Environmental Impact Assessment Review 86 (2021) 106476

Contents lists available at ScienceDirect

Environmental Impact Assessment Review

journal homepage: www.elsevier.com/locate/eiar

How can environmental intervention work during rapid urbanization? Examining the moderating effect of environmental performance-based accountability in China

Bo Yan[a,*], Long Wu[a], XiaoHu Wang[b], Jiannan Wu[c]

[a] School of Public Policy and Administration, Xi'an Jiaotong University, 28 XianNing West Road, Xi'an City, Shaanxi Province 710049, China
[b] Department of Public Policy, City University of Hong Kong, 83 Tat Chee Avenue, Kowloon 999077, Hong Kong
[c] China Institute for Urban Governance, Shanghai Jiao Tong University, 1954 Huashan Road, Shanghai 200030, China

ARTICLE INFO

Keywords:
Governmental environmental intervention
The environmental performance-based accountability system
China environmental policy and governance
Environmental Kuznets curve

ABSTRACT

For the past three decades, ecological decline associated with rapid urbanization has been a global phenomenon, particularly in developing countries, where economic growth is often financed through off-budget earmarked revenue sources such as land sales. Under this context, governmental intervention to improve the environment may not be effective if such intervention suppresses land sales revenues, because these revenues are also used to finance environmental protection projects. What is the relationship between land revenues and environmental quality? More importantly, how does governmental intervention to improve the environment influence this relationship? Employing panel data of 31 provinces in China from 2000 to 2015, this study empirically answers these questions. We find that land financing strongly influences pollution in an inverted U-shape pattern, where local land revenues increase pollution until a turning point at which a decline in pollution is observed. More importantly, we find that environmental intervention programs can accelerate the decline in pollution. These findings establish the moderating impact of environmental intervention programs within a rapid urbanization context.

1. Introduction

For the past several decades, land grant premiums (i.e., revenues from land sales) have been a major revenue source for many governments such as mainland China, Hong Kong, Singapore, India, and others (Mathur, 2013; Murakami, 2018; Wu et al., 2015). Lands are often sold or used as collateral to finance infrastructure programs to boost economic growth and urbanization in these countries (Ji and Zhang, 2020; Theriault et al., 2020). For example, in Hong Kong, land sales normally take about one-fifth of the government's total revenues (Hong Kong Government Budget 2020–21). The figure is even larger in mainland China where land premiums normally comprise more than half of total local revenues (Huang and Chan, 2018). In terms of their uses, land revenues are normally earmarked in governmental revenue systems to finance urbanization projects (including environmental projects), economic growth projects, and infrastructure projects including environmental infrastructure (Tong et al., 2019; Zhu et al., 2019).

Meanwhile, rapid urbanization and growth are associated with ecological decline (Shao et al., 2020). Severe environmental issues, such as air pollution, have led to many governmental actions and interventions (Zheng and Kahn, 2017). The Chinese government has implemented a series of important environmental intervention policies and programs — such as performance responsibility systems, regional collaborations, and reforms in environmental monitoring — to tackle significant pollution problems associated with urbanization and economic growth (Niu et al., 2020; Wang et al., 2019; Zheng and Kahn, 2017). These policy initiatives were made within a centralized decision-making structure but through a decentralized network of local implementers. The central government expects these policies to have a significant strengthening effect on environmental institutions and positive policy outcomes (Wang and Lei, 2020). One of the most significant and drastic policy actions occurred in 2007, when the central government started assessing high-ranking local officials' responsibilities in pollution control outcomes in the Environmental Performance-Based Accountability (EPBA) system.

The EPBA was implemented in response to serious pollution, presumably caused by local economic growth and drastic local infrastructure development during the process of urbanization (Pang et al.,

* Corresponding author.
E-mail address: yanbosir@xjtu.edu.cn (B. Yan).

https://doi.org/10.1016/j.eiar.2020.106476
Received 2 February 2020; Received in revised form 2 August 2020; Accepted 13 September 2020

2019), which was financed through various local government financing platforms (LGFPs), most notably local land financing mechanisms. Land financing, often portrayed by local governments in China as a major form of policy innovation that boosts economic growth (Huang and Chan, 2018), allows local authorities to mortgage land for the premiums needed to carry out infrastructure development in the pursuit of GDP growth, which is a major government performance assessment criterion for local officials. While being seen as a major form of policy response in the rapid urbanization process (Wu et al., 2019), land financing has been recognized as a culprit in rapidly deteriorating environmental quality (Huang and Du, 2018).

The significance of this research lies in its description and critical assessment of this centralized policy-making process and consequential enforcement mechanisms, as part of an environmental policy governance model that differs significantly from the incremental and decentralized environmental policy-making largely seen in the Western context. Moreover, the findings should help policy-makers better understand how environmental assessments work under various local fiscal circumstances.

2. Framework

In this section we consider the impact of land financing on pollution and how environmental assessments may moderate this impact. We describe the rationale and key components of the EPBA as an environmental policy intervention within the Chinese context and highlight differences in motives, policy-making processes, the capacity invested, and the enforcement strength in comparison with Western systems.

2.1. Land financing and its impact on pollution

Land financing (or land finance) is a proactive approach to public land leasing by local governments in China. It is a major fiscal policy initiative, rather than just a financing mechanism (Wang and Ye, 2016). Land revenue normally refers to a local government's off-budgetary sources that come from transferring multiannual land use rights (Shu et al., 2018; Tu and Padovani, 2018). In China, land use rights can only be owned by the state or by rural collectives, according to the dual land regime asserted by the current Constitution of the People's Republic of China enacted in 1982 (Ong, 2020). Apart from directly leasing the land owned by the state for non-profit uses or the mandatory building of national key projects, local governments can expropriate land owned by rural collectives, usually at a low price, with the aim of urbanizing it. Local governments can then convey the land use rights to real estate developers or private users at higher prices through competitive bidding (Tu and Padovani, 2018; Zhu et al., 2019). By this process, local governments can obtain considerable land grant premiums, which usually account for 60% to 80% of local governments' total revenues; this was a major source of extra-budgetary revenues for local governments in the past decades (Huang and Chan, 2018; Tang et al., 2019; Wu et al., 2015).

The predominant role of land financing in local governments' fiscal system reflects an evolving intergovernmental fiscal regime in response to China's rapid economic and administrative reforms (Zhang, 2018). The history of land financing dates back to local experimentations in the 1980s (Wu et al., 2015), but has only become popular since the early 1990s, when the central government, with recentralized revenues due to the 1994 Tax-Sharing Reform, allocated fewer resources to local governments (Xu, 2019). Local governments, facing dwindling resources and growing local needs for public services, resorted to land financing by incorporating the revenues from land transactions into the local fiscal system. This became a significant revenue source due to the housing reform in the late 1990s that saw the local housing market privatized (Jia et al., 2020). The performance assessment system in China accelerated this trend. In China, capital projects are local governments' favorite investment targets because of their revenue generation potential; local officials have been traditionally evaluated by local GDP growth that is largely tied to infrastructure development (Yu et al., 2019). Accordingly, land financing, linked with the proliferation of capital projects, has become a key driver of China's rapid economic growth since the 1990s (Wang and Hui, 2017).

The relationship between land financing and pollution is complex but can be understood from two perspectives. In the short term, land financing, due to its emphasis on economic infrastructure development and residential housing projects, may dry out immediate local resources that could otherwise be used for environmental protection, including pollution control. In the longer term, however, fiscal revenue generated from land financing can be used in pollution control after a level of economic development is achieved.

Land financing is used to finance local infrastructural development (Huang and Chan, 2018), which constitutes a significant part of local GDP growth. Because GDP growth is explicitly used to evaluate local governments' performance in performance assessment systems in China, local governments benefit more from infrastructure development than from the growth of non-infrastructure projects, such as general environmental expenditure. Thus, land financing reflects a strategic choice made by local governments in response to continuous expenditure demands for local economic development under a decentralized intergovernmental fiscal structure and a GDP-centered assessment system (Wu et al., 2019).

