Regional Corruption, Urbanization, and Smokeless Development: An Empirical Study from China

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Abstract: Economic development is not only about quantity, but also about quality, so it's important to regulate the tobacco, and make the development in a low carbon and smokeless way. Relying on the Chinese city-level dynamic panel data of 2005–2018 and using GMM estimation, this study founded that corruption aggravates carbon emission as well as the pollution effects of urbanization. When the environmental effect of corruption via urbanization is controlled, urbanization can reduce carbon emissions. Furthermore, the inverted U-shaped relationship between urbanization and carbon emission exists with turning point at 3.60, that means when the corruption level is below (above) 3.60, urbanization can improve (aggravate) environmental quality. The results also suggested that urbanization improved environmental quality in 32 cities, including Beijing, Shanghai, while in others, it aggravated environmental pollution. Namely that urbanization can improve the local environmental quality only when the corruption level is low; otherwise, it would aggravate the local environmental pollution. By calculating the average corruption level for different city administrative level—above prefecture-level cities, prefecture-level cities, and county-level cities—the values of which were estimated as 3.48, 3.82, and 4.02 respectively, we also founded that urbanization has improved environmental quality only in the above prefecture-level cities, while in the other cities, urbanization has aggravated the local environmental pollution.

Key words: urbanization; local corruption; tobacco regulation; environmental pollution.
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INTRODUCTION AND LITERATURE REVIEW

With the worsening global environment, many people care more about their health. Tobacco regulation, carbon emission, smokeless development, and environmental pollution became an issue for the government. Accompanied by the rapid growth of the economy, urbanization level has rapidly improved since 1980s in China. According to the official statistics data, the urbanization rate in 2019 surpass 60% while it only was 32.53% in 2006, that means an average annual compound growth increase of 5.6%. It will reach 73.67% according to this growth rate in 2025, then achieve the government planning goal of urbanization rate.

However, environmental pollution has continued to be a growing concern. China became the world's

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larger CO2 emitter in 2006, and the emission level reached 10 billion ton in 2013, accounting for 27.7% of the global emission. The research of Lin Baiqiang and Du Kerui indicated that features of energy consumption are rigid demand and rapid increase during the process of China's urbanization and industrialization, it needs to large-scale infrastructure construction and labor-intensive industries for the population agglomeration demand, which leads to production scale of high energy consumption and pollution enterprise unceasingly expanding, including electric power, steel, cement, coal and so on[1]. Only for coal, the disposable consumption volume will increase to 2.88 billion tons by 2020. These polluting enterprises will bring serious pollution in China. As such, the urbanization promotes China's economic growth through the transferring of rural labor and accelerates the industrialization, but China's environmental degradation is tangible. What kind of influence does urbanization have on our environment became a serious issue, because it has a significant impact on the transformation of the economic growth mode and the environmental improvement in China.

So far, there is no consensus regarding the influence of urbanization on environmental pollution among scholars at home and abroad. In general, there are three kinds of views: the first one is the examining research of Environmental Kuznets Curve (EKC) hypothesis, commonly called as an environmental Kuznets curve in Dasgupta et al.'s work[2]. Based on panel data of 42 countries, Grosman and Krueger empirically found that urban population density has a positive influence on SO2, soot emissions, and aggravates environmental pollution[3]. Xiao Yunzhong and Wang Chong studied the relationship between environmental pollution, urbanization, and economic growth, the relationships are positive and relationship between economic growth and environmental pollution shows the trend of nonlinear curve, the relative changes of both has the inverted u-shaped curve characteristics[4].

The second related literature is sustainable development research of environment in urbanization. Dietz and Rosa put forward the STIRPAT Model, the population size, extent of wealth and technology are regarded as driving factors in model, and they quantitatively analyzed the impact on environment being the people-centered activities[5]. Many studies indicate it is necessary to strengthen management of the ecological environment and health in the process of urbanization for sustainable development of the city[6,7]. Based on the ecological environment system balance theory, Yue Zhenghua studied environmental pollution of farmland ecosystem[8].

