▪ Journal of Competitiveness

Go with the wind: Local public financing and air pollution

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Abstract

The intertwining of local public financing and land finance is a direct result of China's economic growth and fiscal reforms. Local government financing vehicles (LGFVs), which are secured by land, subsidies and other implicit government guarantees, are created to finance infrastructure projects. The continued growth of LGFVs debt intensifies competition for land to attract investment, encouraging firms to expand their production scale, which in turn exacerbates pollution. Exploiting municipal corporate bonds (MCBs) issuance by LGFVs, we find that local public financing exacerbates air pollution, and the above conclusion remains robust to instrumental variables and robustness tests. Specifically, when local governments expand the supply of industrial land, it intensifies competition for land and attracts high-consumption, high-pollution, low-value-added firms, thereby increasing air pollution. Meanwhile, the better the financial situation and the stricter the environmental regulation, the less significant is the negative impact of local public financing on air pollution. This study provides novel evidence on the non-economic consequences and social welfare of local public financing, highlighting the underlying logic of prioritizing economic growth over environmental protection. Meanwhile, our study further reveals that competition for land is a driving factor that local public financing exacerbates pollutant emissions among the largest polluters and manufacturers nationwide.

Keywords: *local public financing; air pollution; municipal corporate bonds; local government financing vehicles; land finance*

JEL Classification: Q53, R5, H7

Article history: Received: November 2024; Accepted: March 2025; Published: June 2025

1 INTRODUCTION

Billions of people in developing countries live in severely polluted environments every day and are highly economically dependent on dirty polluting manufacturing industries. However, systematic research on the environment-economy trade-off has focused almost exclusively on developed countries (Walker, 2011; Walker, 2013). Meanwhile, the public debt of many countries has risen rapidly since the global financial crisis,

raising significant concerns around the world. According to a 2018 report by the Organization for Economic Co-operation and Development (OECD), the 35 OECD countries increased their public debt from $25 trillion in 2008 to $43.6 trillion in 2017. Previous literature has primarily focused on the economic consequences of local public financing, including public expenditure (Song et al., 2012), financial constraints (Demirci et al., 2019), financial risk (Liu, 2023), inflation (Teles & Mussolini, 2014; Asteriou et al., 2021), and innovation (Croce et al., 2019; Fan et al., 2022). However, few studies have focused on the unintended environmental consequences of local public financing. Filling this knowledge gap is important, particularly as the continued expansion of local public financing has become an important constraint on economic development (Teles & Mussolini, 2014; Arai et al., 2018; Swamy, 2020; Asteriou et al., 2021).

China is a perfect case to study the environmental consequences of local public financing, as it has experienced severe pollution and debt burdens. Since the 1980s, China's economy has achieved remarkable growth, but this process has been accompanied by rapid industrialization and severe environmental degradation, with water and air pollution becoming increasingly serious, triggering public discontent and social unrest. Meanwhile, local governments are under enormous pressure to roll over LGFVs debt. According to Wind statistics, the total interest-bearing debt of LGFVs was 12727.66 billion yuan in 2017, increasing to 16489.22 billion yuan in 2018, 22214.13 billion yuan in 2019, 28478.05 billion yuan in 2020, 33340.01 billion yuan in 2021, 37189.44 billion yuan in 2022 and 41139.50 billion yuan in 2023. This equates to approximately 0.74, 0.90, 1.17, 1.56, 1.65, 1.83 and 1.90 times the local general budget revenue respectively.

Since the Budget Law was enforced in 1994, local governments have not been allowed to issue bonds. Then, state-owned and off-balance sheet financing vehicles (LGFVs) are created to fund public infrastructure projects. Local governments link land resources to the growing debt of LGFVs and attract industrial capital by increasing the supply of industrial land, with the consequent increase in pollutant emissions. What's more, ever-increasing debt burdens and fierce competition for investment encourage local governments to lower the entry threshold for high-polluting, low-value-added manufacturing industries. Our aim is to determine whether local public financing can explain the increase in pollutant emissions.

