasing behavior and the officials' promotion on the risk of the urban investment bonds.

First, we test the impact of land-leasing revenue (*landrevenue*), land-leasing scale (*landscale*), land financial dependence (*dependence*), and officials' promotion stress (*stress*) on the risk of urban investment bonds. Equation (3) tests the effects of the three core independent variables (land-leasing revenue, land-leasing scale and land financial dependence) together with officials' promotion stress on the risk of urban investment bonds. The econometric model is as follows:

$$y_{it} = \beta_0 + \beta_1 landprice_{i,t-1} + \beta_2 landarea_{i,t-1} + \beta_3 dependence_{i,t-1} + \beta_4 stress_{it} + \beta x_{it} + u_i + u_t + \varepsilon_{it}. \quad (3)$$

Table 2. *F*-test and Hausman test of models

Model	*debt*1	*debt*2	*risk*1	*risk*2
F statistics	2.650	5.650	6.680	3.210
P-value	0.000	0.000	0.000	0.000
Chi-Square Statistics	32.130	58.990	49.310	27.730
P-value	0.009	0.000	0.000	0.034

Second, we consider the effects of the interaction terms between the local governments' land-leasing behavior and the officials' promotion stress on the risk of urban investment bonds. The econometric model is constructed as follows:

$$y_{it} = \beta_0 + \beta_1 landprice_{i,t-1} + \beta_2 landarea_{i,t-1} + \beta_3 dependence_{i,t-1} + \beta_4 stress_{it} + \beta_5 landprice_{i,t-1} \times stress_{it} + \beta_6 landarea_{i,t-1} \times stress_{it} + \beta_7 landprice_{i,t-1} \times stress_{it} + \beta x_{it} + u_i + u_t + \varepsilon_{it}. \quad (4)$$

Equation (4) tests the influence of the interaction between core independent variables and the promotion pressure of officials on the risk of urban investment bonds. In Equations (3) and (4), y_{it} is a vector and represents the four indicators of urban investment bonds risk: probability of issuing debt (*debt*1), total amount of debt (*debt*2), debt scale risk (*risk*1), and debt burden of risk (*risk*2). *i* represents city, and *t* represents time (year). $landprice_{i,t-1}$ is the total land-leasing revenue of city *i* in the year *t*–1, and $landarea_{i,t-1}$ is the land-leasing scale of city *i* in the year *t*–1. $dependence_{i,t-1}$ is the land financial dependence of city *i* in *t*–1 year. $stress_{it}$ is the dummy variable and represents the age of municipal leaders of city *i* in year *t*. x_{it} is the vector of control variables, which may affect the issuing scale of urban investment bonds, including fiscal gap, per capita GDP, and population density. u_i represents the fixed time effects of city *i* on the risk of urban investment bonds. u_t represents the time effects on the risk of urban investment bonds. ε_{it} is the error term.

4. Empirical results

4.1. Benchmark regression analysis

To test our hypothesis that the land-leasing behavior and officials' promotion pressure may increase the local governments' debt risk. We do the regression about the local debt risk on land-leasing behavior and officials' promotion stress.

According to the research of Chen and Kung (2016) on land leasing revenue and political turnover in county-level cities across the country, land leasing revenue and political turnover are endogenous. As we stated in subsection 2.2.2, the land-leasing revenue is lagged by one year to alleviate the endogenous problem. To further confirm there is no collinearity, we do the stepwise regression analysis. As we add variable step by step, the significance of the regression coefficients has no change, and the change of regression coefficients value is very small, which can illustrate that there is no collinearity among the variables. Main results of the stepwise regression are reported in Table 3.

4.1.1. Probability of issuing debt

We first do the regression of the probability of issuing debt on the land-leasing behavior and officials' promotion stress. The probability of issuing debt is binary variable, so we regress Equation (3) based on the probit model. We take the probability of issuing debt as the dependent variable (*debt*1), and consider the land-leasing revenue,

Table 3. Model regression results on the impact of debt and risk

Model	*debt*1 (1)	*debt*2 (2)	*risk*1 (3)	*risk*2 (4)
L.landrevenue	4.032*** (8.599)	4.260** (2.403)	13.794** (2.488)	–5.169 (–0.147)
L.landscale	1.455 (0.945)	–7.549 (–1.165)	–42.826** (–2.113)	–145.331 (–1.133)
L.dependence	–0.005 (–0.572)	–0.024 (–0.674)	–0.155 (–1.417)	1.882*** (2.713)
stress	0.055*** (3.300)	0.194*** (3.965)	0.774*** (5.064)	2.546*** (2.629)
*auto*2	–0.454*** (–3.808)	–0.063 (–1.249)	–0.203 (–1.290)	–0.075 (–0.075)
Ln.realgdppc	0.013 (0.759)	0.279 (1.469)	–0.103 (–0.173)	13.351*** (3.543)
Ln.popden	0.456*** (19.512)	0.242 (0.323)	1.773 (0.758)	11.661 (0.787)
constant	0.073*** (4.288)	–3.770 (–0.837)	–8.356 (–0.594)	–196.190** (–2.201)
province effect	No	Yes	Yes	Yes
year effect	No	Yes	Yes	Yes
N	2480	2480	2480	2479
Adj. R^2	–	0.6138	0.5965	0.3773
F		86.29	64.75	45.95