The third view is the urbanization specific environmental effect theory. Gehendra Kharel found that urbanization has seriously affects to the local ecological system, and results in the pollution of ecological environment[9]. Rong Hongqing confirmed that the faster the urbanization developments speed is, the more serious air pollution is[10]. Atef Al-Kharabsheh has the follow-up studied on the relationship between the urbanization and the surface water quality by GIS and numerical simulation method, he found the relationship was positive[11]. Chen Liuqin founded that when wastewater, waste gas and waste residue exceeded the purification ability of nature, it will cause serious ecological environment problems[12]. Li Shu confirmed that with the speeding up of urbanization process, pollution is more and more serious, industrial structure adjustment can reduce the environmental pollution[13].

Yan Nan studied the relationship between urbanization and environmental pollution, the result showed the expansion of urbanization process and the formation of urban agglomerations were fundamental causes of regional environmental problems[14]. However, Du Wencui et al. used panel data of emerging economies as the research sample, found urbanization did not necessarily lead to environmental pollution, on the contrary, it is helpful for reducing the pollution, and urban agglomeration effect on improving the environment quality is relatively better[15]. In addition, Zhang qian, Wang Hui and Wang qi empirically found urbanization would aggravate city water pollution[16,17].

For corruption impacting on environmental pollution, not many research literatures have been found at home and abroad. Desai applied 10 cases in developing countries, finding that environmental

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degradation tends to increase corruption level[18]. Welsch examined the impact of corruption on pollution, with just one year data, he did not account for unobserved heterogeneity across countries and potential endogeneity of corruption[19]. Fredriksson et al. used data in 12 OECD countries for years 1982–1996, studying how corruption can affect environmental policy, the results show that greater corruption of policy makers reduces energy policy stringency; greater lobby group coordination costs result in more stringent energy policy; and workers' and capital owners' lobbying efforts on energy policy are negatively related[20]. Cole et al., examined the relationships between FDI and environmental policy, finding that if the degree of corruption is sufficiently high (low), FDI leads to less (more) stringent environmental policy[21]. Fredriksson and Svensson examined the impact of political stability on the environmental policy, when the level of corruption was low, the political stability has a negative effect on the stringency of environmental regulations, and vice versa[22]. Usama et al. investigated the relationships of urbanization, financial development and CO2 emission in 23 selected European countries for the period of 1990-2013 by panel data technique. The results indicated that urbanization, financial development, GDP growth, and CO2 emission were cointegrated, and revealed that GDP growth, urbanization, and financial development increase CO2 emission in the long run[23].

From the above, it can be concluded that the literature on the impact of urbanization on environment pollution has been very rich, and the effect of corruption on pollution is mainly concentrated in trade, FDI and political stability, and little attention has been paid to corruption in a country's urbanization effect of environmental pollution. This study analyzes the effect of corruption on the urbanization-environmental pollution mechanism. This effect is tested for the city-level panel data from 2005 to 2018, using the GMM method to overcome the endogenous problem, and it empirically analyzes what impacts different degrees of corruption will have on environmental pollution effect of urbanization.

INFLUENCE MECHANISM OF CORRUPTION IMPACTING ON ENVIRONMENTAL POLLUTION BY URBANIZATION

The Industrial Structure Effect

With low regional corruption and small income gap, people are unwilling to obtain employment in enterprises of energy-extensive consumption and high-pollution, then the amount of these enterprises will reduce, consequently, this will improve the environment pollution. On the contrary, the increase of corruption levels can widen the income gap, lead to Low-income earners mainly work in labor-intensive industries, the enterprises of energy extensive consumption and high pollution will increase, and therefore aggravated pollution of the environment.

The Consumption Effect

Consumption will increase with the urbanization level continuous rise, Chao Wang and Liping Fu tested urbanization on energy consumption, and found when the corruption level is low, per capita income will tend to be equalized. The consumption structure will be optimized overall, which will help to reduce demand of energy-extensive consumption and high-pollution goods, improve the local environment. On the contrary, the increase of corruption level can widen income gap. The presence of vast low-income groups is not conducive to upgrade the consumption structure. Therefore, the technology level of products is low and, added value is low, and the local environment worsens[24].