This strategy inevitably leads to various negative environmental outcomes, including pollution (Xie and Sun, 2020). In order to pursue rapid economic growth, a local government is inclined to transfer underdeveloped lands, as the most basic element of industrial production, to energy-intensive and pollution-inducing industries (e.g., steel, cement, electrical power); this would directly attract vast numbers of investments in fixed assets but would also contribute to an increase in emissions from land use and industry development (Dong et al., 2018; Tang et al., 2018). Since an increase in emissions in most of these industries leads to severe problems regarding energy consumption and pollution (Yao et al., 2018), the ecological environment across the country has been under great stress for decades.

Nevertheless, land financing can benefit pollution control as well. As resources generated from land financing are normally not earmarked for infrastructure development and can be treated as general revenues in the Chinese system, they can be used for environmental purposes. For instance, local infrastructure development financed through land financing can prompt international investments that help local enterprises upgrade their technological levels, thereby directly contributing to reducing emissions of PM2.5 (Xie and Sun, 2020). Thus, at least in theory, land financing may also represent efforts to grow fiscal resources that can be used for environmental protection. This view is consistent with that of the Environmental Kuznets Curve (EKC), which indicates that, in the early stages of economic growth, pollution increases with the growing use of resources but, when a certain level of economic growth is reached, the trend reverses, so that further growth leads to environmental improvement (Alam et al., 2016; Le and Ozturk, 2020; Sarkodie and Ozturk, 2020). The above arguments suggest a curvilinear function between land financing and pollution that can be specified as follows.

Hypothesis 1. *Land financing increases pollution in the short term, with growing infrastructure outputs, but, in the long term, reduces pollution, with greater fiscal resources for environmental protection, forming an inverted U-shaped relationship.*

2.2. The environmental performance-based accountability (EPBA) system and its moderating effects

Rapid industrialization and urbanization have contributed to China's ecological decline since the late 1970s (Shao et al., 2020). The central government has implemented policy reforms and various innovations to reinforce environmental protection, and has already issued nearly 400 major legislative terms and policy measures since the early 1970s to combat environmental problems (Mu, 2018a). Among these national laws and policies emerges a rather centralized environmental governing structure, with a super-ministry of the central government responsible for the rapid mobilization of power and resources to influence and coordinate local implementations (Wen, 2020). In this system, the central government sets environmental targets, assigns local responsibilities, and monitors implementation and policy outcomes (Wu and Hu, 2019).

Under this environmental governing context, the EPBA system has been promoted as a major policy initiative to tackle increasing pollution problems facing the nation since the early 2000s. The EPBA system, as a central government policy initiative, was experimentally implemented by selected provincial governments starting in the mid-2000s, fully implemented among all provinces starting in 2007, and reinforced with new measurement in 2011. It mainly consists of two components: (a) an environmental performance measurement system and (b) a target responsibility system that holds local officials accountable for environmental outcomes (Wang and Lei, 2020). The latter is known as the One-Vote Veto, in which underachievement in environmental outcomes can be the sole reason for punishment, such as reduced wages and benefits, demotions, the retraction of previous honors, or even dismissal (Kennedy and Chen, 2018; Wu et al., 2018). By linking an official's career advancement with environmental measures, the EPBA hopes to make environmental targets high-stake and high-priority for local officials. The EPBA has been implemented with a campaign-style enforcement characterized by highly-centralized resource mobilization, highly-specified policy goals, and empowered local authorities (Shen and Ahlers, 2019). National performance targets were allocated to local governments with strict policy mandates regarding performance expectations and consequential results if such expectations were not met (Jin, 2017). More than 180,000 local officials had been sanctioned under the EPBA mechanism by early 2018.

The EPBA emphasizes the individual responsibilities of high-level officials and the rapid deployment of institutional capacities to control pollution. It has been touted by the Chinese government as a major policy innovation aimed at improving environmental quality. Policy advocates expect the EPBA to motivate local officials to implement environmental regulation policies to achieve economic growth that also considers environmental needs (Chen et al., 2018). Unlike environmental governance practices of decentralized systems in many Western countries, bureaucratic mandates from above are the core of Chinese environmental governance (Wen, 2020). The EPBA reflects this practice, as summarized in Table 1, in comparison to the Western context.

The EPBA is expected to mitigate local preferences regarding economic growth. By integrating environmental criteria in assessments, the central government expects to influence local decision-making toward a more balanced growth model that considers the environmental impact of economic growth. The EPBA is expected to increase environmental resource inputs in the short term and, in the long term, to become institutionalized in local decision-making for a more balanced growth model. This thinking coincides with the first hypothesis in that resources allocated to the environment become greater over time due to greater resources from land financing, which results in an accelerated impact to reduce pollution, moderated by the EPBA, as specified in the following hypothesis.

Hypothesis 2. *The EPBA accelerates the long-term impact of land financing on pollution, resulting in an increasing impact to reduce pollution (*i.e.*, an earlier arrival of the turning point in the inverted U-curve).*

3. Method

3.1. Data and variables

We constructed a panel data-set covering 31 provinces in China from 2000 to 2015 —

the period of the most rapid growth of land financing and significant environmental deterioration in China. Meanwhile, the EPBA was formally implemented across the country in 2007 when almost all leaders of provincial government began to be held accountable for environmental performance targets with career consequences. Subsequently, the central government reinforced this system in 2011 by adding new mandated indicators. Hong Kong, Macau, and Taiwan are excluded due to their significant socio-economic or institutional differences. Data in this research derive from the China Land and Resources Statistical Yearbook, the China Environmental Yearbook, and the China Statistical Yearbook. The values of the variance inflation factors (VIF) of all variables are less than 10, indicating that multicollinearity is not a concern in this data.

Land financing was measured by land grant premiums, as suggested by Wu and colleagues (Wu et al., 2015). The quadratic term of land financing (LF^2) was used to measure its nonlinear relationship (inverted U-shape) with pollution (Shao et al., 2019; Wang and Wang, 2019). Pollution is measured by the emission levels of four types of priority pollutants mandated by national five-year plans that specify specific control targets for local governments (Liu and Liang, 2017): chemical oxygen demand (COD) and sulfur dioxide (SO_2), as required in the EPBA since 2007, and ammonia nitrogen (NH_x) and nitrogen oxides (NO_x), as required in the EPBA since 2011. Consequently, two dummy variables in 2007 and 2011 were constructed to measure the effects of land financing on pollution. An interaction term, $LF^2 \times EPBA$, constructed through the mean-centering approach, was created to estimate the moderating effects (Hayes, 2017; Liu et al., 2019; Yu et al., 2019) of the EPBA on the relationships between land financing and pollution. All the variables, aside from the EPBA (dummy variable), industrialization, and the number of employees working in a government's environmental protection units (ratio variable), are transformed to the natural logarithm scale in order to control significant regional differences and model heteroscedasticity. The descriptive statistics of each variable are

Table 1
The distinctive features of the EPBA as an environmental policy initiative.

	The EPBA	The Western Context
Major policy motives	Mainly political concerns over issues such as civil protests against pollution, in addition to environmental motives	Mainly environmental considerations due to ecological quality decline and natural resource depletion
Policy making process	Centralized top-down and campaign-style with the central government in charge of policy making and local governments as implementers	Legally based, systematic, and often incremental approaches, normally within a decentralized system with various levels of governments making policies for the issues of their own interests, with involvement of various stakeholder groups
Implementation capacity invested	Significant investment of the central government and rapid deployment of resources	Resource allocations competing with other needs
Responsibility focus	Individual high-ranking officers are hold responsible for policy outcomes	Normally, systems or institutions are accountable though individual managers are assessed as well
Enforcement accountability	Linked directly to individual officials' career advancement opportunity and financial incentives	Linked mainly to institutional factors such as budgets or institutional changes

Table 2
Descriptive statistics, 2000–2015.