Exploiting the issuance of MCBs by LGFVs, we find that local public financing exacerbates air pollution. Specifically, local governments have expanded the supply of industrial land, which has attracted high-consumption, high-pollution, low-value-added firms, increasing air pollution. Meanwhile, in regions with great financial situations and strict environmental regulations, the negative environmental externalities of local public financing are weaker. A number of potential threats to the inferences drawn and alternative interpretations put forward are examined and ruled out, including

instrumental variables, alternative interpretations of green municipal corporate bonds and alternative measures of explained variables, explanatory variables and sample selection.

This study contributes to several bodies of literature. First, we provide rigorous and comprehensive empirical evidence on the unintended environmental consequences of local public financing. Previous substantial empirical literature has studied how local public financing affects economic consequences, with a positive view that local public financing promotes local economic development by accelerating costly construction and time-consuming infrastructure projects (Arai et al., 2018), and a negative view that local public financing hinders economic development by increasing debt, raising taxes and inflation, and crowding out private investment (Teles & Mussolini, 2014; Swamy, 2020; Asteriou et al., 2021). Our study supplements this growing literature with non-economic consequences and social welfare.

Second, our study contributes to the emerging literature on land finance. Specifically, land finance has greatly stimulated local economic growth in China in recent decades (Mo, 2018). However, it has also led to the misallocation of land resources (Pan et al., 2015) and higher house prices (Wu et al., 2014). We provide direct evidence that competition for land is a driving factor that local public financing exacerbates pollutant emissions among the largest polluters and manufacturers nationwide.

Third, our study relates to the broader empirical literature on environmental economics (Burgess et al., 2012; Lipscomb & Mobarak, 2016; He et al., 2020). The negative economic consequences of pollution have focused on mortality (Knittel et al., 2016; Deschênes et al., 2017; Deryugina et al., 2019), health (Schlenker & Walker, 2016; Deschênes et al., 2020; Balietti et al., 2022), labor productivity (Graff-Zivin & Neidell, 2012; Fu et al., 2021; Wang et al., 2022), migration (Xue et al., 2021; Chen et al., 2022), and crime (Bondy et al., 2020; Herrnstadt et al., 2021). Our study provides further evidence that local public financing exacerbates pollutant emissions through land competition among the largest polluters and manufacturers nationwide, highlighting the underlying logic of prioritizing economic growth over environmental protection.

The remainder of this paper is organized as follows. Section 2 describes the theoretical background. Section 3 introduces the research objective, methodology and data. Section 4 presents the research results and provides further discussion. Section 5 concludes the paper.

2 THEORETICAL BACKGROUND

2.1 MUNICIPAL CORPORATE BONDS

Since China's tax-sharing reform in the 1990s, local governments have seen a sharp decline in their share of tax revenue from the central government. The 1994 Budget

Law prohibited local governments from directly financing debt in any form. LGFVs are state-owned, off-balance sheet financing vehicles created to fund public projects. They engage in borrowing from financial institutions and issuing bonds that are secured by land, subsidies, or other implicit government guarantees. Municipal corporate bonds (MCBs) are issued by LGFVs , with the term 'municipal' signifying implicit government guarantees (Chen et al., 2020; Gao et al., 2021).

Before the global financial crisis, regulatory constraints had slowed the development of LGFVs. In response to the crisis, the central government launched a substantial stimulus package. The fiscal component, often referred to as the '4 trillion yuan plan', with more than two-thirds of the financing burdened by local governments. To encourage local government financing through LGFVs, the central government introduced a series of policies aimed at expanding credit and deregulating finance (Bai et al., 2016; Cong et al., 2019). LGFVs more dependent on bond financing after the central government further normalized active credit policies in 2010 (Chen et al., 2020).

