How Have Political Incentives for Local Officials Reduced Environmental Pollution in Resource-Depleted Cities?

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Abstract: Chinese resource-exhausted cities face more severe environmental pollution problems than other cities. In addressing these problems, the way local officials (usually senior party and government leaders) operate is very important, as their focus on political achievements may complicate how they manage environmental pollution in these cities. On the one hand, the traditional Gross Domestic Product-based quest for political achievement may lead top leaders to de-emphasize environmental pollution. On the other hand, changes made in 2003 to the way the performance of Chinese officials is evaluated have encouraged some local senior party and government leaders to pay more attention to environmental problems. Based on this, we analyze the relationship between political incentives and environmental pollution by applying the 2004–2014 panel data from 37 resource-exhausted cities. The findings reveal that firstly, among the factors which impact the environmental pollution of resource-exhausted cities, investment in fixed assets, foreign direct investment, industrial structure, per-capita education expenditure, and population density do not have a significant impact, thus indicating that local openness levels, the degree of industrial upgrading, and local investment in fixed assets are not the key variables in environmental pollution control. Secondly, the extent to which officials vie for political achievement affects environmental pollution in resource-exhausted cities. This depends upon whether the officials are municipal party secretaries or mayors; the former play a greater dynamic role in environmental pollution and have stronger robustness than the latter. The conclusion verifies both the existing authority structure of China and its effectiveness in the control of environmental pollution of resource-exhausted cities. That is to say, in contrast to the principles of the party committees, the mayors are in a subordinate position and often fail to fully and effectively exercise their functions. Accordingly, we point out that the selection of municipal party secretaries, rather than mayors, is particularly important in coming to terms with local environmental pollution.

Keywords: municipal party secretaries; mayors; political incentives; resource-exhausted cities; environmental pollution

1. Introduction

According to the definition provided in Several Opinions on Promoting the Sustainable Development of Resource-exhausted Cities (GF (2007) No. 38), "resource-exhausted cities" are cities where development of mineral resources is already in a late stage and the accumulative recovered

reserves have already exceeded 70% of recoverable reserves. There are a number of resource-depleted cities, such as Lorraine, Ruhr, and Montreal, which face difficulties such as the resource curse, unemployment, and environmental pollution. These are issues are of great concern to the academic community [1–6].

Compared with more developed countries, China faces serious problems with respect to resource-depleted cities. Among those problems, environmental pollution needs to be addressed most urgently. China established the first list of 12 resource-exhausted cities in 2008, including Fuxin, Shizuishan, and Baiyin. Based on the provisions of policy articles in 2009 and 2013, China now has 69 resource-exhausted cities and regions. Development in these cities (or regions) has brought about a serious problem of environmental pollution and this has become a barrier to urban transformation. We looked at data concerning 37 resource-exhausted cities from 2004 to 2014 and it was revealed that the average acreage of forest in built-up areas was far lower than that of the country overall, with the gap growing ever wider with time. The multipurpose waste utilization rate in 37 prefectural-level resource-exhausted cities in 2004 was 63.83%, while the rate for the whole country in the same year was 71.37%, indicating a notable increase. In terms of pollution emission, the average industrial fume emission rate in these cities in 2014 was 59,389.89 tons per city, far higher than the average yearly emission rate for cities in the country overall (43,783.12 tons). Under such circumstances, the transformation of resource-exhausted cities is an urgent task. Although China has promulgated several opinions from the State Council on Promoting the Sustainable Development of Resource-Based Cities (2007) and the Notice on the Transformation Evaluation of First Batch of Resource-Depleted Cities (2010), etc., future work is required with respect to the driving factors of environmental pollution.

Many studies confirm that both the characteristics and the incentives of officials often drive economic growth [7–13]. Similarly, local officials are also likely to play an important role in the pollution control of resource-exhausted cities. China has been carrying out the "championship system" of GDP for a very long time, that is to say, GDP is taken as one of the incentives for the promotion of officials. Against this background of central and local government fiscal decentralization, local officials also seek to advance their chances of promotion [14,15]. If, in resource-exhausted cities, party secretaries and mayors cooperate with each other, they may promote economic growth and employment. However, because this incentive system may result in only short-term economic growth, officials consider economic growth as more rewarding than the control of environmental pollution. This often aggravates environmental pollution. In 2003, Hu Jintao, the former General Secretary of the CPC of China, proposed "the scientific outlook on development", emphasizing the comprehensive, coordinated and sustainable development of the economy. The central government set aside its GDP-centered performance-based assessment of officials and began to focus assessment on environmental and ecological protection. In 2014, the General Office of the State Council printed and issued Performance Assessment Measures for Air Pollution Prevention and Control Action Plan (For Trial Implementation), marking the official establishment of both strict responsibility and assessment of management over the atmospheric environment in China. To a certain extent, paying attention to the ecological environment facilitates improvement in the environment of resource-exhausted cities.