Variables		Obs.	Mean	SD	Min	Max
Land Financing (*LF*)		496	14.264	1.992	6.227	17.929
Environmental Performance-based Accountability (EPBA)		496	0.313	0.464	0	1
Pollutants Emission	COD	496	3.449	0.900	−0.223	4.828
	SO2	496	3.820	1.331	−2.526	5.300
	NHx	434	1.237	0.927	−2.303	2.839
	NOx	306	3.630	1.053	−2.303	5.001
Control Variables	Population (POP)	496	8.068	0.867	5.568	9.292
	Industrialization (IND)	496	0.463	0.084	0.010	0.615
	Public Participation (PP)	496	8.544	1.527	2.773	11.656
	Environmental Protection Employee (EPE)	496	13.886	5.366	5.025	32.999
	Expenditure of Cultural, Sports & Media (ECSM)	496	3.216	0.990	0.327	5.278

shown in Table 2.

In this research, the use of panel data with space-time and cross-sectional configuration of variables, as employed in many environmental governance studies (Baltagi, 2008; Postula and Radecka-Moroz, 2020; Zhang, 2020), should alleviate the concern of omitted variables, which will be elaborated in the modeling process below.

3.2. The model

Proper control is important for modeling (Lo and Broto, 2019), though it is not always feasible and necessary to create an all-inclusive model for model control due to the concerns of data availability and reliability. The modeling process of this research considers (a) the impact of land financing on pollution and (b) the moderating effect of a central government assessment scheme (EPBA) on the impact, while controlling contextual and institutional variables. The process considers the literature on pressure-state-resources (PSR) to identify contextual variables of socioeconomic and environmental pressures (Wang, 2011; Wang and Berman, 2014), and Neo-institutional Theory (Liu et al., 2016; Suddaby et al., 2013; Wang and Chen, 2014) and Resource Dependence Theory (Malatesta and Smith, 2014; Pang et al., 2019) for institutional variables of resource and capacity.

Environmental pressures are captured in the model by measuring the population size and industry share of GDP for ecological stress and the number of residents' environmental petitions regarding socio-political pressure (Czyżewski et al., 2020; Wu et al., 2018). Moreover, institutional resources and capacity are measured by the number of employees working in a government's environmental protection units (Zhang and Cao, 2017). As a measure of institutional political dynamics (specifically concerning resource allocation decisions in which various public services compete for limited funding), government spending on cultural elements, sports, and the media is used as a proxy for non-environmental services that are expected to compete for funding with environmental services; this measure is thus expected to have a negative influence on the pollution measures in the model (Wang, 2011; Wang and Berman, 2014).

In modeling the relationship between land financing (LF) and pollution level, we adopt a form of curvilinear relationship between economic development level and environmental pollution level as specified in the existing EKC studies (Sarkodie et al., 2020; Sarkodie and Strezov, 2019). We use traditional Hausman test (Hausman, 1978) and corrected Huasman test by the auxiliary regression (Wooldridge, 2010) to choose fixed effect model instead of random effect model for estimation. The *F*-statistic results imply that both individual fixed effect and time fixed effect should be introduced into the model (Baltagi, 2008), because the degree of land financing and environmental governance varies with provinces and years. Therefore, the basic model is specified as follows:

$$Pollution_{it} = \alpha + \beta_1 LF_{i\,t-1} + \beta_2 LF^2_{i\,t-1} + \gamma_k X_{it} + \lambda_t + \mu_i + \varepsilon_{it} \tag{1}$$

where $Pollution_{it}$ represents the annual environmental pollutant emissions in year t in province i. LF_{it-1} indicates the land financing level in a province in year t-1. LF^2_{it-1} is the quadratic term of LF_{it-1}, used to test the curvilinear impact of land financing on pollution. The control variables (X_k) include socioeconomic and environmental variables, such as population (*POP*), industrialization (*IND*), and public participation (*PP*), and institutional variables, for instance, environmental protection employee (*EPE*) and expenditure of cultural, sport & media (*ECSM*). Besides, λ_t is used to control the time effect, μ_i is used to control the individual effect, and ε is the stochastic term.

With the moderating effect of the EPBA included, the model is expressed as follows:

$$\begin{aligned} Pollution_{it} = {} & \alpha + \beta_1 LF_{i\,t-1} + \beta_2 LF^2_{i\,t-1} + \beta_3 EPBA_{i\,t-1} \\ & + \beta_4 LF_{i\,t-1}{}^2 \times EPBA_{i\,t-1} + \gamma_k X_{it} + \lambda_t + \mu_i + \varepsilon_{it} \end{aligned} \tag{2}$$

In Eq. (2), the EPBA indicates the central government intervention, and the interaction item of $LF_{it-1}{}^2 \times EPBA_{it-1}$ represents the moderating effect of the EPBA on the impact of land financing on pollution. The meanings of the other parameters are the same as in Eq. (1). Moreover, β_1 and β_2 denote the regression coefficients of the impact of land financing on pollution. β_3 is the estimated coefficient of the governmental intervention. β_4 is the estimated coefficient of the moderating effect.

3.3. Model robustness

We conducted the Cross-Sectional Dependence test, the Individual Heterogeneity test, and the Panel Stationary test step by step to ensure model estimate robustness (Le and Sarkodie, 2020; Xie and Sun, 2020).

First, the spatial correlations across provinces were examined using the Cross-Sectional Dependence test. Because our data (a short panel dataset) are characterized by large sample sizes (*N*) and small time series (*T*), the Lagrange Multiplier (LM) test is no longer applicable (Pesaran et al., 2008). We employed both the semi-parametric tests with the time effect (Frees, 2004) and the parametric tests (Pesaran, 2004). Both methods can properly treat balanced panels with small *T* and large *N*. Furthermore, we corrected the cross-sectional dependence problem reflected in Table 3 in the next steps.

Second, we estimated the individual heterogeneity through the Intercept Heterogeneity test. The standard assumption in panel data analysis is that the intercept coefficients are homogeneous across the sample, but the assumption is not applicable when the individual observations are at different development stages. So we utilized the *F*-statistic for individual homogeneous tests by which the null hypothesis is that the observations across individuals and time is homogeneity of regress coefficients (Baltagi, 2008). Table 3 shows that the null hypothesis is rejected, which means that there are different intercept coefficients among provinces. According to Driscoll and Kraay (1998), we adopted the fixed effect model with Driscoll-Kraay standard error to correct the cross-sectional dependence and individual heterogeneity for efficient and unbiased estimations (Driscoll and Kraay, 1998).

Third, we followed the Levin-Lin-Chu (LLC) procedure of Panel Unit

Table 3
The result of the CD test and heterogeneity test.

Dependent Variable	CD test				Heterogeneity test	
	Pesarans's test	abs	Free's test	alpha = 0.01	F statistic	*p*-value
COD	−2.043**	0.487	5.423***	0.335	38.62***	0.000
SO_2	−2.274**	0.475	5.819***	0.335	163.41***	0.000
NH_x	−1.708*	0.436	5.256***	0.360	33.37***	0.000
NO_x	5.468***	0.452	3.257***	0.581	19.12***	0.000

Notes: *p < .1,**p < .05,***p < .01.

Table 4
Results of stationary properties of panel data.

Dependent Variable	Adjusted t*	p-value
COD	−10.533***	0.000
SO_2	−7.291***	0.000
NH_x	−9.354***	0.000
NO_x	−19.245***	0.000
LF	−14.043***	0.000
POP	−6.641***	0.000
IND	−3.173***	0.000
PP	−10.694***	0.000
EPE	−8.998***	0.000
ECSM	−8.868***	0.000

Notes: *p < .1,**p < .05,***p < .01.

Root test to identify the stationary properties of panel data before estimation (Levin et al., 2002). The LLC test assumes that a panel dataset contains unit roots and it allows the model to add fixed effects or time trends. We added a demean option to alleviate cross-sectional dependence issues. The results show that the null hypothesis is rejected in all variable tests at the 1% significance level, which means this panel dataset is stationary and can be used for subsequent estimation (Table 4).

Besides the above analyses, two other estimation methods — the fixed effect model with White Cluster standard error, and the Feasible Generalized Least Squares (FGLS) model — were employed as further robustness tests (Greene, 2003). The results confirmed our model estimations as robust.

4. Findings

The trends of land financing (annual land grant premiums) and the four pollutant emissions are displayed in Fig. 1. The figure shows a growing trend in land financing, along with fluctuating but generally declining trends of pollutant emissions. Three of the four pollutant emissions in this research (COD, SO_2, and NH_x) show an upward trend with the growth of land financing before 2007, turning downward since. Moreover, the pollution trends of COD, SO_2, and NO_x have declined significantly since 2011.