The Basic Public Services Effect

Basic public services include education, medical treatment, health, training skills and so on. When the corruption level is low, expenditure on education, medical treatment, health, training skills are high, this is conducive to efficient allocation of financial resources, Rolf and Linda, Venkatesh and Rashid's works have confirmed the results[25,26]. Which will help to promote R&D level, human capital, and financial development level, enhance spillover effects of public services in the process of urbanization, and help to increase urbanization

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through basic public services effect to improve the environment. On the contrary, a higher level of corruption will decrease the financial capital of education, medical treatment, health, training skills, hinder the efficient allocation of financial resources, and reduce the level of R&D, human capital, and financial development level, which are not helpful to improve the environment quality through basic public services effect.

The Technology Effect

Urbanization process is accompanied by industrialization, when the corruption level is low, expenditure on imported technology and equipment is high. This is conducive to promote local environmental technology, and helps to increase urbanization through the technical effect to improve the environment. On the contrary, with a higher level of corruption, the capital used to import technology and equipment would be reduced, and this is not conducive to promote local environmental technology, which hinders foreign trade through the technical effect to improve the environment.

The Environmental Regulation Effect

With the increase of people's income, the requirement for environmental regulation rises. By low level corruption, the government in the process of urbanization will increase the proportion of renewable energy consumption, urban green coverage rate and other social welfare through improving environmental regulation. Furthermore, the probability of reducing environmental regulation is low by bribing government officials, this is beneficial to improve the environment. On the contrary, when the level of corruption is high, the events of bribing government officials will increase, it will increase the probability of the government to reduce environmental regulation, and which is not conducive to improve the environment. The stringency of environmental regulations can be reduced by corruption, and consequently aggravate pollution of the environment, Lopez and Mitra's theoretical studies have verified the similar result[27].

From what has been discussed above, this study puts forward the following hypothesis: when regional corruption level is low, urbanization can improve local environmental quality, and when the level of corruption reaches a certain level, urbanization can increase the local environmental pollution.

METHODOLOGY

Model Specification, Variable Measurement, and Data Verification

Based on the analysis of corruption impacting on environment pollution through urbanization, the study adopts the following model:

$$LnEP_{it} = C + \beta_0 LnEP_{it-1} + \beta_1 LnVG_{it} + \beta_2 LnVG_{it}^2 + \beta_3 LnIS_{it} + \beta_4 LnTE_{it} + \beta_5 LnBPS_{it} + \beta_6 LnEI_{it} + \beta_7 LnU_{it} + \beta_8 LnU_{it} * LnCO_{it} + \beta_9 LnCO_{it} + \beta_{10} LnCL + \mu_{it} \quad (1)$$

The variables EP, VG, IS, TE, BPS, EI, U, CO, and CL represent degree of environmental contamination, economy of scale, industrial structure, technical development, basic public services, environmental regulation, level of urbanization, degree of corruption, and consumption level, respectively. The model is added to the lagged explanatory variables, the reason is that any changes in economic factors themselves have a certain tendency, a result that the last period tends to have some influence on the later one. Environmental pollutions in Chinese cities are likely to have a lagged effect; the introduction of dynamic models with lagged term can control the lag factor better and can take into account the influence of other environmental factors. The introduction of quadratic term of economy scale is used in model, it is to satisfy the assumption of the inverted u-shaped curve between the economic scale and environment pollution.

For the measure of environmental pollution, many scholars adopt a single or a few environmental pollution indicators, based on the practice of most scholars, including Li Zihao and Liu Huihuang, this study uses industrial waste gas, wastewater, and per capita solid waste emissions to measure the environmental pollution level[28]. For

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the measure of economic scale, we follow the general index to use the per capita GDP.