As a whole, the changes to evaluation standards for local government officials show how control of environmental pollution in resource-exhausted cities can differ. Accordingly, based on respective consideration of senior local communist party committee and municipal government leaders, we attempt to answer the following questions: Do political incentives significantly impact the environments of resource-exhausted cities? What are the differences in their impacts?

The rest of this article is organized in the following way. First, hypotheses are put forward with regard to the impact of political incentives on environmental pollution in the resource-depleted cities. Second, a comparative study between the municipal party secretaries and the mayors is carried out.

2. Literature Overview and Theoretical Hypotheses

2.1. Literature Overview

Political incentives refer to the reelection or promotion of policy executives in exchange for loyalty to their superiors [16]. As for the political system of Chinese communist party, promotion/reelection is the most important political incentive for local cadres. The top-down cadre index evaluation system dominated by the organization department is used for the regular examination of party and government officials at all levels. This is an institutional arrangement reflecting the party's managing cadres and supervising local officials who implement the central policies. In contrast to material incentives for individuals, political incentives for officials are mainly embodied at the psychological level.

As mentioned above, the present literature on local political incentives is generally focused on economic growth, while research on urban resource development is focused on the weak economic growth of cities, reduced social and economic welfare [17], Dutch disease and concentration of manufacturing in the same region [18], low efficiency of resource utilization [19], and evaluation of environmental pollution in resource-oriented cities [20,21]. Research directly or indirectly related to this thesis is grouped into two types. The first type focuses on the relationship between political incentives for local officials (or local politics) and environmental pollution. The second type focuses on the pollution factors of resource-oriented cities.

Politics play a very important role in the projects of environmental improvement [22]. The political influence of lobby groups [23], government rent-seeking corruption [24], bureaucracy [25], and local policy agenda [26] are all manifestations of local politics, possibly producing impacts on environmental pollution. Among numerous manifestations of politics, little attention has been paid to the relationship between the political incentives and environmental pollution. According to Maskin [27], although officials in the administrative pyramid should first prioritize local fiscal revenue, they attach more importance to their promotion opportunities and their political careers. This implies that they are in pursuit of economic growth and overlook environmental improvement. As found by Zhou, being the incentive mode of government officials, promotion championship has not only brought rapid development to the Chinese economy, but also a series of problems to China, including environmental deterioration [28]. Similarly, Qiao [29] also held the opinion that China had a mechanism of official "promotion championships" with economic growth as a major part of the assessment. This mechanism is characterized by "layer-by-layer overcharge", that is to say, competition escalates gradually from top to bottom, and from the provincial to municipal level. Under this competitive mechanism, lower-level officials have a strong motive and desire to get promoted politically by developing the economy, and overlook environmental protection and improvement. Based on the provincial panel data from 2003 to 2011, Yu et al. [30] inferred that the claim for political achievement was an important factor that results in the frequent occurrence of environmental accidents in their administrative areas. Based on investigation, Ran [16] found that the opportunities for flow and promotion for officials in departments of environmental protection were far fewer than for those for officials in core government departments with economy as their major function. This phenomenon indicates that although the central government presently encourages local officials to improve the environment rather than developing the economy as a systematic mode of political incentives for cadre assessment, this assessment system is obviously characterized by a "pressure-based system", which tends to make local officials try their utmost to show their own political achievements to their superiors through superficial and visible "economic achievements", namely "political achievement engineering", thus overlooking environmental protection. Taking municipal party secretaries and mayors of 109 Chinese cities as samples, Zhang and Lu revealed that the vertical exchange of officials was not conducive to improving the quality of urban environment. The environmental performance incentives were ineffective because the vertical exchange officials had the advantage of political promotion [31]. Some scholars studied political incentives with respect to decentralization of the central and local governments. For example, James et al. showed that decentralization made local governments lower environmental standards in order to obtain competitive

capital. This would probably promote the rapid development of regional economy while aggravating pollution [32–34]. Employing regional air data in the year 1999 and 2000, Konisky and Woods investigated the impact of decentralization on environmental pollution. They found that decentralization contributed to pollution level across the countries and borders [35]. Political incentives may also reduce pollution. Oates argued that the lateral government competition could provide effective regional public service, which would reduce regional environmental pollution [36]. According to Sigman's studies, decentralization was negatively correlated with regional water pollution [37].