Provincial governments are allowed to issue municipal bonds directly after the new Budget Law came into force in 2015. Although municipal authorities do not have the discretion to directly issue municipal bonds, the market still believes in the implicit municipal guarantee for LGFVs (Liu et al., 2023). In practice, MCBs' rating reports give priority to the financial condition of local governments. Local governments at all levels have repeatedly resolved LGFVs' debt repayment crises, with no actual defaults occurring.

The determinants of local public financing have focused primarily on fiscal policy (Babina et al., 2021; Gao et al., 2021), local governance quality (Gao et al., 2020), demographic characteristics (Dougal et al., 2019; Butler & Yi, 2022), credit rating (Cornaggia et al., 2018), and other market frictions (Chalmers et al., 2021; Cornaggia et al., 2022).

2.2 MUNICIPAL CORPORATE BONDS AND AIR POLLUTION

Land plays an important role in attracting industrial capital because it is a fundamental input in the production process. The link between LGFVs debt and land finance is as follows. LGFVs are established through financial allocations or contributions of land assets, which directly determine their financing capacity to obtain financial credit lines and bond issuance quotas. Land assets can provide credit enhancement for debt financing, i.e. bank loans and the issuance of MCBs are guaranteed by land transfer revenues. In addition, local governments entrust LGFVs with the development of land and the repurchase of developed land assets at full cost plus an approved profit. These repurchases and land transfer revenues are the main source and important guarantee for the repayment of LGFVs debt. Local governments' capacity to develop and allocate land resources is increasing.

The continued growth of LGFVs debt intensifies land competition to attract investment. To encourage firms to expand their production scale, industrial land is sold at lower prices and land-related tax exemptions are granted. However, this leads to higher levels of pollution. Meanwhile, local governments supply commercial land at high prices to generate land transfer revenues, which is an important guarantee for debt repayment. In addition, the local government tolerates pollutant emissions in consideration of short-term economic interests. Therefore, fierce competition for investment encourages local governments to lower the entry threshold for high-consumption, high-pollution, low-value-added manufacturing industries, thereby increasing pollution.

Hypothesis 1. Local public financing exacerbates pollutant emissions.

3 RESEARCH OBJECTIVE, METHODOLOGY AND DATA

3.1 DATA DESCRIPTION

MCBs data are obtained from Wind Information Co. (WIND) and fully follow WIND's own classification. This data in 2003 is the earliest MCBs data that we can find, and MCBs are assigned to corresponding cities at the municipal level. Data on air pollution and other urban factors, including economic and social conditions, is obtained from the China Urban Statistical Yearbook. We use the 2003 GDP deflator to deflate price indicators and drop observations with values outside the range from 1th to 99th percentile. The final sample consists of 4761 city-year observations, which are derived from 2590 LGFVs in 283 cities and cover the period from 2003 to 2020.

3.2 SUMMARY STATISTICS

Table 1 presents variable definitions. As shown in Table 2, which presents the descriptive statistics, the mean value of MCBs is 0.011, consistent with the existing literature. The intensity of SO2 emission varies from 0 to 0.186, with a mean value close to 0.029.

Tab.1 – Variable definitions. Source: own research

Variable name	Variable definition
SO2 Emission Intensity	total SO2 emissions in tons at the city level/total industrial output value in 10000 yuan.
MCB	municipal corporate bonds issuing amount in million yuan/gross domestic product in million yuan.
Pgdp	gross domestic product in million yuan/permanent residents population.
Spgdp	(gross domestic product in million yuan/permanent residents population)^2.
Fi	budgeted expenditure per capita of municipal finance/expenditure per capita of central finance.

Ind	secondary sector output in million yuan/gross domestic product in million yuan at the city level.
Patent	patent grants amount/permanent residents population.
Edu	expenditure on education costs in 10000 yuan/permanent residents population.
Urb	urban population/permanent residents population.
Dens	permanent residents population in 10000 people/administrative area in square kilometer.