Industrial pollution mainly comes from the second industry sector, this conclusion has been verified by Hidemichi[29] and Steinbuks[30], so to measure the industrial structure, the ratio of the added value of the second industry to GDP will be used. In general, in the early stages of urbanization, traditional production methods still are used, that requires sufficient resources to realize urbanization and industrialization, and leads to consume large amounts of resources, so environmental pollution will aggravate. However, when economic development reaches a certain level, the economy will gradually be concentrated, the industrial structure will also upgrade. At this time, the proportion of added value of secondary industries in the GDP tends to decline, while that of tertiary industries will rapidly increase, which will improve environmental quality.

Regarding the basic public services, it includes many aspects. Assessment indicator system, which has been discussed by Liu Qin[31], will be used, including 4 level indicators, 12 secondary indicators, and 57 three-level indicators. In general, in the early stages of urbanization, the requirements and consciousness for basic public service level are lower, the level of environmental pollution is higher, with the improvement of living standards, the requirements and consciousness of environment will gradually be improved, the pollutant emissions will reduce, furthermore, it will improve the environment quality.

To measure the technological progress, the capital-labor ratio, which has been discussed by Kan Daxue[32], will be used. This is mainly because higher capital-labor ratio implies higher technical efficiency, which can increase the speed of technological progress and the technical capabilities of reducing pollution. Furthermore, the increase of capital-labor ratio often implies a shift from labor-intensive industry to capital and technology-intensive industry. Consequently, the proportion of capital and technology in production will increase. In general, it is believed that technological advances made it possible for enterprises to adopt cleaner technology, which will reduce emissions of pollution so as to improve the environment. Here, labor inputs will be measured by the situation of city employment at the end of the year.

To measure environmental regulation, this study uses the ratio of the sum of pollutant discharge fee and investment to control environmental pollution to GDP. Following Antweiler et al.[33], energy policy is likely to respond slowly to pollution problems. As the income level rises, people begin to have a higher requirement for improved quality of environment. Thus, the government will also improve environmental regulations and strengthen control and punishment for environmental pollution. Hence, the environment quality improves.

To measure urbanization, this study used urbanization rate. On the one hand, the populations moving to city will lead to increase of pollutants in the process of urbanization, then aggravate environmental pollution. Meanwhile, the increase of investment in infrastructure will lead to production increases of cement, steel, coal, electric power and so on, this will increase the local environmental pollution. On the other hand, it is helpful to improve the environmental standards and local environment quality by aborting advanced technology, improving the social security, and strengthening environment protection consciousness. In a word, urbanization can influence the environment through various ways such as the scale, structure, technology, and regulation.

Corruption is difficult to measure. In general, three indexes are widely used as corruption indicator: Corruption Perception Index (CPI), Corruption Index (CI), and Control of Corruption Index (CCI). Corruption Perception Index comes from Transparency International is a good and widely used proxy for corruption, this could be seen in the study of Persson et al.[34], and William et al.[35]. However, the basic data of these indexes comes from different counties, which can't be used to measure different cities in China. To measure corruption, our study uses the number of embezzlements, bribery and misconduct cases[36]. Corruption often intensifies environmental pollution in a country by twisting environmental policies, reducing environmental regulation,

hindering investment in environment, and reducing investment in the development of environmental technology and the introduction of input channels.

To measure consumption, the study uses Engel's coefficient of reflecting the consumption level, namely the proportion of food expenditure to all the spending. When the Engel's coefficient is low, the level of living standard is high, and there has higher requirement for the quality of environment, so the production of high energy consumption and pollution enterprises will be suppressed, the environmental quality will improve, and vice versa.

In order to study the heterogeneity impact in different cities. We classified the cities by administrative levels[37], leading to adopt 612 samples, including 32 above prefecture-level cities, 254 prefecture-level cities and 326 county-level cities, the cities have been excluded from the study when they belong to county-level city transforming to prefecture-level city during 2005-2018. The raw data of the above variables were extracted from the "China Environment Yearbook", "China Statistical Yearbook", Statistical Yearbook of the various cities of China, and the "Chinese Procuratorial Almanac".