There are number of factors influencing environmental pollution in resource-depleted cities, which mainly include industrialization or natural resources. For example, Fang and Chen established a model using the panel data of prefecture-level resource-depleted cities between 2003 and 2011 to analyze the impact of industrialization, fixed asset investment, economic growth, urbanization, and technological progress on environmental pollution [38]. Tang et al. [39] and Liang et al. [40] examined the polluting elements of Chinese coal cities. The former investigated the pollution characteristics of heavy metals in Huai'nan, and held the opinion that metal dust mainly came from industrial emissions, vehicle-related activities, coal dust, natural soil weathering, and coal burning. The latter authors revealed with the case of Lianyuan City in Hunan Province that industrial activities, natural resources, aerial sediment, and agricultural activities are important pollution factors of this coal-mining city. Miners are also of concern to some scholars, for example Li et al. [41] and Zeng et al. [42]. Li et al. employed data from 1999 to 2013 and used a data envelopment analysis model to assess the post-transformation development of Jiaozuo City. Therein, input indicators included quantity of year-end work staff, investment in fixed assets, local fiscal expenditure, annual water consumption, and annual power consumption. Environmental development is one of the output indicators. Zeng et al. investigated the environmental, economic, and social features of these cities, and found out that most of coal-mining cities have a large percentage of mining practitioners, implying a stern challenge for reducing the emission of dust pollution. Evidently, similar to the opinions of Fang and Chen, Li et al. argued that fixed asset investment was also an important factor.

As a whole, a number of studies on the relationship between political incentives and environmental pollution in the general cities, or the factors causing pollution in resource-oriented cities have been conducted, but regrettably, few scholars have paid attention to the political incentives in resource-exhausted cities. This gap will be filled, which is our major contribution.

2.2. Theoretical Hypotheses

The attention paid by the Chinese government to ecology has gone through a process of evolution. In the early period, under the impact of orientation to GDP and the reform of fiscal decentralization, and driven by political achievements, officials were able to, on the one hand, promote the rate of economic growth of resource-exhausted cities and solve local employment problems in local resource-based enterprises. However, on the other hand, due to the pursuit of GDP and fiscal decentralization, officials tended to neglect environmental protection. After Hu Jintao came into power, the emergence of the idea of scientific outlook on development, to some extent, changed the standards for assessing the political achievements of officials. In contrast, under the rule of Xi Jinping, attention has also been paid to ecological civilization.

In theory, the complicated impacts of political incentives on the environmental improvement of resource-exhausted cities are also embodied in the comparison of the effects of "the last attempt" and "tranquil life". "The last attempt" refers to the phenomenon whereby local officials take measures to control environmental pollution before leaving their office. The "tranquil life" is the opposite phenomenon, whereby local officials have no desire to improve environmental quality at the end of their terms. In China, the engagement system of Party and government leading cadres is explicitly stipulated in Article 40 of Chapter 7 of The Work Regulations on the Selection and Appointment of Party and Government Leading Cadres. There is an explicit provision in Article 40 "*The System of Engagement is Tentatively Implemented among some Professional Leading Positions in Party and Governmental*

Organs": Under the system of engagement, each term for a leading position shall last no more than five years, but re-engagement can be carried out upon the expiry of the term. In general, almost all local officials desire to serve two terms of office in succession or be promoted to a higher level of administration. Along with the extension of terms of office, especially within the second term of office, political incentives are weakened relatively. This is particularly true with regard to those officials whose probability of promotion is small and who face the auditing of economic responsibility before leaving their office, and for whom a "tranquil life" is the optimal choice for their remaining political career. Such cases tend to be unfavorable for the environmental improvement of resource-exhausted cities. The opposing viewpoint suggests that, before leaving their office, officials also have the impetus to expand investment, and respond to promotion assessment by triggering economic growth and controlling environmental pollution, and in so doing, make "a last-ditch attempt" at a promotion. Therefore, Hypothesis 1 is put forward:

Hypothesis 1 (H1). *The longer an official has been in his current post (i.e., the closer he/she is to the end of their term), the stronger his or her incentive for political achievements, which will facilitate the environmental improvement of resource-exhausted cities.*

In China, the top leaders in local governments are mayors and municipal party secretaries. Although they are at the same administrative level, municipal party secretaries are officials within the party, as the top leaders in the municipal party committees. In contrast, mayors are the top leaders in municipal governments. The party committees are chiefly responsible for publicizing the guidelines, policies, routes and ideas of the party, leading and supervising the normal operation of other institutions, ensuring the implementation of the guidelines, policies, routes and ideas of the party, and deciding on important topics related to local social affairs at the same time. In contrast, municipal governments are mainly responsible for administrating urban affairs according to laws (the constitution, laws, administrative regulations and local regulations). Under the current administrative system of China, party committees are in charge of the governments. Therefore, in theory, municipal party secretaries play a more significant role than mayors in the environmental improvement of resource-exhausted cities.