Notes: ***, **, and * denote variables that are statistically significant at the 1%, 5%, and 10% levels, respectively. The values of *t* are in parentheses.

land-leasing scale, and land financial dependence as the explanatory variables to obtain corresponding result showing in Column (1) of Table 3.

We can find that the land-leasing revenue (*L.landrevenue*) has a positive and significant effect on the probability of issuing debt at the 1% level (coefficient value of 4.032). This indicates that when the land-leasing revenue increases, the local governments are inclined to issue debt (urban investment bonds). The coefficient of officials' promotion pressure (*stress*) is positive and significant (coefficient value of 0.055), which indicates that the officials' promotion pressure will promote the issuing probability. The land-leasing scale (*L.landscale*) and land financial dependence have no significant effect on the probability of issuing debt.

According to the result of *debt*1, we also find that the effect of fiscal gap on the probability of issuing debt is significant and negative (coefficient value of –0.454). That is, the increase of fiscal gap reduces the probability of issuing debt. The population density positively influences the probability of issuing debt, which is significant. This indicates that the probability of issuing debt will continue to escalate as the population density increases.

4.1.2. Total amount of debt

The dependent variable in Equation (3) is the total amount of debt. The empirical result of *debt*2 is listed in column (2) of Table 3. The effect of land-leasing revenue (*L.landrevenue*) on the total amount of debt is positive and significant at the 5% level (coefficient value 4.260). It indicates that the city with more the land-leasing revenue last year tends to issue more new urban investment bonds this year. Both the land-leasing scale and land financial dependence have no significant effect on the total amount of debt, and the coefficient value of the land-leasing scale is negative. The empirical result is consistent with the regression result of land-leasing revenue on the county's political turnover in Chen and Kung (2016), which find that the land price has a significant and positive effect on the county's political turnover, but the land-leasing scale (or area) has no significant effect on the political turnover.

The estimation result of *debt*2 shows that the officials' promotion pressure has a significant and positive effect on the total amount of debt issued by prefecture-level cities, with the coefficient, 0.193. Given that municipal officials with age 55–58 have remarkable promotion pressure they are inclined to issue larger-scale urban investment bonds to foster local economic development.

4.1.3. Debt scale risk

Debt scale risk (*risk*1) reflects the debt size of prefecture-level cities. We take debt scale risk as the dependent variable of Equation (3), considering land-leasing revenue, land-leasing scale, and land financial dependence as the explanatory variables. The empirical result of *risk*1, reported in column (3), shows that the effect of land-leasing revenue (*landrevenue*) on debt scale risk is positively significant at 5% level with coefficient 13.794, which indicates the rise in land-leasing revenue in the previous year will increase the scale of urban investment bonds. Hence, the debt scale risk will increase this year. The land-leasing scale (*landscale*) has significantly negative effect on debt scale risk at a significant level of 5% (the coefficient is −42.826), indicating that when land-leasing scale increased in the previous year, the prefecture-level city tends to reduce the scale of debt issuance in this year, thereby will reduce the debt scale risk.

4.1.4. Debt burden risk

Debt burden risk (*risk*2) is expressed by the ratio of the amount of urban investment debt to the city's fiscal revenue. Considering debt burden risk as the dependent variable of Equation (3), we regress debt burden risk on land-leasing revenue, land-leasing scale, land financial dependence and officials' political pressure. The regression result is reported in column (4) of Table 3.

The regression result shows that land financial dependence has a significantly positive impact on the debt burden risk at the 1% level (coefficient value 1.882). That is, the city with high land financial dependence tends to have high debt burden risk. From column (4), both officials' promotion pressure and urban per capita GDP have a significant and positive effect on local debt burden risk at the 1% level. So the city with high officials' promotion pressure, high land financial dependence, and high per capita GDP has high debt burden risk. The literature of Chen et al. (2017) finds that when the debt scale reaches a certain point, its impact on the economy growth will turn from positive to negative, so we can't just assume the local governments' debt risk increases as the debt scale increases. The debt burden risk is more accurate to measure the local governments' debt risk. For the cities with high land financial dependence, policy makers should focus on the local governments' debt risk.