Data Verification and Endogenous Problems

For the panel data model, its premise of estimate is that the panel data must be stable, otherwise it may produce fallacy regression results. In this study, the Hadri test, IPS test, Fisher-ADF test, and Fisher-PP test methods are used to test the stability of the above-mentioned variables data. Test results show that the variables have a unit root, is non-stationary, and further inspection of the first-order difference, the results overall showed no unit root that variables are first-order I(1), Because the panel data is not stable, we need to continue to determine whether there is cointegration problems among variables. This study uses Pedroni test and Kao test, and results show that some statistic refused cointegration relationship exists. Therefore, it is necessary to return to the residuals obtained from the econometric model to know whether residuals are stable or not.

Here direct regression will lead to bias and inconsistent by the econometric model because the explanatory variables are endogenous, even if the regression results show that the urbanization, corruption have significant relationships with environmental pollution, also cannot assert that urbanization and corruption are intensified to environmental pollution, and thus, the least square method can no longer be consistent and unbiased. Because differential generalized moment estimation methods will lose some of the sample information, and instrumental variables exhibit weak effectiveness, there will be situations in which the test cannot be passed. Therefore, two tests are necessary for identification: the first is the Sargan test, which verifies the validity of the instrumental variables; the second is the differential error serial correlation test, using the statistics of the Arellano-Bond test. The results are shown in Table 1. The residual error of the econometric equation is obtained, and the residual series is tested. The results show that the residual series is stable and the cointegration relationship exists between the variables.

Empirical Results

In this study, Xtabond2 program of Stata16.0 software is used to solve the generalized moment estimation of the system. The Sargan test and Arellano-Bond statistical test were carried out, which were tested for the effectiveness of the selected instrumental variables and the autocorrelation of residual sequence. Specific estimation results are shown in Table 1 below, where the Wald statistic, the Sargan test, and the Arellano Bond test showed no abnormality. The Arellano Bond AR (1) values indicate that the residuals have first-order autocorrelation, while the Arellano Bond AR (2) values indicate that the residuals have no second-order autocorrelation.

The main results are shown in Table 1. When no corruption variables are included in Model 1, the urbanization did contribute to environmental pollution, however, it was not significant. In Model 2, after the introduction of the corruption variables, regression results show that the corruption aggravated environmental pollution by twisting environment policies, reducing the environmental regulation, and hindering investment in the environment and development of environmental

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technology. When the degree of corruption increased by 1%, per capita industrial wastewater emissions, per capita industrial emissions, and per capita industrial solid waste emissions—were increased by 0.675%, 0.646%, and 0.649%, respectively. In Model 3, the study further introduces the interaction variables of urbanization and corruption, and the result shows that the regression coefficient for the interaction variables is significantly positive; the interactive variable improved by 1%, the three industrial emissions were increased by 0.312%, 0.301%, and 0.280%, respectively. This result implies that increased corruption aggravated environmental pollution through the industrial structure, public service, government regulation effect.

From Model 3, the results of the regression also show that, due to the interactive variables of urbanization and corruption, the regression coefficient of urbanization changes from insignificant positive to significant negative, and economies of scale, industrial structure, public services, technical progress, and environmental regulation still passed statistical tests, This indicates that by controlling the effect of corruption on the pollution of the environment, urbanization improves the environmental quality. There are several possible reasons to explain this phenomenon: the first one is the upgrade of China's industrial structure, the proportion of secondary industry decreases, and the proportion of tertiary industry rises. Meanwhile, the proportion of high-tech products to all goods is also increasing, it will reduce the environmental pollution; the second one is the upgrade of public services level, the development of education, health care, social security and employment services increases environmental awareness, so the consumption of high energy and pollution products will fall, and reduce the local environmental pollution; the third is the introduction of advanced technology and equipment in China in recent years, leads to technological progress of china, at the same time, the development of R&D level, human capital investment and financial industry improve the ability of absorbing technology spillover, these are helpful to improve the environment quality; The fourth is urbanization promotes rural population flow to cities, this improves the level of per capita income in china and increases the demand for clean environment, and this has prompted the Chinese government to adhere to international environmental standards. Thus, environmental pollution has reduced. These effects are more overwhelming than the effects of the environmental pollution caused by industrial agglomeration and population size.