Hypothesis 2 (H2). *In comparison with mayors, the political incentives for municipal party secretaries produce more remarkable impacts on the environmental pollution of resource-exhausted cities.*

3. Model and Variable Selection

3.1. Model and Variables

As there are 37 samples and the time span is between 2004 and 2014, it is reasonable to use the panel data model to analyze the factors influencing explained variables. Equation (1) is built and the impacts of political incentives for the local officials are examined:

$$InY_{it} = \alpha_0 + \beta Perf_{it} + \lambda Control_{it} + \varepsilon_{it} \tag{1}$$

where i denotes various resource-based cities, and t represents years. Y and Perf denote the explained variable (the environmental pollution indicators of resource-exhausted cities) and the explaining variable (the political incentives). There are different methods to measure environmental pollution. Yu et al. [43] carried out principal component analysis to five indicators, including unit SO_2 emissions, unit smoke emission, unit waste water emissions, unit industrial waste gas emissions, and unit industrial solid waste emissions, obtaining the local overall level of environmental pollution. Zheng et al. [44] and Wu et al. [45] used PM10 concentration and PM2.5 to measure the degree of environmental pollution. In the opinion of this thesis, based on the availability and conciseness principles of Chinese data, SO_2 emissions are selected, because integrated indicators will distort some information after principal component analysis. The measurement scales of political achievements of

officials chiefly include: the difference between the actual average growth rate of accumulative GDP of a given official in office and the actual average growth rate of average GDP of his/her predecessor, and the amount of investment in control of environmental pollution [46]. However, these indicators, to a certain extent, display the results of political achievements, rather than standing in for political ambition or desire for political achievement. We draw on the opinion of Li and Zhou [14], and use the office-serving term of mayors or municipal CPC committee secretaries to measure the key explanatory variables, namely, the political incentives for the officials. This is because of following consideration: When an official is not promoted when his/her term of office is about to expire or when he/she is about to be 65 years old, the objective function of his/her decision-making may change, thus influencing the environmental pollution control of resource-exhausted cities.

The control variables are as follows. Firstly, there is investment in fixed assets (fixed). In the investment structure of fixed assets, if the investment in energy saving and emission reduction accounts for a large percentage, this will help reduce environmental pollution to a certain extent; on the other hand, if investment, for example, is in the heavy chemistry industry and accounts for a large percentage, pollution will be aggravated. Secondly, the percentage of the amount of foreign direct investment in regional GDP (Fdi) is used to control the impacts of the differences in degrees of openness and market orientation on environmental pollution. Foreign direct investment produces some impacts on the environmental pollution of developing countries [47]. In order to attract foreign companies and capital, local officials lower environmental standards, which may, as GDP rises, aggravate environmental pollution. Although this is true, the introduction of some foreign capital may actually also bring in advanced technology to prevent and control environmental pollution. Thirdly, there is the industrial structure (Indus). The value of tertiary industry as a percentage of output is used to measure industrial structure. The higher the value, the more effective the lowering of environmental pollution levels. Fourthly, there is per-capita educational expenditure (Edup). The higher the per-capita educational expenditure, the more attention is paid to the environment. This occurs with rises in staff knowledge, educational levels, and academic levels, and forces the local government to make control of environmental pollution a priority. Fifthly, there is population density. The larger the population density, the larger the population per square kilometer is, and the higher the local environmental pressure. Sixthly, the personalities of officials include their previous work history, terms of office, and age. Here, "government officials with backgrounds in companies" (Company) refers to municipal party secretaries or mayors who once served as party committee secretaries, factory directors, board chairmen, or general managers or assumed other important posts in enterprises. The term, however, excludes deputy posts, middle-level cadres, or lower posts in general. Government officials with enterprise background tend to boast greater experience in environmental protection. The term "Improve" refers to the level of improvement made locally by officials. The officials' major (Major) in postgraduate school may also affect environmental pollution in the resource-depleted cities. An official with a major in economics or management will be more aware of the importance of industrial upgrading and is more likely to take measures to control pollution. The term "Cons" is the constant term. In order to reduce the impact of price changes, we have adjusted the above-mentioned control variables for inflation, starting with 2004 as the base year.

3.2. Data Source

The starting year of 2004 for this study is the year following which Hu Jintao introduced the concept of scientific development, and correspondingly the duration of our research is from 2004 to 2014. The data of the environmental pollution of resource-exhausted cities come from The Statistical Yearbook of Chinese Cities (2005–2015). In 2013, the State Council promulgated The Plan for the Sustainable Development of Chinese Resource-based Cities (2013–2020), in which 262 resource-based cities are defined, 69 of which are resource-exhausted ones. Restricted by the difficulty in obtaining the data of county-level cities and lower administrative levels, we consider only prefectural cities (a total of 37).