Tab.2 – Descriptive statistics. Source: own research

	N	Mean	SD	Median	Min	Max
SO2 Emission Intensity	4761	0.029	0.033	0.017	0.0004	0.186
MCB	4761	0.011	0.021	0	0	0.102
Pgdp	4761	0.013	0.010	0.010	0.003	0.056
Spgdp	4761	0.0003	0.0005	0.0001	0.000	0.003
Fi	4761	4.065	3.061	3.368	0.807	19.612
Ind	4761	0.471	0.108	0.475	0.195	0.745
Patent	4761	0.001	0.002	0.0002	0.000	0.015
Edu	4761	0.033	0.023	0.027	0.009	0.165
Urb	4761	0.496	0.174	0.480	0.156	0.946
Dens	4761	0.047	0.042	0.038	0.002	0.293

3.3 EMPIRICAL STRATEGY

We exploit the OLS approach to compare the relative changes in local public financing and air pollution, and estimate the following model:

$$SO2\ Emissions\ Intensity_{it} = \alpha + \beta MCB_{it} + \gamma_1 Controls_{it} + \gamma_2 u_t + \gamma_3 v_i + \gamma_4 \delta_{jt} + \varepsilon_{ijt} \quad (1)$$

where $SO2\ Emissions\ Intensity_{it}$ is defined as the ratio of total SO2 emissions to total industrial output value in city i and year t. To improve the reliability of the findings, Soot emission intensity (the ratio of total Soot emissions to total industrial output value) is used in the robustness test. Following Chen et al. (2020), MCB_{it} is denoted by the ratio of total MCB issuance to gross domestic product in the city i and year t. To improve the reliability of the findings, MCBsize (total MCBs issuance) is used in the robustness test. Following Liu et al. (2023), $Controls_{it}$ denotes city-level control variables, including *Pgdp*, *Spgdp*, *Fi*, *Ind*, *Patent*, *Edu*, *Urb*, *Dens* (described in

Table 1). *Pgdp* and *Spgdp* measure economic development and are positively correlated with pollutant emissions. *Fi* measures the financial autonomy of local government, and the higher it is, the more attention it may pay to growth rather than the environment. *Ind* measures the proportion of the secondary sector output in gross domestic product (GDP). The higher the proportion, the more pollutants are emitted. *Patent* measures technological innovation. Some argue that technological progress can improve energy efficiency and reduce pollution, while others claim that it increases energy consumption and worsens pollution. *Edu* measures investment in education, and the higher it is, the lower the emissions. *Urb* measures the rate of urbanization, where a higher rate of urbanization means more emissions. *Dens* measures population density, and the more densely populated an area is, the more emissions it produces. We include city-level fixed effects v_i, year fixed effects u_t and province-by-year fixed effects δ_{jt}, which allow us to absorb systematic differences across cities, years and provinces in different years. Standard errors are clustered at the city level in all specifications.

4 RESULTS AND DISCUSSION

4.1 BASELINE RESULTS

The baseline estimates of Equation (1) are presented in Table 3. As shown in columns (1) and (2), the estimates remain statistically significant and stable when various levels of fixed effects and city-level controls are included. Our findings are consistent with previous studies, which indicate that government debt is an important determinant of energy consumption (Sun and Liu, 2020). Therefore, local public financing results in increased air pollution.

Tab.3 – Baseline regressions. Source: own research

	SO2 Emission Intensity	
	(1)	(2)
MCB	0.053** (2.11)	0.040** (2.27)
Pgdp		-0.883*** (-3.55)
Spgdp		9.677** (2.46)
Fi		0.001*** (2.60)
Ind		-0.052*** (-8.72)
Patent		0.356 (1.31)

Edu		-0.111*** (-2.61)
Urb		-0.004 (-0.79)
Dens		0.004 (0.37)
Cons	-2.440*** (-7.35)	-3.696** (-2.05)
Year FE	✓	✓
City FE	✓	✓
Province × Year FE	✓	✓
Adj. R^2	0.369	0.387
Observations	4761	4761

Notes: The t-statistics are adjusted for clustering at the city level using the standard error and are displayed below the estimate. *, ** and *** indicate significance at the 10%, 5% and 1%, respectively.