Moreover, the regression results in Model 3 show that the regression coefficient sign of urbanization is opposite to that of interactive variables, it changes from a minus sign to a plus sign, by calculating the partial derivative of urbanization to environmental pollution, we can get critical value of pollution level, at which urbanization would aggravate environmental pollution as approximately 3.60. That is, when corruption level is below3.60, urbanization can reduce environmental pollution and improve environmental quality. A comparison of the levels of corruption in every city in 2013 shows that only in Beijing, Shanghai, Tianjin, Hangzhou, and other 25 cities, the level of corruption is lower than the critical value, the urbanization helps to improve environmental quality. However, as for the other cities, the level of corruption is higher than the critical value, which means that in these cities, urbanization aggravated environmental pollution. Furthermore, from the perspective of different types of cities, the average level of corruption for the above prefecture-level cities in 2013 is approximately 3.48, and for prefecture-level cities and county-level cities eastern region in 2013 is approximately 3.82 and 4.02 respectively, which shows that among the three categories cities in china, only the urbanization in the above prefecture-level cities is helpful to improve the environmental quality, while in prefecture-level cities and county-level cities, the findings are the opposite. The study will carry out robustness tests below based on the three categories cities data respectively to further validate the conclusions.

Analyzing the relations between the other variables and environmental pollution, It can been found that monomial coefficient of economical scale is positive, and the quadratic term coefficient is negative, which confirms the relationship

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between the size of the economy and environment pollution is the inverted u-shaped curve, and the hypothesis in China was established. The coefficients of industrial structure, public service, technological progress, and environmental regulation are negative, and means these effects reduce environmental pollution, however, consumption effect aggravates pollution of the environment, but it not significant. That may be because the gap is large between the rich and the poor in China, thus leads to the consumption is given priority to low-end and high pollution products for low-income groups, which will aggravate environmental pollution. From 2000 to 2014, China has become the fastest country in widening gap between the rich and poor, 10% of the richest man in wealth have increased by 15.4%.

Table 1
Overall Empirical Results

	Per capita emissions of industrial wastewater			Per capita industrial emissions			Per capita emissions of industrial solid waste		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Constant term	3.369**	4.126**	1.580**	3.997**	4.775**	1.921**	3.826**	4.125**	1.117**
ln EP_{it-1}	0.562***	0.536***	0.528***	0.596***	0.586***	0.563***	0.598***	0.578***	0.509***
lnVG	3.159**	3.148**	3.095**	3.203**	3.195**	3.136**	3.321**	3.231**	3.115**
$lnVG^2$	-0.189***	-0.178***	-0.170***	-0.198***	-0.189***	-0.183***	-0.175***	-0.165***	-0.174***
lnIS	-0.662**	-0.656***	-0.646***	-0.699**	-0.683***	-0.676***	-0.692**	-0.686***	-0.650***
lnTE	-0.680**	-0.678**	-0.671**	-0.690**	-0.688**	-0.679**	-0.685**	-0.683**	-0.679**
lnBPS	-0.654**	-0.604***	-0.599***	-0.655**	-0.648***	-0.645***	-0.687**	-0.673***	-0.670**
lnEI	-0.198***	-0.192***	-0.186***	-0.196***	-0.187***	-0.178***	-0.203***	-0.199***	-0.186***
lnU	0.809	0.823	-0.349***	0.996	0.982	-0.336***	0.912	0.906	-0.313***
lnU*lnCO			0.312**			0.301**			0.280**
lnCO		0.675**	0.512**		0.646**	0.506**		0.649**	0.501**
lnCL	0.211	0.205	0.217	0.295	0.291	0.268	0.318	0.302	0.299
Wald test	3042	3080	3115	3239	3084	3059	3065	3117	3123
Sargan test	30.19	31.26	35.02	31.33	30.75	32.82	30.26	32.45	32.45
Arellano-Bond AR(1)	-3.07	-3.12	-3.22	-2.34	-2.24	-2.12	-3.39	-3.58	-3.20
Arellano-Bond AR(2)	1.80	1.76	1.54	1.32	1.43	1.41	1.42	1.48	1.52

Note.
*, **, and *** denote significance at the 1%, 5%, and 10% levels, respectively.