The statistical results of the model effects (i.e., the impact of land financing on pollution; Hypothesis 1) and the moderating effects of EPBA (Hypothesis 2) are reported in Table 5 and Table 6, respectively.

4.1. The model effects

The results in Table 5 show that all four pollutant emissions measured in the models display a curvilinear relationship with the independent variable land financing, demonstrated by the squared term of the land financing variable (LF) at a statistically significant level of 0.05, confirming the inverted U-shaped curve (Hypothesis 1). Specifically, an increase of 1% in land grant premiums respectively increases COD emissions by 0.366%, SO_2 emissions by 0.561%, NH_x emissions by 0.199%, and NO_x emissions by 0.646%. Nevertheless, as demonstrated by the negative coefficient of a LF^2 term, land financing is negatively associated with pollutant emissions when it reaches a certain stage in time for an inverted U relationship. For example, the discharge of COD reduces 0.015% when the LF^2 increases by 1%. The results suggest that land financing affects environmental outcomes in a nonlinear way, in that land financing increases pollution until a turning point is reached, at which point pollution starts to decline, further demonstrated visually in Fig. 2 (take the case of SO_2, for example).

We estimate the turning points for all pollutants measured in the models: $635.619 million (US dollar, same hereafter) for COD, $2.188 billion for SO_2, $74.867 million for NH_x, and $34.704 billion for NO_x in land premium. This means that, for example, the increase in land grant premium is positively associated with SO_2 emissions until the premium reaches $2.188 billion, then a decline in SO_2 emissions is observed. In more wealthy provinces with a higher level of economic growth and social development, such as Jiangsu and Zhejiang, this turning point was reached around 2001 for COD, while in less wealthy areas, such as Guangxi and Jinlin, the turning point was after 2009, suggesting

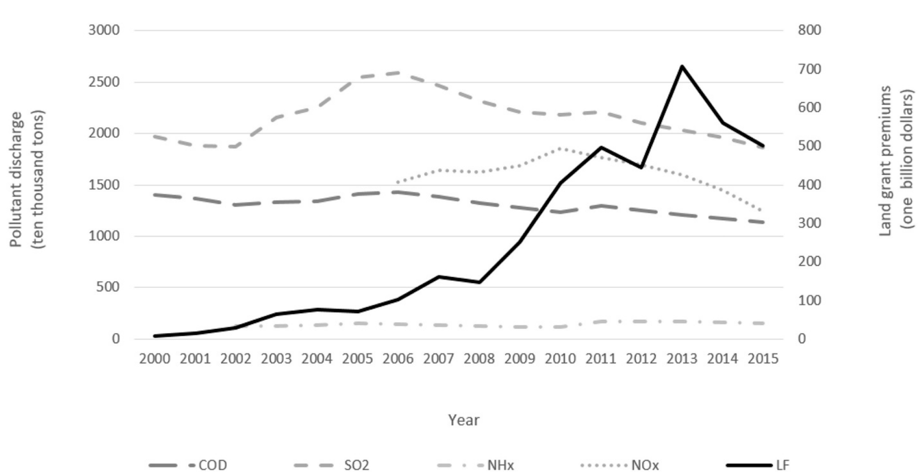

Fig. 1. The trends of pollutant emissions.

Table 5
Regression results of the model effect.

	COD			SO_2		
	FE_ Driscoll-Kraay	FE_White	FGLS	FE_ Driscoll-Kraay	FE_White	FGLS
LF	0.366***	0.366***	0.206***	0.561***	0.561***	0.331***
	(0.048)	(0.090)	(0.020)	(0.121)	(0.129)	(0.024)
LF^2	−0.015***	−0.015***	−0.008***	−0.022***	−0.022***	−0.011***
	(0.002)	(0.004)	(0.001)	(0.004)	(0.005)	(0.001)
$EPBA_{2007}$	0.022	−0.165	−0.015	−0.002	−0.002	−0.040**
	(0.016)	(0.166)	(0.012)	(0.036)	(0.041)	(0.019)
POP	0.039	0.039	0.158**	−0.416***	−0.416	−0.238***
	(0.089)	(0.347)	(0.061)	(0.137)	(0.543)	(0.048)
SIP	0.405*	0.405	0.209***	0.705*	0.705	0.273***
	(0.220)	(0.442)	(0.065)	(0.369)	(0.649)	(0.076)
PC	0.023**	0.023	−0.005**	0.009	0.009	−0.004
	(0.009)	(0.015)	(0.002)	(0.013)	(0.017)	(0.003)
PE	0.012**	0.012	0.011***	0.013**	0.013	0.010***
	(0.004)	(0.009)	(0.002)	(0.005)	(0.015)	(0.002)
ECS	0.089***	0.089	0.023*	0.110***	0.110	0.035**
	(0.028)	(0.103)	(0.009)	(0.033)	(0.133)	(0.018)
N	465	465	465	465	465	465

	NHx			NOx		
	FE_ Driscoll-Kraay	FE_White	FGLS	FE_ Driscoll-Kraay	FE_White	FGLS
LF	0.199***	0.199*	0.097***	0.646***	0.646**	0.987***
	(0.053)	(0.101)	(0.031)	(0.188)	(0.312)	(0.306)
LF^2	−0.009***	−0.009**	−0.003***	−0.024***	−0.024**	−0.031***
	(0.002)	(0.003)	(0.001)	(0.007)	(0.011)	(0.010)
$EPBA_{2011}$	−0.040	−0.040	0.398***	−0.068	−0.068	−0.006
	(0.084)	(0.219)	(0.017)	(0.140)	(0.157)	(0.037)
POP	0.316***	0.316	0.090	−2.117***	−2.117**	−1.364**
	(0.095)	(0.408)	(0.121)	(0.234)	(0.926)	(0.564)
SIP	0.299	0.299	0.367**	0.264	0.26	0.833***
	(0.270)	(0.377)	(0.169)	(0.192)	(0.238)	(0.142)
PC	0.006	0.006	0.004	0.004	0.004	−0.009
	(0.006)	(0.012)	(0.003)	(0.006)	(0.024)	(0.010)
PE	0.016**	0.016	0.010***	0.008	0.008	0.004
	(0.005)	(0.011)	(0.002)	(0.006)	(0.012)	(0.004)
ECS	0.193	0.193	0.140***	0.129**	0.129*	0.145***
	(0.039)	(0.114)	(0.025)	(0.047)	(0.0169)	(0.045)
N	434	434	434	310	310	310

Notes: *p < .1,**p < .05,***p < .01. Robust standard errors are in parentheses.

regional differences in environmental improvement occur due to various levels of land financing.

The results provide evidence to support the first hypothesis regarding the impact of land financing on pollution. These results not only add to the growing literature that suggests a general relationship between economic growth and environmental quality, but, more importantly, it further specifies the importance of local policy initiatives (in this case, land financing policies in China) in influencing environmental quality.

4.2. The moderating effects

How might the introduction of the EPBA influence the relationship between land financing and pollution? The results in Table 6 indicate that there are potential moderating impacts of the EPBA in three of the four pollutants measured (COD, SO_2, and NO_x). The coefficients of the interaction term of $LF^2 \times EPBA$ for COD, SO_2, and NO_x are significant, except in the case of NH_x, indicating that the EPBA moderates the impact of land financing on COD, SO_2, and NO_x, but not that of NH_x.

More specifically, according to the estimation results, the COD emissions decrease by 0.002% and the SO_2 emissions by 0.003%, respectively, when the interaction term of $LF^2 \times EPBA$ increases by 1%. This finding suggests that the implementation of the EPBA may result in intensified local efforts to reallocate resources from land financing to environmental purposes, causing the earlier arrival of the return point at which the growth of land financing starts to be associated with a decline in pollution. This phenomenon can be demonstrated visually, as in Fig. 3, in the case of SO_2. In summary, the implementation of EPBA accelerates the inverted-U curve relationship, likely causing local governments to reallocate more resources from land financing to environmental protection.