4.2 ROBUSTNESS TESTS

4.2.1 INSTRUMENTAL VARIABLE ESTIMATION

The average slope and the distance to Beijing are chosen as instrumental variables. First, the higher the average slope, the less likely it is that a large city will be established and the fewer funds raised by LGFVs will be used primarily to build urban infrastructure. This satisfies the correlation of instrumental variables. As a natural geographic variable, the average slope should be orthogonal and relatively exogenous to air pollution.

Second, the Ministry of Finance, the State Council and other departments regulate the issuance of MCBs to strictly control the risk of hidden debt. The closer to Beijing, the more likely the authorities will regulate it. This makes it less favourable for MCBs issuance. This satisfies the relevance of the instrumental variable. Meanwhile, distance to Beijing is a natural geographic factor, and there is no evidence that distance to Beijing directly or indirectly affects air pollution, satisfying the exogeneity of the instrumental variable. To account for potential time trends, the distance to Beijing is measured using the natural logarithm of the cross-multiplication term of distance and year.

As shown in Table 4, in the first stage, the estimates are significantly negative and the F-values are greater than 10. This suggests that the instrumental variables are reasonable and satisfy the weak instrumental variables test. In the second stage, the estimates of the MCB are significantly positive, indicating that our baseline results are reliable and valid.

Tab.4 – Instrumental variable estimation. Source: own research

	SO2 Emission Intensity	
	The Average Slope	*The Distance With Beijing*
	(1)	(2)
MCB	2.404* (1.72)	0.761* (1.79)
Pgdp	-4.127*** (-3.67)	-2.866*** (-7.42)
Spgdp	58.512*** (2.97)	36.409*** (5.41)
Fi	-0.001 (-0.94)	0.0002 (0.31)
Ind	0.091*** (2.63)	0.052*** (4.49)
Patent	-2.595 (-1.07)	0.195 (0.25)
Edu	0.424 (1.42)	0.088 (0.87)
Urb	-0.024 (-0.98)	0.004 (0.44)
Dens	-0.120*** (-3.00)	-0.081*** (-4.79)
Cons	0.038** (2.38)	0.048*** (5.45)
Year FE	✓	✓
City FE	✓	✓
Province × Year FE	✓	✓
1st Stage	-0.0001** (-2.07)	-0.006*** (-4.15)
1st Stage F Statistic	52.30	52.68
Observations	4761	4761

Notes: The t-statistics are adjusted for clustering at the city level using the standard error and are displayed below the estimate. *, ** and *** indicate significance at the 10%, 5% and 1%, respectively.

4.2.2 ALTERNATIVE MEASURES

First, we use a more flexible measure of Soot emission intensity. As shown in column (1) of Table 5, including air pollution variables in the estimation did not change our baseline results. Second, in column (2), the alternative MCB measure remains statistically significant. Third, in column (3), we examine the robustness using

alternative sample data by excluding province-level city cities. We find that the estimates are similar to the baseline results.