Robustness Check

In order to verify the finding that the urbanization of above prefecture-level cities can improve environment quality, while that of prefecture-level and county-level cities increases environmental pollution, this study establishes the following model:

$$LnEP_{it} = C + \beta_0 LnEP_{it-1} + \beta_1 LnVG_{it} + \beta_2 LnVG_{it}^2 + \beta_3 LnIS_{it} + \beta_4 LnTE_{it} + \beta_5 LnBPS_{it} + \beta_6 LnEI_{it} + \beta_7 LnU_{it} + \beta_8 LnCO_{it} + \beta_9 LnCL + \mu_{it} \quad (2)$$

Variables in this model are the same as the above mode l. It is based on dynamic panel data in three categories cities, respectively, and used Stata11.0 software to do econometric regression. The results are shown in Table 2, it shows that urbanization of the above prefecture-level cities improves environmental quality, urbanization increased by 1% and per capita industrial wastewater, waste gas, and solid waste emissions decreased by 0.246%, 0.208%, and 0.316%, respectively, they all pass the significant test at the 5% level.

These results are derived due to the following reasons: First, among the above prefecture-level cities, the proportion of high-tech products and services to whole products is high, and thus, product structure upgrade reduces environmental pollution. Second, because of basic public service, consumption level development, and health consciousness enhancement, many polluting enterprises are forced to transfer to prefecture-level cities and county-level cities, this reduces the local environmental pollution. Third, the urbanization promotes high increase of per capita income in above prefecture-level cities, so

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the requirement and standards of environmental protection are high, and lead to improving the environment quality. These effects surpass the consumption, urban scale, the population agglomeration effects in the environmental pollution caused by the urbanization of above prefecture-level cities.

However, the urbanization of prefecture-level and county-level cities intensify environmental pollution, it passes the significant test at 10% level. The following reasons may account for this result. First, many polluting enterprises move to prefecture-level and county-level cities, and their own industrial structure is mainly labor-intensive pollution industry in these regions, which will aggravate pollution of local environment. Second, the level of public service of prefecture-level and county-level cities is lower than that of above prefecture-level cities, and low levels of consumption, environmental protection consciousness, R&D, human capital and financial development hinder the progress of environmental requirements and standards, accordingly, pollution emissions deteriorate the local environmental pollution. Third, per capita income growth is slow in prefecture-level and county-level cities, so the local governments focus more on increasing the GDP and will improve the attraction of investment promotion and capital introduction by improving the infrastructure construction, the requirement of environmental quality is not high, there is little constraint to the pollution of local environment. Four, compared with high and new technology, urbanization is easier to increase GDP in prefecture-level and county-level cities, that is very important to Local officials for personal assessment in china, although high and new technological progress can also increase GDP by enhancing product competitiveness, but the overall effect is not obvious, and thus, environmental pollution is more serious in prefecture-level and county-level cities. From the above, we can see that the prefecture-level and county-level cities still have a long way to go with regard to urbanization, which will aggravate pollution of the environment.

Contrast other explanatory variables between table 1 and table 2, it can been found that the sign of industrial structure in the prefecture-level and county-level cities is changed from negative to positive sign, and there are significant, however, the sign of industrial structure in above prefecture-level cities is always a minus sign, which implies industrial structure of the prefecture-level and county-level cities aggravated environmental pollution, so it is necessary to promote industrial structure to improve the quality of the environment.