Unlike SO_2 and NO_x, which are largely derived from the manufacturing industry and traffic in China, the emission source of NH_x is relatively unclear (Pan et al., 2016; Wang et al., 2016). Moreover, unlike COD or SO_2, NH_x and NO_x are relatively new additions to the priority targets listed in the EPBA system in 2011, resulting in fewer data points for analysis. Additionally, the statistical standard of these two pollutants was adjusted in 2011, resulting in a sudden increase in data in that year, which may explain the insignificant EPBA effect on NH_x and NO_x. Despite these, the findings largely confirm the second hypothesis regarding the moderating effect of EPBA.

5. Discussion

In this section, the key findings of this research are discussed. First, land financing is found to influence pollution in an inverted U-shape fashion. Although the potential impact of economic growth on environmental quality has been well established through the Environmental Kuznets Curve, the more specific policy dynamics of this relationship have yet to be established (Xu, 2018). The evidence in this

Table 6
Regression results of the moderating effects.

	COD			SO_2		
	FE_ Driscoll-Kraay	FE_White	FGLS	FE_ Driscoll-Kraay	FE_White	FGLS
LF	0.232***	0.232**	0.067***	0.339***	0.339***	0.184***
	(0.046)	(0.084)	(0.016)	(0.109)	(0.121)	(0.022)
LF^2	−0.009***	−0.009**	−0.002***	−0.012***	−0.012**	−0.005***
	(0.002)	(0.004)	(0.001)	(0.004)	(0.005)	(0.001)
$EPBA_{2007}$	−0.001	−0.125	−0.038	−0.039	−0.039	−0.051*
	(0.013)	(0.177)	(0.030)	(0.032)	(0.043)	(0.026)
LF^2*$EPBA_{2007}$	−0.002**	−0.002**	−0.001***	−0.003**	−0.003***	−0.002***
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)
POP	0.114	0.114	−0.059	−0.292	−0.292	−0.283***
	(0.090)	(0.347)	(0.060)	(0.168)	(0.540)	(0.038)
SIP	0.403*	0.403	0.182***	0.701*	0.701	0.461***
	(0.211)	(0.430)	(0.039)	(0.346)	(0.602)	(0.056)
PC	0.022**	0.022	−0.001	0.006	0.006	−0.004**
	(0.009)	(0.016)	(0.001)	(0.012)	(0.018)	(0.002)
PE	0.011**	0.011	0.004***	0.011**	0.011	0.007***
	(0.004)	(0.009)	(0.001)	(0.005)	(0.014)	(0.002)
ECS	0.052*	0.052	0.011	0.049	0.049	−0.042***
	(0.025)	(0.103)	(0.009)	(0.038)	(0.130)	(0.012)
N	465	465	465	465	465	465
	NH_x			NO_x		
	FE_ Driscoll-Kraay	FE_White	FGLS	FE_ Driscoll-Kraay	FE_White	FGLS
LF	0.129	0.129	0.134***	0.054	0.054	0.180***
	(0.096)	(0.154)	(0.039)	(0.194)	(0.194)	(0.082)
LF^2	−0.006	−0.006	−0.005***	−0.003	−0.003	−0.004
	(0.004)	(0.006)	(0.001)	(0.002)	(0.007)	(0.003)
$EPBA_{2011}$	−0.002	−0.002	0.347***	0.362**	0.140	0.065
	(0.098)	(0.237)	(0.027)	(0.121)	(0.161)	(0.041)
LF^2*$EPBA_{2011}$	−0.001	−0.001	0.000	−0.004***	−0.004***	−0.003***
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)
POP	0.323***	0.323	0.228*	−2.213***	−2.213**	−1.688***
	(0.092)	(0.403)	(0.136)	(0.252)	(0.867)	(0.207)
SIP	0.273	0.273	0.214	0.025	0.025	0.599***
	(0.271)	(0.373)	(0.145)	(0.179)	(0.242)	(0.163)
PC	0.007	0.007	−0.002	0.010	0.010	−0.013
	(0.006)	(0.012)	(0.03)	(0.008)	(0.021)	(0.009)
PE	0.015**	0.015	0.008***	−0.002	−0.002	−0.004
	(0.005)	(0.010)	(0.002)	(0.007)	(0.011)	(0.003)
ECS	0.185***	0.185	0.136***	0.097**	0.097	0.189***
	(0.041)	(0.115)	(0.020)	(0.041)	(0.065)	(0.038)
N	434	434	434	310	310	310

*Notes: *p < .1,**p < .05,***p < .01. Robust standard errors are in parentheses.*

research shows that environmental quality may be influenced dramatically by land financing and land use policies established in a rapid urbanization process. Indeed, resources from land transactions have been touted as a major local government funding model in many regions in the world and land financing has become a major funding model to obtain resources for growth (Mitlin et al., 2018; Theriault et al., 2020). Rapid economic growth, incentivized by land transaction revenues for infrastructure development, has weighed on the environment. In the long run, however, such a funding model could lead to more resources allocated for environmental purposes. This research indicates a potential positive aspect of this funding model in influencing environmental quality, clearly suggesting an area for future research.

Second, a positive impact of the EPBA on the relationship between land financing and pollution was found in this research. This finding calls for a deeper understanding of the conditions and circumstances under which this assessment system works. Unlike environmental governance in many Western countries, the EPBA system involves a top-down approach, characterized by centralized decision-making, the rapid assembling of institutional capacity, and an emphasis on individual leaders' responsibilities (Bina et al., 2011). The central government's urgent need for rapid outcomes, as well as the potential consequential outcomes for individual leaders, make this approach a potentially effective policy tool for making policy changes in environmental governance. Given that local governments in China are still driven largely by economic growth, with strong extrinsic incentives for a growth model in practice, the EPBA can help local officials align their economic development goals with a more nuanced consideration of the ecological impact of these goals.

Perhaps most importantly, from the perspective of the central government, the finding of the EPBA moderating effect in this study illustrates the importance of understanding the policy design and implementation plan of the EPBA as a major form of environmental policy innovation in China. The complex intergovernmental structure in China features a powerful central government as the major initiator of environmental policies and local governments as implementers. Within this complex structure, by introducing performance-based assessment such as the EPBA, the central government alternates between controlling and empowering local governments in order to maintain control over policy directions. Meanwhile, to achieve desirable policy outcomes, the central government must allow local autonomy in implementation. This process is a delicate balancing act in environmental policy-making, involving the maintenance of equilibrium between local

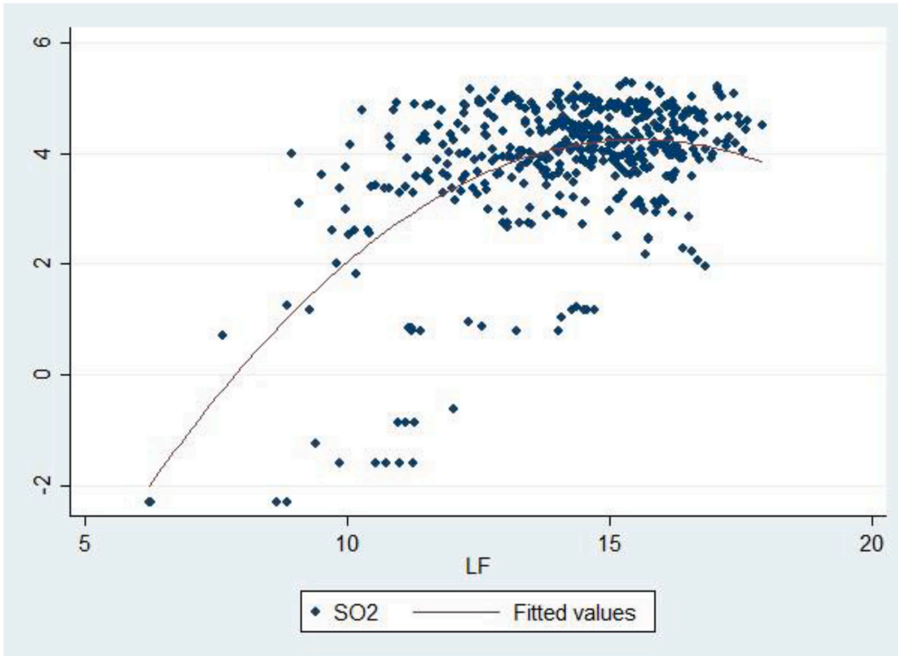

Fig. 2. The impact of land premium on SO_2 emissions.