Tab.5 – Robustness tests. Source: own research

	Soot Emission Intensity		*SO2 Emission Intensity*	
	(1)	(2)	(3)	(4)
MCB	0.017** (2.29)			
MCBsize		0.128** (2.45)		
MCB_noprovince level city			0.042** (2.34)	
MCB_nogreen				0.041** (2.29)
Pgdp	-0.006*** (-3.73)	-0.009* (-1.85)	-0.009*** (-3.73)	-0.009*** (-3.55)
Spgdp	0.001*** (3.74)	0.001 (1.61)	0.001*** (2.58)	0.001** (2.47)
Fi	-0.001* (-1.70)	0.001 (1.45)	0.001*** (3.18)	0.001*** (2.60)
Ind	-0.027*** (-5.98)	-0.052*** (-4.24)	-0.054*** (-8.79)	-0.052*** (-8.72)
Patent	0.000 (0.61)	0.000 (0.18)	0.000 (1.04)	0.000 (1.31)
Edu	0.049 (1.58)	-0.115* (-1.91)	-0.132*** (-2.80)	-0.111*** (-2.61)
Urb	0.003 (0.82)	-0.003 (-0.34)	-0.003 (-0.75)	-0.004 (-0.80)
Dens	0.004 (0.95)	0.004 (0.28)	0.005 (0.37)	0.004 (0.38)
Cons	-1.014*** (-4.34)	-3.590*** (-5.33)	-3.880** (-2.13)	-3.701** (-2.05)
Year FE	✓	✓	✓	✓
City FE	✓	✓	✓	✓
Province × Year FE	✓	✓	✓	✓
Adj. R^2	0.532	0.387	0.387	0.387
Observations	4761	4761	4689	4761

Notes: The t-statistics are adjusted for clustering at the city level using the standard error and are displayed below the estimate. *, ** and *** indicate significance at the 10%, 5% and 1%, respectively.

4.2.3 ALTERNATIVE INTERPRETATIONS

LGFVs have issued green MCBs to bridge the funding gap for the urban infrastructure. For green MCBs, the issuance standard, the regulatory requirements for fundraising investments, fund management and information disclosure are stricter than for MCBs. As shown in column (4) of Table 5, the estimates are numerically similar to the baseline results after excluding green MCBs. Thus, we can rule out the impact of green bonds on our baseline findings.

4.3 TESTING FOR UNDERLYING MECHANISMS

4.3.1 INDUSTRIAL LAND COMPETION

Our theoretical analysis suggests that local public financing exacerbates air pollution, primarily due to competition for industrial land. As shown in Table 6, when the area of industrial land is used as the explained variable, the estimates are significantly positive. This indicates that more MCBs are issued, the more the supply of industrial land increases. Therefore, competition for low quality land is a potential driving factor behind our baseline findings.

Tab.6 – The role of industrial land. Source: own research

	Industrial Land	
	(1)	(2)
MCB	0.562***	0.397**
	(3.27)	(2.54)
Pgdp		0.184
		(0.07)
Spgdp		-16.746
		(-0.35)
Fi		-0.004
		(-0.60)
Ind		-0.042
		(-0.77)
Patent		22.725***
		(3.34)
Edu		0.423
		(0.65)
Urb		-0.011
		(-0.15)
Dens		0.342
		(1.53)
Cons	76.827***	77.547***
	(33.07)	(15.97)

Year FE	✓	✓
City FE	✓	✓
Province × Year FE	✓	✓
Adj. R^2	0.220	0.258
Observations	4761	4761

Notes: The t-statistics are adjusted for clustering at the city level using the standard error and are displayed below the estimate. *, ** and *** indicate significance at the 10%, 5% and 1%, respectively.

4.3.2 GOVERNMENT IMPLICIT GUARANTEE

The market still believes in the implicit municipal guarantee for LGFVs (Liu et al., 2023). The implicit guarantee is measured using fiscal revenues and the fiscal self-sufficiency rate (general public budget revenues/expenditures), which are obtained from the China Urban Statistical Yearbook. The higher these figures are, the better the implicit guarantee. Table 7 shows that the estimates of the cross-multiplier term are significantly negative. This suggests that the better the local financial situation, the weaker the negative externalities of local public financing on the environment.