4.2. Interaction terms test

As we analyzed in Section 4.1, the officials' promotion pressure may affect the relationship of the local governments' land-leasing behavior and debt risk. To analyze how the officials' promotion stress increases the local debt risk, we construct three interaction terms between the official promotion pressure and land-leasing revenue, land-leasing scale, land financial dependence, respectively. Including these three interaction terms as the explanatory variables in Equation (3), we obtain a new econometric – Equation (4).

Based on Equation (4), we analyze the impact of the interaction terms on the total amount of debt issued (*debt*2), debt scale risk (*risk*1), and debt burden risk (*risk*2). The regression result is reported in Table 4.

4.2.1. Impact of interaction terms on total amount of debt issued

Table 4 shows the empirical results included the interaction term. Column (1) shows that the interaction term of land-leasing revenue and officials' promotion pressure has a positive effect on the total amount of debt issued (*debt*2),

Table 4. Impact of interaction items on the debt scale and debt risk

Model	*debt*2		*risk*1		*risk*2	
	(1)	(2)	(3)	(4)	(5)	(6)
L.landrevenue	2.472 (1.614)	2.721 (1.456)	2.754 (0.578)	4.564 (0.786)	–16.588 (–0.462)	–6.495 (–0.176)
L.landscale	–9.209 (–1.352)	–8.630 (–1.256)	–61.949*** (–2.921)	–58.206*** (–2.724)		–162.809 (–1.197)
L.dependence		–0.006 (–0.155)		–0.045 (–0.394)	1.204* (1.669)	1.312* (1.804)
*L.dependence*stress*		4.390** (2.214)		26.970*** (4.376)	2.002** (2.530)	2.540 (0.065)
*L.landrevenue*stress*	3.450* (1.924)	3.367 (0.534)	21.372*** (3.829)	41.951** (2.139)	5.862 (0.155)	29.724 (0.238)
*L.landscale*stress*	3.016 (0.479)	–0.045 (–1.134)	39.876** (2.034)	–0.272** (–2.186)		2.020** (2.548)
stress	0.031 (0.359)	0.063 (0.686)	–0.395 (–1.450)	–0.204 (–0.716)	–0.862 (–0.491)	–0.969 (–0.534)
auto	–0.066 (–1.328)	–0.063 (–1.257)	–0.225 (–1.453)	–0.207 (–1.327)	0.048 (0.048)	–0.012 (–0.012)
Ln.realgdppc	0.297 (1.561)	0.305 (1.602)	0.019 (0.032)	0.068 (0.114)	13.276*** (3.525)	13.397*** (3.555)
Ln.popden	0.249 (0.334)	0.231 (0.309)	1.813 (0.779)	1.704 (0.732)	11.074 (0.750)	12.301 (0.831)
constant	–3.935 (–0.875)	–3.920 (–0.871)	–9.416 (–0.673)	–9.327 (–0.667)	–191.609** (–2.158)	–199.155** (–2.237)
province effect	Yes	Yes	Yes	Yes	Yes	Yes
year effect	Yes	Yes	Yes	Yes	Yes	Yes
N	2481	2480	2481	2480	2479	2479
Adj. R^2	0.6145	0.6143	0.6009	0.6017	0.3792	0.3791
F	81.35	72.36	62.92	56.37	43.69	38.91

Notes: ***, **, and * denote variables that are statistically significant at the 1%, 5%, and 10% levels, respectively. The values of *t* are in parentheses.

and the estimated coefficient is significant at 5% level with an estimate of 3.450. According to the empirical results of the benchmark regression, land-leasing revenue positively affects total amount of debt issued. This indicates that the officials' promotion pressure enlarges the positive effect of land-leasing revenue on the local governments' debt risk. For the cities with high officials' promotion pressure, the officials are inclined to get more revenue from land-leasing, which leads to larger scale urban investment bonds (*debt*2).

Column (2) shows that the interaction term of the land financial dependence and officials' promotion stress has a positive effect on the *debt*2. But from the result of the benchmark regression (column (1) of Table 3), the land financial dependence has no significant effect on *debt*2. So we cannot use the result of this interaction term to analyze *debt*2, though its regression coefficient is significant.