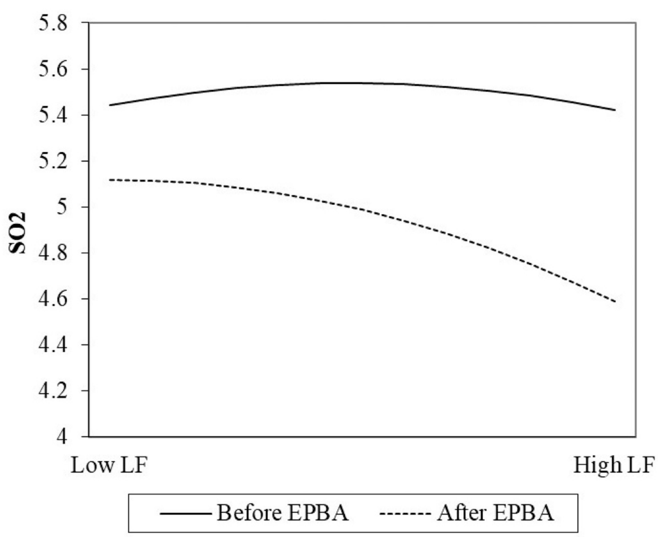

Fig. 3. The moderating effect of EPBA on the impact of land financing in regard to SO2 emissions.

motives in economic growth and ecological concerns. Essentially, the EPBA is part of the central effort to regulate institutional behaviors of local officials through a tightening of environmental performance control, which is also commonly known as the "tightening-crown spell" (a metaphor from a classic Chinese novel *Journey to the West*) in China (Yang, 1990).

The institutional logic of this mechanism plays out early in the development phase of transitional China, with local officials being motivated to involve themselves in land financing in order to benefit from China's rapid economic and administrative reforms. They do so in pursuit of economic growth and urbanization through land development. However, the central government enacts the "tightening-crown spell" to remedy the undesirable environmental consequences of economic growth in order to achieve a balance between economic growth and ecological quality. In this system, local governments are expected to maintain a balance between economic growth and pollution, either to avoid punitive consequences implemented by the central government or to simultaneously ensure adequate local development. Rational officials will not stop pursuing local economic growth, yet they might adjust decision-making and policy implementation behaviors to avoid central punitive measures enacted through the EPBA. Our findings provide some early evidence to support this approach.

Finally, it is important to note that the EPBA is an ongoing assessment system that plays out in a dynamic intergovernmental relationship system in China in which local governments, facing policy stimuli in the assessment scheme, would develop coping strategies accordingly. In this research, the moderating effect of the EPBA for NH_x is not verified. Indeed, as stated above, NH_x emissions are more costly and technically difficult to monitor and manage (Postula and Radecka-Moroz, 2020), creating a game space for local governments to evade the central government's monitoring. The finding demonstrates the dynamic nature of a performance assessment system like the EPBA and provides evidence that it has room to improve.

6. Conclusion

For more than three decades, land financing has been a dominant institutional effort to finance economic development globally. In this research, we provide evidence that land financing in Chinese local governments leads to a growth-then-decline pattern in pollution. We also show that the central government's environmental assessment system accelerates this decline. Our findings are indicative of the efficacy of an environmental governance model that emphasizes centralized decision-making, and a strong enforcement mechanism that stresses individual responsibility.

These findings contribute empirical evidence to the extant research exploring the environmental assessment policy of China in a context of incremental reform, which could help further our understanding of the effectiveness of environmental governance practices in transitional economies. Distinct from the Anglo-American models of governance at work in most Western countries, environmental governance in China, characterized by the EPBA in this study, may provide some lessons in regard to dealing with developmental priorities in these economies. Particularly, China stands out from other Asian countries in its pursuit of economic growth and determination to curb environmental degradation (Ahlers and Shen, 2018; Mao and Zhang, 2018). The rationale of the environmental governance process within the Chinese eco-social context differs from that in many Western countries. While many qualitative or case studies have depicted China's environmental assessment reform and governance process from various perspectives (Lo et al., 2012; Mao et al., 2019; Mu, 2018b; Ran, 2017; Shen and Ahlers, 2019; Zeng et al., 2019), our research is one of the first empirical studies situated in the local fiscal context of China to explore local environmental behaviors in regard to balancing the trade-offs between economic growth, urbanization, and environmental protection. It provides implications of achieving a trade-off between environmental and economic targets during the rapid urbanization process for other developing or transitional countries around the world.

Further studies should be designed to test the longer-term effects of the EPBA system. Studies replicating this research in other similar contexts should also help validate the outcomes of this study. Despite these limitations, this study describes and assesses the role of an innovative environmental assessment model in a complex fiscal reality in local Chinese governments. In doing so, it demonstrates an alternative form of environmental policy-making that warrants further research.

Author statement

Bo Yan: Conceptualization, Writing- Original draft preparation, Methodology.

Long Wu: Formal analysis, Data curation, Software, Formal analysis, Visualization.

XiaoHu Wang: Validation, Writing- Reviewing and Editing.

Jiannan Wu*:* Project administration**,** Validation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

This study was supported by the China NFSC General Program (71473190), the Key Philosophy and Social Science Research Project of Chinese Ministry of Education (17JZD025).