Tab.7 – The role of government implicit guarantee. Source: own research

	SO2 Emission Intensity	
	(1)	(2)
MCB×Revenue	-1.634*** (-2.77)	
Revenue	0.179*** (7.01)	
MCB×Ft		-0.191*** (-2.65)
Ft		0.007* (1.67)
MCB	0.174*** (3.28)	0.133*** (3.38)
Pgdp	-0.820*** (-3.30)	-0.934*** (-3.75)
Spgdp	9.454** (2.41)	10.485*** (2.67)
Fi	0.0004 (1.11)	0.010** (2.54)
Ind	-0.054*** (-8.91)	-0.055*** (-9.05)
	0.601**	0.540*

Patent	(2.18)	(1.92)
Edu	-0.077* (-1.79)	-0.106** (-2.49)
Urb	-0.005 (-1.19)	-0.004 (-0.88)
Dens	0.004 (0.32)	0.003 (0.26)
Cons	-3.184* (-1.75)	-2.922 (-1.61)
Year FE	✓	✓
City FE	✓	✓
Province × Year FE	✓	✓
Adj. R^2	0.392	0.388
Observations	4739	4761

Notes: The t-statistics are adjusted for clustering at the city level using the standard error and are displayed below the estimate. *, ** and *** indicate significance at the 10%, 5% and 1%, respectively.

4.3.3 GOVERNMENT MONITORING

China's current environmental protection system gives local governments more discretion to flexibly adjust the strength of environmental regulation. We measure local environmental regulation by calculating the ratio of environmental regulation investment to real GDP. Data are from the China Urban Statistical Yearbook and are grouped by median. As shown in Table 8, the estimates are not significant for the sub-sample with good environmental regulation. Meanwhile, where environmental regulation is poor, the estimates are significant. These results suggest that environmental regulation can effectively reduce the environmental externalities of local public financing.

Tab.8 – The role of environmental governance. Source: own research

	SO2 Emission Intensity	
	High Environmental Regulation	Low Environmental Regulation
	(1)	(2)
MCB	0.005 (0.10)	0.054** (2.08)
Pgdp	-0.014*** (-2.78)	-0.001 (-0.26)
Spgdp	0.002*** (2.96)	-0.0001 (-0.13)

Fi	0.002* (1.67)	-0.001** (2.35)
Ind	-0.052*** (-2.95)	-0.056*** (-6.55)
Patent	0.0002*** (3.23)	0.0001*** (4.09)
Edu	-0.137 (-1.32)	0.090 (1.34)
Urb	-0.024** (-2.30)	0.016** (2.39)
Dens	-0.054 (-1.53)	0.020 (1.20)
Cons	0.074*** (6.11)	-0.052*** (9.16)
Year FE	✓	✓
City FE	✓	✓
Province × Year FE	✓	✓
Adj. R^2	0.717	0.746
Observations	2312	2327

Notes: The t-statistics are adjusted for clustering at the city level using the standard error and are displayed below the estimate. *, ** and *** indicate significance at the 10%, 5% and 1%, respectively.

5 CONCLUSION

Given the current backdrop of local government debt pressures in China, the environmental consequence of local public financing are significant. LGFVs' reliance on land finance is a product of central government fiscal reforms and restrictions on direct local government borrowing. LGFVs have provided critical funding for infrastructure investment by using land assets as collateral, creating a close link between LGFVs debt and land finance. The continued growth of LGFVs debt intensifies competition for land to attract investment, encouraging firms to expand their production scale, which in turn increases pollution.

Exploiting the issuance of MCBs by LGFVs, we find that local public financing exacerbates air pollution, and the above conclusion remains robust to instrumental variables and other robustness tests. Specifically, the expansion of the industrial land supply has attracted high-consumption, high-pollution, low-value firms, thereby increasing air pollution. Meanwhile, the better financial situation and stricter environmental regulation, the less negative impact of the local public financing on air pollution. The intensification of LGFVs debt risk has affected fiscal solvency and exacerbated the risk to the broader financial system. Thus, investors and policymakers

need to closely monitor the vulnerability of LGFVs debt.

Some limitations and directions for future research are discussed. Although we attempt to deal with endogeneity using instrumental variables, not all confounding factors may have been controlled for, and further research could use randomized controlled trials (RCT) to narrow down confounding factors and provide stronger identification. An important topic for future research is the other non-economic consequences and social welfare of local public financing.

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We acknowledge financial support from National Social Science Foundation of China (20BGL030) and National Natural Science Foundation of China (72002198).