The term of office, age, and other personality data of municipal party secretaries and mayors come from Baidu, people.com.cn, xinhuanet, and local government websites. It should be noted that the number of office-holding years of local officials is calculated from the current year if they take office during first half of a given calendar year. Otherwise, the starting year is the following year.

4. Empirical Results and Discussion

4.1. Descriptive Statistical Analysis

A descriptive statistical analysis is conducted. As shown in Figure 1, from 2004 to 2014, the average value of SO_2 emissions of the 37 resource-exhausted cities was 77,517 tons per city, with the minimum and maximum values being 1245 tons and 331,863 tons, respectively.
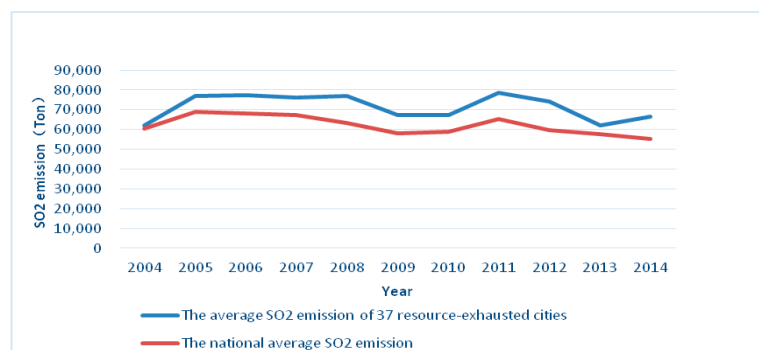

Figure 1. Comparison of SO_2 emissions/per city between resource-exhausted cities and the nation overall.

The minimum value of foreign direct investment was USD 230,000, and the maximum value was about USD 2,410,250,000, with an average value of USD 285,630,000 (see Table 1). The average value of industrial structure is about 33%, meaning that the percentage accounted by tertiary industry is low. The per capita educational expenditure was RMB 1920, with the minimum value being RMB 726.400. The average value of population density was 387.188 people/square kilometer, with the minimum and maximum values being 37.195 and 1013.610 people/square kilometer, respectively. In terms of average value, the average value of population density in resource-exhausted cities is greater. The average number of office-holding years of mayors and municipal party secretaries was 2.700 and 2.800 respectively, far lower than the two-term expiry value of 10 years.

Table 1. Descriptive statistics of major variables.

Variable	Mean	Standard Deviation	Minimum	Maximum
SO_2 (ten thousand tons)	7.7517	6.3649	0.1245	33.1863
Fixed (billion yuan)	484.9572	522.2806	21.2472	3096.893
Fdi (billion dollars)	2.8563	4.1386	0.0023	24.1025
Indus (percentage)	33.0312	5.8968	16.99	48.29
Edup (yuan)	0.1920	0.1197	0.07264	1.0641
Density (people/square kilometer)	387.188	270.4572	37.1951	1013.61
Position year (mayor) (year)	2.70	1.51	1	9
Improve (mayor)	0.6143	0.4874	0	1
Company experience (mayor)	0.3587	0.4802	0	1
Major (mayor)	0.6830	0.4659	0	1

Note: Cons: the constant term; Indus: industrial structure; Fixed: investment in fixed assets; Fdi: foreign direct investment in regional GDP; Edup: per-capita educational expenditure; Density: the popularity density; Position year: the political incentives for the officials; Improve: the level of improvement made locally by officials; Company experience: municipal party secretaries or mayors who once served as important posts in enterprises; Major: the officials' major in postgraduate school.

The Regressive Results

First, correlation analysis is conducted with respect to the variables. The correlation coefficient between investment in fixed assets and foreign direct investment and between investment in fixed assets and per-capita educational expenditure is 0.7720 and 0.6466, respectively. All the correlation coefficients of other variables are less than 0.50, indicating a weak correlation between explaining variables and control variables. Panel data regression can be conducted.