References

Ahlers, A.L., Shen, Y., 2018. Breathe easy? Local nuances of authoritarian environmentalism in China's battle against air pollution. China Q. 234, 299–319. https://doi.org/10.1017/S0305741017001370.
Alam, M.M., Murad, M.W., Noman, A.H.M., Ozturk, I., 2016. Relationships among carbon emissions, economic growth, energy consumption and population growth: testing environmental Kuznets curve hypothesis for Brazil, China, India and Indonesia. Ecol. Indic. 70, 466–479. https://doi.org/10.1016/j.ecolind.2016.06.043.
Baltagi, B.H., 2008. Forecasting with panel data. J. Forecast. 27, 153–173. https://doi.org/10.1002/for.1047.
Bina, O., Jing, W., Brown, L., Partidário, M.R., 2011. An inquiry into the concept of SEA effectiveness: towards criteria for Chinese practice. Environ. Impact Assess. Rev. 31, 572–581. https://doi.org/10.1017/S0305741017001370.
Chen, Y.J., Li, P., Lu, Y., 2018. Career concerns and multitasking local bureaucrats: evidence of a target-based performance evaluation system in China. J. Dev. Econ. 133, 84–101. https://doi.org/10.1016/j.jdeveco.2018.02.001.
Czyżewski, B., Smędzik-Ambroży, K., Mrówczyńska-Kamińska, A., 2020. Impact of environmental policy on eco-efficiency in country districts in Poland: how does the decreasing return to scale change perspectives? Environ. Impact Assess. Rev. 84, 106431. https://doi.org/10.1016/j.eiar.2020.106431.
Dong, N., You, L., Cai, W., Li, G., Lin, H., 2018. Land use projections in China under global socioeconomic and emission scenarios: utilizing a scenario-based land-use change assessment framework. Glob. Environ. Chang. 50, 164–177. https://doi.org/10.1016/j.gloenvcha.2018.04.001.
Driscoll, J.C., Kraay, A.C., 1998. Consistent covariance matrix estimation with spatially dependent panel data. Rev. Econ. Stat. 80, 549–560. https://doi.org/10.1162/003465398557825.
Frees, E.W., 2004. Longitudinal and Panel Data: Analysis and Applications in the Social Sciences. Cambridge University Press.
Greene, W.H., 2003. Econometric Analysis. (Pearson Education India).
Hausman, J.A., 1978. Specification tests in econometrics. Econom. J. Econom. Soc. 1251–1271. https://doi.org/10.2307/1913827.
Hayes, A.F., 2017. Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach. Guilford publications.
Huang, D., Chan, R.C.K., 2018. On 'land finance'in urban China: theory and practice. Habitat Int. 75, 96–104. https://doi.org/10.1016/j.habitatint.2018.03.002.
Huang, Z., Du, X., 2018. Urban land expansion and air pollution: evidence from China. J. Urban Plan. Dev. 144, 5018017. https://doi.org/10.1061/(ASCE)UP.1943-5444.0000476.
Ji, L., Zhang, W., 2020. Fiscal incentives and sustainable urbanization: evidence from China. Sustainability 12, 12. https://doi.org/10.3390/su12010103.
Jia, M., Liu, Y., Lieske, S.N., Chen, T., 2020. Public policy change and its impact on urban expansion: an evaluation of 265 cities in China. Land Use Policy 97, 104754. https://doi.org/10.1016/j.landusepol.2020.104754.
Jin, Z., 2017. Environmental management system in China: The target achieving process. In: Kitagawa, H. (Ed.), Environmental Policy and Governance in China. Springer Japan, Tokyo, pp. 69–88. https://doi.org/10.1007/978-4-431-56490-4_1.
Kennedy, J.J., Chen, D., 2018. State capacity and cadre mobilization in China: the elasticity of policy implementation. J. Contemp. China 27, 393–405. https://doi.org/10.1080/10670564.2018.1410971.
Le, H.P., Ozturk, I., 2020. The impacts of globalization, financial development, government expenditures, and institutional quality on CO 2 emissions in the presence of environmental Kuznets curve. Environ. Sci. Pollut. Res. 1–18. https://doi.org/10.1007/s11356-020-08812-2.
Le, H.P., Sarkodie, S.A., 2020. Dynamic linkage between renewable and conventional energy use, environmental quality and economic growth: evidence from emerging market and developing economies. Energy Rep. 6, 965–973. https://doi.org/10.1016/j.egyr.2020.04.020.
Levin, A., Lin, C.-F., Chu, C.-S.J., 2002. Unit root tests in panel data: asymptotic and finite-sample properties. J. Econom. 108, 1–24. https://doi.org/10.1016/S0304-4076(01)00098-7.
Liu, L.-J., Liang, Q.-M., 2017. Changes to pollutants and carbon emission multipliers in China 2007–2012: an input-output structural decomposition analysis. J. Environ. Manag. 203, 76–86. https://doi.org/10.1016/j.jenvman.2017.07.061.
Liu, N., Tang, S., Lo, C.W.-H., Zhan, X., 2016. Stakeholder demands and corporate environmental coping strategies in China. J. Environ. Manag. 165, 140–149. https://doi.org/10.1016/j.jenvman.2015.09.027.
Liu, T., Liang, D., Zhang, Y., Song, Y., Xing, X., 2019. The antecedent and performance of environmental managers' proactive pollution reduction behavior in Chinese manufacturing firms: insight from the proactive behavior theory. J. Environ. Manag. 242, 327–342. https://doi.org/10.1016/j.jenvman.2019.04.050.
Lo, C.W.-H., Fryxell, G.E., van Rooij, B., Wang, W., Honying Li, P., 2012. Explaining the enforcement gap in China: local government support and internal agency obstacles as predictors of enforcement actions in Guangzhou. J. Environ. Manag. 111, 227–235. https://doi.org/10.1016/j.jenvman.2012.07.025.
Lo, K., Broto, V.C., 2019. Co-benefits, contradictions, and multi-level governance of low-carbon experimentation: leveraging solar energy for sustainable development in China. Glob. Environ. Chang. 59, 101993. https://doi.org/10.1016/j.gloenvcha.2019.101993.
Malatesta, D., Smith, C.R., 2014. Lessons from resource dependence theory for contemporary public and nonprofit management. Public Adm. Rev. 74, 14–25. https://doi.org/10.1111/puar.12181.
Mao, K., Zhang, Q., 2018. Dilemmas of state-led environmental conservation in China: environmental target enforcement and public participation in Minqin County. Soc. Nat. Resour. 31, 615–631. https://doi.org/10.1080/08941920.2017.1422063.
Mao, Z., Xue, X., Tian, H., Michael, A.U., 2019. How will China realize SDG 14 by 2030?— a case study of an institutional approach to achieve proper control of coastal water pollution. J. Environ. Manag. 230, 53–62. https://doi.org/10.1016/j.jenvman.2018.09.028.
Mathur, S., 2013. Self-financing urbanization: insights from the use of town planning schemes in Ahmadabad, India. Cities 31, 308–316. https://doi.org/10.1016/j.cities.2012.09.004.
Mitlin, D., Colenbrander, S., Satterthwaite, D., 2018. Editorial: finance for community-led local, city and national development. Environ. Urban. 30, 3–14. https://doi.org/10.1177/0956247818758251.
Mu, R., 2018a. Role of law, position of actor and linkage of policy in China's National Environmental Governance System, 1972–2016. Sustainability 10, 1065. https://doi.org/10.3390/su10041065.
Mu, R., 2018b. Bounded rationality in the developmental trajectory of environmental target policy in China, 1972–2016. Sustainability 10, 199. https://doi.org/10.3390/su10010199.
Murakami, J., 2018. The government land sales programme and developers' willingness to pay for accessibility in Singapore, 1990–2015. Land Use Policy 75, 292–302. https://doi.org/10.1016/j.landusepol.2018.03.050.
Niu, X., Wang, XiaoHu, Gao, J., Wang, XueJun, 2020. Has third-party monitoring improved environmental data quality? An analysis of air pollution data in China. J. Environ. Manag. 253, 109698. https://doi.org/10.1016/j.jenvman.2019.109698.
Ong, L.H., 2020. "Land grabbing" in an autocracy and a multi-party democracy: China and India compared. J. Contemp. Asia 50, 361–379. https://doi.org/10.1080/00472336.2019.1569253.
Pan, Y., Tian, S., Liu, D., Fang, Y., Zhu, X., Zhang, Q., Zheng, B., Michalski, G., Wang, Y., 2016. Fossil fuel combustion-related emissions dominate atmospheric ammonia sources during severe haze episodes: evidence from 15N-stable isotope in size-resolved aerosol ammonium. Environ. Sci. Technol. 50, 8049–8056. https://doi.org/10.1021/acs.est.6b00634.

Pang, R., Zheng, D., Shi, M., Zhang, X., 2019. Pollute first, control later? Exploring the economic threshold of effective environmental regulation in China's context. J. Environ. Manag. 248, 109275. https://doi.org/10.1016/j.jenvman.2019.109275.

Pesaran, H.M., 2004. General diagnostic tests for cross-sectional dependence in panels. Univ. Cambridge, Cambridge work. Pap. Econ. 435.

Pesaran, M.H., Ullah, A., Yamagata, T., 2008. A bias-adjusted LM test of error cross-section independence. Econom. J. 11, 105–127. https://doi.org/10.1111/j.1368-423X.2007.00227.x.

Postula, M., Radecka-Moroz, K., 2020. Fiscal policy instruments in environmental protection. Environ. Impact Assess. Rev. 84, 106435. https://doi.org/10.1016/j.eiar.2020.106435.

Ran, R., 2017. Understanding blame politics in China's decentralized system of environmental governance: actors, strategies and context. China Q. 231, 634–661. https://doi.org/10.1017/S0305741017000911.

Sarkodie, S.A., Ozturk, I., 2020. Investigating the environmental Kuznets curve hypothesis in Kenya: a multivariate analysis. Renew. Sust. Energ. Rev. 117, 109481. https://doi.org/10.1016/j.rser.2019.109481.

Sarkodie, S.A., Strezov, V., 2019. A review on environmental Kuznets curve hypothesis using bibliometric and meta-analysis. Sci. Total Environ. 649, 128–145. https://doi.org/10.1016/j.scitotenv.2018.08.276.

Sarkodie, S.A., Adams, S., Owusu, P.A., Leirvik, T., Ozturk, I., 2020. Mitigating degradation and emissions in China: the role of environmental sustainability, human capital and renewable energy. Sci. Total Environ. 137530. https://doi.org/10.1016/j.scitotenv.2020.137530.

Shao, S., Chen, Y., Li, K., Yang, L., 2019. Market segmentation and urban CO2 emissions in China: evidence from the Yangtze River Delta region. J. Environ. Manag. 248, 109324. https://doi.org/10.1016/j.jenvman.2019.109324.