Table 2
Sub-Regional Empirical Results

	above prefecture-level cities			**prefecture-level cities**			**county-level cities**		
	waster water	waste gas	solid waste	waster water	waste gas	solid waste	waster water	waste gas	solid waste
Constant term	3.381**	3.756***	4. 214**	3.349**	3.236	4.314***	3.126**	3.380	4.223***
ln EPit-1	0.315***	0.322***	0.362***	0.405***	0.456***	0.512***	0.539***	0.505***	0.526***
lnVG	3.265**	3.181**	3.862**	3.753**	3.635**	3.652**	3.128**	3.402**	3.168**
lnVG2	-0.203**	-0.211**	-0.225**	-0.263***	-0.215***	-0.184***	-0.145***	-0.163***	-0.150***
lnIS	-0.564**	-0.525**	-0.510**	0.402***	0.436***	0.447***	0.512***	0.556***	0.504***
lnTE	-0.623**	-0.614**	-0.665**	-0.628**	-0.604**	-0.708**	-0.599**	-0.584**	-0.570**
lnBPS	-0.264**	-0.278***	-0.298***	-0.633**	-0.645***	-0.632***	-0.708**	-0.732***	-0.741***
lnEI	-0.321**	-0.311**	-0.356**	-0.280***	-0.217***	-0.208***	-0.201***	-0.236***	-0.245***
lnU	-0.246**	-0.208**	-0.316**	0.210***	0.278***	0.265***	0.302***	0.356***	0.309***
lnCO	0.556**	0.518**	0.503**	0.585**	0.598**	0.546**	0.699**	0.623**	0.680**
lnCL	0.412	0.409	0.395	0.365	0.345	0.352	0.213	0.215	0.284
Adjusted R2	0.811	0.843	0.824	0.843	0.803	0.868	0.802	0.855	0.872
Wald test	3012	3042	3026	3562	3421	3008	2978	2956	2931
Sargan test	30.23	30.63	31. 85	28. 91	28. 74	28. 41	29. 42	29. 97	29. 07
Arellano-Bond AR(1)	-2.97	-3.02	-3.12	-2.34	-2.74	-2.82	-3.87	-3.88	-3.20

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Arellano-Bond AR(2)	1.96	1.87	1.25	0.96	0.83	0.87	1.56	1.85	1.23

Note.
*, **, ***means at the 1%, 5%, 10% level through significant test, respectively.

CONCLUSION

In the past, economic growth played as the Chinese government's priority target, urban development means a pursuit of urbanization rate. However, there always came along environmental costs. Nowadays government gives increasing weight to the protection of environment, so the relationship of pollution and urbanization becomes more and more worth studying, especially against the backdrop of anti-corruption.

Using the panel data of Chinese city-level in 2005-2018, we apply the dynamic panel model to study the effect of urbanization and corruption on environmental pollution. This research has shown that an inverted U-shaped relationship between urbanization and environmental exist, with turning point at 3.60. The results also suggest that urbanization improved environmental quality in 32 cities, while in others, it aggravated environmental pollution. What's more, we experiment the effect by different city administrative level, and only get the improving impact in above prefecture-level cities.

RELATED POLICY SUGGESTIONS

Based on the above empirical results, we can conclud that urbanization can play an active role in improving environmental quality in China. Methods such as tobacco regulation, carbon emission decline, and smokeless development can control the environmental pollution. As for the three type cities, especially in the prefecture-level and county-level cities, we need to take various countermeasures to deal with corruption as follows:

Firstly, we need to take countermeasures to deal with corruption, especially set up the mechanism of punishment in the prefecture-level and county-level cities, the corruption probably can be prevented through strengthening ideological education, improving the level of public morality and public servants, increasing the corruption cost, and formulating special law in anti-corruption, provide the powerful law to intensify fight corruption.

Secondly, aiming to promote the economic development, and narrow the gap between rich and poor, the local government need to develop the urbanization and industrialization to increase GDP, the good ways of which are to develop high-tech industry and use more new equipment in the prefecture-level and county-level cities as well as above the prefecture-level cities. Meanwhile, it is also important to increase investment in R&D and education, deepen the reform of the financial markets and improve the level of human capital and the level of financial development, better to absorb the technological spillover effect of urbanization. Thus, it is feasible to improve environmental quality through the industrial structure effect, consumption effect, infrastructure investment effect, basic public services effect, and technology effect.

Thirdly, it is necessary to strengthen environmental propaganda in reducing the pollution of environment, improve people's environmental protection consciousness, make the region improve environmental regulation, further promote the influence of urbanization on improving the effect through regulation effect.

Conflicts of Interest Disclosure Statement

This research is not funded by any organization related to tobacco production.

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