In order to ensure the robustness of results, we successively adopt ordinary least square (OLS), fixed effect, and random effect tests to investigate the impact of political incentives on the environmental pollution of resource-exhausted cities. As shown in Table 2, although all the impact coefficients of the number of office-holding years of mayors in the above models have negative values, they are not significant, with the conclusions being highly consistent. With regard to control variables, the empirical result of the OLS model is different from that of the other models. The analysis of the former indicates that, along with the increase in investment in fixed assets, environmental pollution is aggravated, while the analysis of the latter indicates that the environmental pollution of resource-exhausted cities correlates with foreign direct investment and per-capita educational expenditure. Clearly at odds with analysis of the mayors, with increases in the number of office-holding years of municipal party secretaries, the environmental pollution level of resource-exhausted cities will decline, and pollution will be effectively controlled. There is a significance level in the OLS model of 10%, with an impact coefficient of −0.0290. As inferred from the Hausman inspection value of fixed effect and random effect (0.0000), we should reject the original hypothesis and select the fixed effect. In the fixed effect, the impact coefficient of the office-holding years of municipal party secretaries is −0.0344. Therefore, against the political incentives for municipal party secretaries, the conclusions of OLS and fixed effect model are relatively consistent with each other. Other control variables, however, show significant differences between the OLS and fixed effect models. Such differences include investment in fixed assets, per-capita educational expenditure, the percentage of foreign direct investment in GDP, whether municipal party secretaries have work experience in enterprises, and the specialty of municipal party secretaries. The results of Table 2 verify the marked differences in the impacts of mayors and municipal CPC committee secretaries on the environmental pollution in Chinese resource-exhausted cities. The possible reasons are that in China, in terms of appointment, municipal party secretaries are decided and appointed by provincial party committees, or generated through election at the plenary meetings of municipal party committees, and approved by provincial party committees. In contrast, mayors are decided by provincial-level party committees, recommended by municipal party committees to municipal people's congresses, and generated through election at the plenary meetings of municipal people's congresses. Although they are at the same administrative level, municipal party secretaries are officials within the party, as the top leaders in the municipal party committees. In contrast, mayors are the top leaders in municipal governments.

In the process of environment governance, the party committees are chiefly responsible for publicizing the guidelines, policies, routes, and ideas of the party, leading and supervising the normal operation of other institutions, ensuring the implementation of the guidelines, policies, routes and ideas of the party, and deciding on important things related to local social affairs at the same time. In contrast, municipal governments are mainly responsible for administrating urban environment pollution affairs according to laws (the constitution, laws, administrative regulations and local regulations). Under the current administrative system of China, the party committees are in charge of the governments. Therefore, municipal party secretaries play a more significant role than mayors in the environmental improvement of resource-exhausted cities. If the elected municipal party secretaries have a strategic vision and the ability to handle complicated problems, the pollution governance decision of municipal party secretaries can be well implemented by the mayors, improving the environment effect to a certain degree.

Table 2. The regressive results of samples.

Explanatory Variable	Mayors			Municipal Party Secretaries		
	OLS Test	Fixed Effect	Random Effect	OLS Test	Fixed Effect	Random Effect
Cons	4.7652 *** (5.31)	8.8889 ** (2.66)	8.6042 *** (8.40)	4.5745 *** (5.35)	7.5783 ** (2.26)	8.9268 *** (8.44)
Fixed	0.3638 *** (4.56)	−0.0548 (−0.70)	0.0698 (0.90)	0.3808 *** (4.67)	−0.0467 (−0.60)	0.0515 (0.67)
Fdi	0.0347 (0.74)	−0.0949 ** (−2.33)	−0.0442 (−1.13)	0.0270 (0.53)	−0.1076 ** (−2.69)	−0.0681 * (−1.73)
Indus	−0.0011 (−0.13)	−0.0065 (−0.75)	−0.0026 (−0.32)	−0.0029 (−0.32)	−0.0070 (−0.80)	−0.0032 (−0.38)
Edup	0.0088 (0.28)	0.0610 ** (2.29)	0.0311 (1.16)	0.0075 (0.24)	0.0609 ** (2.24)	0.0380 (1.40)
Density	0.0991 (1.49)	0.6492 (1.10)	0.2909 ** (2.63)	0.0952 (1.41)	0.9053 (1.53)	0.3331 ** (2.66)
Position year	−0.0282 (−1.03)	−0.0157 (−0.78)	−0.0211 (−0.99)	−0.0290 (−0.89)	−0.0344 * (−1.71)	−0.0347 * (−1.66)
Improve	0.0895 (0.97)	0.0844 (1.24)	0.0790 (1.11)	−0.0624 (−0.68)	0.0493 (0.73)	0.0383 (0.56)
Company experience	0.1620 (1.64)	0.0098 (0.12)	0.0553 (0.68)	0.0999 (0.98)	−0.1290 * (−1.84)	−0.0852 (0.0720)
Major	−0.5870 *** (−7.00)	−0.1273 * (−1.72)	−0.2094 ** (−2.73)	−0.2826 ** (−3.22)	−0.1185 * (−1.73)	−0.1406 ** (−1.18)
F	20.11	15.69		15.21	17.90	
Prob > F	0.0000	0.0296		0.0000	0.0066	
R-squared		0.0522	0.0272		0.0641	0.0470
Hausman	-	Prob > chi2 = 0.0000			Prob > chi2 = 0.0000	

Note: The figures in brackets are the t statistics; *, **, and *** denote passing the test with 10%, 5% and 1% significance levels, respectively. Cons: constant term.