Shao, Z., Bakker, M., Spit, T., Janssen-Jansen, L., Qun, W., 2020. Containing urban expansion in China: the case of Nanjing. J. Environ. Plan. Manag. 63, 189–209. https://doi.org/10.1080/09640568.2019.1576511.

Shen, Y., Ahlers, A.L., 2019. Blue sky fabrication in China: science-policy integration in air pollution regulation campaigns for mega-events. Environ. Sci. Pol. 94, 135–142. https://doi.org/10.1016/j.envsci.2018.12.005.

Shu, C., Xie, H., Jiang, J., Chen, Q., 2018. Is urban land development driven by economic development or fiscal revenue stimuli in China? Land Use Policy 77, 107–115. https://doi.org/10.1016/j.landusepol.2018.05.031.

Suddaby, R., Seidl, D., Lê, J.K., 2013. Strategy-as-Practice Meets Neo-Institutional Theory. https://doi.org/10.1177/1476127013497618.

Tang, P., Yang, S., Fu, S., 2018. Do political incentive affects China's land transfer in energy-intensive industries? Energy 164, 550–559. https://doi.org/10.1016/j.energy.2018.09.054.

Tang, P., Shi, X., Gao, J., Feng, S., Qu, F., 2019. Demystifying the key for intoxicating land finance in China: an empirical study through the lens of government expenditure. Land Use Policy 85, 302–309. https://doi.org/10.1016/j.landusepol.2019.04.012.

Theriault, M., Le Berre, I., Dube, J., Maulpoix, A., Vandersmissen, M.H., 2020. The effects of land use planning on housing spread: a case study in the region of Brest, France. Land Use Policy 92, 19. https://doi.org/10.1016/j.landusepol.2019.104428.

Tong, K., Zhao, Z., Feiock, R., Ramaswami, A., 2019. Patterns of urban infrastructure capital investment in Chinese cities and explanation through a political market lens. J. Urban Aff. 41, 248–263. https://doi.org/10.1080/07352166.2018.1499417.

Tu, L., Padovani, E., 2018. A research on the debt sustainability of China's Major City governments in post-land finance era. Sustainability 10. https://doi.org/10.3390/su10051606.

Wang, D.T., Chen, W.Y., 2014. Foreign direct investment, institutional development, and environmental externalities: evidence from China. J. Environ. Manag. 135, 81–90. https://doi.org/10.1016/j.jenvman.2014.01.013.

Wang, G., Zhang, R., Gomez, M.E., Yang, L., Zamora, M.L., Hu, M., Lin, Y., Peng, J., Guo, S., Meng, J., 2016. Persistent sulfate formation from London fog to Chinese haze. Proc. Natl. Acad. Sci. 113, 13630–13635. https://doi.org/10.1073/pnas.1616540113.

Wang, W., Ye, F., 2016. The political economy of land finance in China. Public Budg. Financ. 36, 91–110. https://doi.org/10.1111/pbaf.12086.

Wang, X., 2011. Exploring trends, sources, and causes of environmental funding: a study of Florida counties. J. Environ. Manag. 92, 2930–2938. https://doi.org/10.1016/j.jenvman.2011.07.002.

Wang, X., Berman, E., 2014. Financing conservation: some empirical evidence from Florida local governments. J. Environ. Plan. Manag. 57, 733–750. https://doi.org/10.1080/09640568.2013.767781.

Wang, X., Lei, P., 2020. Does strict environmental regulation Lead to incentive contradiction? - evidence from China. J. Environ. Manag. 269, 110632. https://doi.org/10.1016/j.jenvman.2020.110632.

Wang, X., Berman, E.M., Chen, D., Niu, X., 2019. Strategies to improve environmental networks for pollution control: evidence from eco-compensation programs in China. J. Environ. Manag. 234, 387–395. https://doi.org/10.1016/j.jenvman.2018.12.080.

Wang, Y., Hui, E.C., 2017. Are local governments maximizing land revenue? Evidence from China. China Econ. Rev. 43, 196–215. https://doi.org/10.1016/j.chieco.2017.02.005.

Wang, Y., Wang, J., 2019. Does industrial agglomeration facilitate environmental performance: new evidence from urban China? J. Environ. Manag. 248, 109244. https://doi.org/10.1016/j.jenvman.2019.07.015.

Wen, B., 2020. Old problems and new dilemmas: the conundrum of environmental management reform in China. J. Environ. Policy Plan. 1–19. https://doi.org/10.1080/1523908X.2020.1713067.

Wooldridge, J.M., 2010. Econometric Analysis of Cross Section and Panel Data. MIT press.

Wu, A.M., Ye, L., Li, H., 2019. The impact of fiscal decentralization on urban agglomeration: evidence from China. J. Urban Aff. 41, 170–188. https://doi.org/10.1080/07352166.2018.1484254.

Wu, J., Xu, M., Zhang, P., 2018. The impacts of governmental performance assessment policy and citizen participation on improving environmental performance across Chinese provinces. J. Clean. Prod. 184, 227–238. https://doi.org/10.1016/j.jclepro.2018.02.056.

Wu, Q., Li, Y., Yan, S., 2015. The incentives of China's urban land finance. Land Use Policy 42, 432–442. https://doi.org/10.1016/j.landusepol.2014.08.015.

Wu, R., Hu, P., 2019. Does the "miracle drug" of environmental governance really improve air quality? Evidence from China's system of central environmental protection inspections. Int. J. Environ. Res. Public Health 16, 850. https://doi.org/10.3390/ijerph16050850.

Xie, Q., Sun, Q., 2020. Assessing the impact of FDI on PM2.5 concentrations: a nonlinear panel data analysis for emerging economies. Environ. Impact Assess. Rev. 80, 106314. https://doi.org/10.1016/j.eiar.2019.106314.

Xu, N., 2019. What gave rise to China's land finance? Land Use Policy 87, 104015. https://doi.org/10.1016/j.landusepol.2019.05.034.

Xu, T., 2018. Investigating environmental Kuznets curve in China–aggregation Bias and policy implications. Energy Policy 114, 315–322. https://doi.org/10.1016/j.enpol.2017.12.027.

Yang, D., 1990. Patterns of China's regional development strategy. China Q. 122, 230–257. https://doi.org/10.1017/S0305741000008778.

Yao, X., Kou, D., Shao, S., Li, X., Wang, W., Zhang, C., 2018. Can urbanization process and carbon emission abatement be harmonious? New evidence from China. Environ. Impact Assess. Rev. 71, 70–83. https://doi.org/10.1016/j.eiar.2018.04.005.

Yu, Y., Yang, X., Li, K., 2019. Effects of the terms and characteristics of cadres on environmental pollution: evidence from 230 cities in China. J. Environ. Manag. 232, 179–187. https://doi.org/10.1016/j.jenvman.2018.11.002.

Zeng, Y., Cao, Y., Qiao, X., Seyler, B.C., Tang, Y., 2019. Air pollution reduction in China: recent success but great challenge for the future. Sci. Total Environ. 663, 329–337. https://doi.org/10.1016/j.scitotenv.2019.01.262.

Zhang, B., Cao, C., 2017. Four gaps in China's new environmental law: implementation and accountability will remain challenging, especially at the local level. Nature 517, 433. https://doi.org/10.1038/517433a.

Zhang, G., 2018. The revolutions in China's inter-governmental fiscal system. Public Money Manag. 38, 419–426. https://doi.org/10.1080/09540962.2018.1486104.

Zhang, P., 2020. Target interactions and target aspiration level adaptation: how do government leaders tackle the "environment-economy" Nexus? Public Adm. Rev. 1–11. https://doi.org/10.1111/puar.13184.

Zheng, S., Kahn, M., 2017. A new era of pollution Progress in urban China? J. Econ. Perspect. 31, 71–92. https://doi.org/10.1257/jep.31.1.71.

Zhu, X., Wei, Y., Lai, Y., Li, Y., Zhong, S., Dai, C., 2019. Empirical analysis of the driving factors of China's 'land finance' mechanism using soft budget constraint theory and the PLS-SEM model. Sustainability 11, 742. https://doi.org/10.3390/su11030742.