4.2.2. Impact of interaction terms on debt scale risk

To test effect of officials' promotion pressure on debt scale risk, we choose debt scale risk (*risk*1) as the dependent variable in Equation (4). Columns (3) and (4) in Table 4 reported the regression result. The three interaction terms all have a significant effect on local debt risk. The interaction term between land-leasing revenue and official promotion pressure has a positively significant effect on the land scale risk at the 1% level (coefficient value 41.951). The interaction term between the land-leasing scale and official promotion pressure has a negative and significant effect on the land scale risk at the 5% level (coefficient value –0.272). The interaction term of land financial dependence and official promotion pressure (*dependence*stress*) negatively affects land scale risk at the 5% of significance level (coefficient value 26.970).

From the result in column (4), the land-leasing scale has a negative and significant effect on the debt scale risk. This indicates that the increase of land-leasing area can reduce the debt scale risk. However, the interaction term (*landscale*stress*) have a negative significant effect on the local debt scale risk. That is, the officials' promotion pressure will reduce the negative effect of land-leasing scale on the debt scale risk, and increase the debt scale risk.

From the benchmark analysis result, the land-leasing revenue has a positive and significant effect on the debt scale risk. The interaction term (*landrevenue*stress*) has a positively significant effect on the debt scale risk, which

indicates that the officials' promotion pressure will increase the positive effect of land-leasing revenue on the debt scale risk. The city with high officials' promotion pressure is inclined to obtain large land-leasing revenue, and have high debt scale risk.

Therefore, we can conclude that the officials' promotion pressure positively affects the local debt scale risk mainly through the land-leasing scale and the land-leasing revenue. With the more land-leasing revenue and the larger land-leasing scale, the local debt scale risk becomes higher. If the local government would like to control its debt scale risk, it must reduce the land-leasing revenue and land-leasing scale.

4.2.3. Impact of interaction terms on debt burden risk

This subsection used debt burden risk as the dependent variable to test the impact of interaction terms. The regression result of *risk*2 is reported in columns (5) and (6) of Table 4. From the result in column (5), land financial dependence has a positively significant effect on the local debt burden risk, and the interaction term between land financial dependence and officials' promotion pressure has a positively significant effect on the debt burden risk at the 5% level (coefficient value 2.002). This indicates that the officials' promotion pressure increases the positive effect of land financial dependence on the local debt burden risk. So the officials' promotion pressure affects the debt burden risk through the land financial dependence. To control local debt burden risk, the local land financial dependence should be controlled first.

Conclusions

This research aims to analyze the impact of land-leasing behaviors and officials' promotion mechanism on local governments' debt risk. First, we analyze the effects of land-leasing revenue, land-leasing scale, and land financial dependence and officials' promotion pressure on the urban debt risk. Then we also investigate the impact of these interaction terms between the land-leasing behaviors and officials' promotion pressure on the local governments' debt risk.

The empirical result based on the benchmark regression of land-leasing behavior and officials' promotion pressure on local governments' debt risk is as follows:

(1) Land-leasing revenue positively affects probability of debt issued, total amount of issued debt, and debt scale risk. This illustrates that the increase of land-leasing revenue enlarges probability of debt issued, total amount of issued debt and debt scale risk, but does not affect debt repayment risk.

(2) Land-leasing scale has a negative effect on the debt scale risk, while land financial dependence has a positive effect on the debt burden risk. This illustrates that the debt scale risk and debt burden risk mainly come from the land-leasing scale and land financial dependence, respectively.

(3) The officials' promotion pressure has a positive effect on the four indicators of the local governments' debt-issuing behavior. This indicates the officials' promotion pressure is the key factor to affect the local governments' debt-issuing behavior. Higher officials' promotion pressure not only increases the debt-issuing probability and total amount of the debt issued, but also enlarges the debt scale risk and the debt burden risk.

Meanwhile, from the empirical analysis of the interaction terms, we can get:

(1) Both land-leasing revenue and its interaction term have a positive effect on the total amount of debt issued. This indicates that the officials' promotion pressure enlarges the positive effect of land-leasing revenue on the local governments' debt risk. For the city with high officials' promotion pressure, its total amount of debt issued is large.

(2) The interaction term of land-leasing scale and officials' promotion pressure has a negative effect on local debt scale risk, while the interaction term of land-leasing revenue and officials' promotion pressure has a positive effect on local debt scale risk. This illustrates that the officials' promotion pressure reduces the negative effect of land-leasing scale on debt scale risk, and enlarges the positive effect of land-leasing revenue on debt scale risk. For the cities with high promotion stress, when land-leasing scale and land-leasing revenue increase, we should focus on the city's debt scale risk.

(3) Both land financial dependence and its interaction term have a positive effect on debt burden risk. Since the debt burden risk is a more accurate indicator to measure the local governments' debt risk than the debt scale risk. For the city with high land financial dependence and high promotion pressure, policy makers should focus on its high debt risk.

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Conflict of interests

The authors declare no conflict of interests.

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