Differing from China in environmental governance modes of resource-depleted cities, the United States focuses on the rule of law, market mechanisms, and public participation in urban management. The United States firstly established a favorable environmental laws and regulations system at the national level, and then each state developed more detailed and operational legal rules in accordance with their own characteristics. As for the market mechanism, the United States has weak power and there tends to be government–market cooperation. From the perspective of public participation, the public is fully involved in problem identification and the implementation and evaluation of measures [48].

Similarly, Japan also attaches importance to the legal system for the environmental governance in resource-depleted cities. This is highlighted by the three functions of urban management, which are the local autonomy system, enterprise system, and social organization system, respectively. As for the local autonomy system, its decision organs and executive organs are elected by the residents. When a disagreement between the chief executive and the parliamentarian is not resolved, the decision will be made in the form of a referendum in the region [49].

In developing countries, India also has some resource-exhausted cities. While in the process of environmental governance, the Indian local government has a very weak authority to manage the city, and the municipality only is managed according to the opinions of superior government. Although India has established "finance committees" to put forward allocation suggestions for the state's fiscal revenue, the local government, actually, is not really financially independent. It is extremely weak in property management, financial budget and tax rights, which is in significant contrast to China's central and local decentralization [50].

This is demonstrated most prominently in Zaozhuang City, Shandong Province. Since 2008, the environmental pollution of Shizuishan City in Ningxia Autonomous Region, as a resource-exhausted

city, has been tremendously reversed, with the SO_2 value declining year by year from 272,076 tons to 89,315 tons in 2014. In particular, in 2011, the newly-appointed municipal party secretary Peng Youdong began to work out policies on optimizing the industrial structure, namely refining the primary industry, reinforcing the secondary industry, and activating the tertiary industry. Since the secondary industry of Shizuishan accounted for more than 60% in 2011, according to the policies worked out by Peng Youdong, Shizuishan should adjust stock and transform and upgrade its traditional industries on the one hand, and should expand the increment and vigorously develop new-pattern industries on the other hand. In terms of investment attraction, Shizuishan set up an access threshold and embodied the adjustment of structure and the promotion of upgrading; transformed the existing six traditional advantageous industries of coal mining and dressing, equipment manufacturing, calcium carbide deep-processing, characteristic metallurgy, carbon-based material, and new-pattern coal chemical industry; and vigorously developed such new-pattern environmental industries such as polyvinyl chloride material and agricultural product deep-processing. In terms of the tertiary industry, Shizuishan planned the construction of "five scenic areas and ten scenic spots" according to the idea of "cultural tourism". In addition, in terms of strategic planning, Shizuishan selected two old industrial parks: Pingluo Industrial Park and Hongguozi Industrial Park, for emphatic industrial upgrading. In terms of regulation policy, Shizuishan improved the widespread markets of coal operation and processing represented by Chonggang Town, reducing environmental pollution. Mayor Zhang Zuoli (2011–2012) and Mayor Wang Yongyao (2013–2014) partnered with Peng Youdong from 2011 to 2014. All the policies on optimizing the industrial structure of Shizuishan were worked out by Peng Youdong, instead of Mayor Zhang Zuoli and Mayor Wang Yongyao, who were only responsible for detailed implementation.

4.2. Robustness Test

The environmental pollution level of resource-exhausted cities of the preceding period may affect the current period, leading to the problem of variables endogeneity. As such, we adopt the Generalized Method of Moments (GMM) system to re-estimate models for maintaining the robustness of results. This method also applies the information in differential and horizontal formula. Therefore, it is more effective than the differential generalized method of moments. In addition, considering that the number of samples is small and the problem of overfitting tends to arise, we only select the differential or horizontal items in the period after endogenous variables as instrumental variables during estimation.

The results of Tables 2 and 3 are similar: the number of office-holding years of mayors has non-significant impacts upon the environmental pollution of resource-exhausted cities. However, as indicated by the regressive results of municipal party secretaries, their office-holding years are negatively correlated with the level of environmental pollution, and the significance level of the regressive coefficient -0.0541 is 5%. This implies that, along with the increase of the number of office-holding years, municipal party secretaries tend to effectively manage the environmental pollution of resource-exhausted cities. The instrumental variable of foreign direct investment can remarkably reduce the emissions of SO_2, possibly because foreign direct investment will bring an effect of technology spillover and enhance the level of pollution control technology. The emissions of SO_2 with a lag phase, investment in fixed assets, industrial structure, per-capita educational expenditure, population density, officials' characteristics, and all other control variables produce a weak impact on the SO_2 emissions of resource-exhausted cities. Obviously, as for the key variables, the impact coefficient of political incentives for the mayors and municipal party secretaries and its significance level are consistent with those in Table 3, proving the robustness of the empirical analysis.

Table 3. GMM test results.

Explanatory Variable	Mayor	Municipal Party Secretaries
L. Y	−0.0116 (−0.20)	−0.0085 (−0.15)
Fixed	−0.0256 (−0.23)	0.0080 (0.07)
Fdi	−0.0950 * (−1.96)	−0.1245 ** (−2.60)
Indus	−0.0182 * (−1.75)	−0.0163 (−1.54)
Edup	−0.0013 (−0.01)	−0.0262 (−0.29)
Density	0.5811 (0.85)	0.6866 (1.01)
Position year	−0.0168 (−0.77)	−0.0541 ** (−2.47)
Improve	0.1366 * (1.82)	0.0595 (0.76)
Company experience	−0.0508 (−0.58)	−0.1098 (−1.37)
Major	−0.0940 (−1.07)	−0.0990 (−1.25)
AR(1)	−12.94 (0.000)	−12.69 (0.000)
AR(2)	−0.28 (0.778)	−0.08 (0.936)
Sargan test (*P*-value)	0.068	0.076

Note: AR denotes Arellano-Bond test. * and ** indicated that passing the test with 10% and 5% significance levels, respectively.

5. Conclusions and Policy Suggestion

The system for assessment of Chinese officials has been changing substantially since 2003, not only attaching importance to economic growth, but also emphasizing ecological protection. Compared with other cities, Chinese resource-exhausted cities face more serious levels of environmental pollution. While addressing these problems, local officials, especially local top leaders, play a very important role, because the political incentives for them may, to a certain extent, impact environmental pollution control. For this reason, a study of the relationship between political incentives and environmental pollution of mayors and municipal party secretaries by applying the 2004–2014 panel data of 37 resource-exhausted cities has been conducted. Results indicate that: (1) the number of office-holding years is negatively correlated with environmental pollution, although this correlation is not significant under certain circumstances; and (2) the significant impacts of political incentives for the local officials on the environmental pollution of resource-exhausted cities depend on whether the officials are municipal party secretaries or mayors. Therefore, Hypothesis 1 is supported only partially. The findings also reveal that municipal party secretaries play a greater and more dynamic role in urban transformation and have a stronger robustness than mayors, which supports Hypothesis 2. Among the factors that impact the environmental pollution of resource-exhausted cities, investment in fixed assets, foreign direct investment, industrial structure, per-capita educational expenditure, and population density are not significant, proving that the local openness level, industrial upgrading degree, and local investment in fixed assets are not key variables that boost the control of environmental pollution.

Obviously, our results are different from those of [31,43]. All of them considered the general cities instead of resource-depleted ones. Furthermore, they measured environmental pollution with different indicators, for example, the comprehensive index or PM10.

The conclusions verify the current authority structure of China and its effectiveness to the environmental improvement of resource-exhausted cities. Evidently, the party committees under the ruling of the Communist Party of China have a strong consciousness of political achievements, which becomes stronger and stronger as the day the officials leave their offices approaches. "Localized management" and "administrative contract-awarding systems", which have existed in China for a long time, determine that the authority of local governments is concentrated in local party committees. As the top leaders of party committees, municipal party secretaries work out environmental policies compatible with their own benefits so as to promote their political achievements, for example selecting strategic emerging industries which can optimize the industrial structure and trigger employment, closing environment-polluting enterprises or meting out fines to them, or increasing investment in the control of environmental pollution. In contrast with principles of party committees, the mayors in charge of governments lie in a subordinate position in the authority structure, failing to exert their effective function in the process of environmental improvement. The policy implications are as follows. First, it is obvious that the current authority structure poses a challenge to the selection and appointment of municipal party secretaries, instead of those of mayors. That is to say, we should appoint people with a strategic vision and a strong ability to solve complicated problems, such as local municipal party secretaries, and try to enable them to hold office until the expiry of their term. Second, the stability of party committee leadership should be maintained. There are some municipal party secretaries from resource-exhausted cities who have been promoted from the position of mayor. This kind of promotion may be more conducive to the stability of party committee leaders. When they were in the position of mayors, the municipal party secretaries were in an auxiliary position; once they were promoted to a communist party secretary, they could use the power better because of the experience accumulated in the environmental governance of resource-exhausted cities.

The following areas need to be addressed in the future: (1) A comparison the impacts of political incentives between the first term and second term of the top officials in the resource-depleted cities should be performed, as well as (2) an investigation of the relationship between political incentives of officials of both genders and environmental pollution in these cities.

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