

## **BACKGROUND OF GOVERNORS, ECONOMIC GROWTH AND ENVIRONMENTAL POLLUTION IN CHINA**

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### **Abstract**

*In this paper, we study the impact of officials' background or working experience on environmental pollution based on the panel data of 30 governors from 30 provinces and 35 mayors from 35 large and medium-sized cities in China during 2003-2010. This paper finds that holding other factors constant, the provinces or cities governed by officials promoted locally record more serious environmental pollution. Provinces with governors or cities with mayors who have prior central government working experiences usually have more serious pollution problems when they worked in local government. The impacts of the officials with central government working experiences on environmental pollution will be weakened with their airborne background. Officials who have central government working experiences have more serious impact on the environment pollution in cities or provinces with higher per capita GDP than those underdeveloped areas with lower per capita GDP. At present, the major method in pollution emission reduction is to include the promotion criteria of environmental quality improvement. Furthermore, a market-oriented mechanism of emissions reduction should be established.*

*Keywords: Environmental pollution; local/central governors; econometric model; officials; emission reduction*

## INTRODUCTION

The market transition that started in 1978 not only leads to a rapid economic growth but also environmental degradation in China. At present, China is a country with the worst air pollution in the World. Only 1% of the people in China can enjoy the clean and healthy air (Jia, 2017). The quality of drinking water is a serious issue in China, especially when it comes to chemical pollutants (Zhang, 2012). In December of 2013, most of the regions in China suffered from continuous haze weather, which was the largest and longest of that year, ranging from moderate to severe haze weather since the winter of 2013. The haze weather is still lingering in many cities now (Jiang et al., 2015). Serious environmental pollution not only adversely affects the economic development of China, also directly harms the nation's health and quality of lives (Lu et al., 2015; Wang et al., 2014). Moreover, it has been widely recognized that the level of environmental protection and resource utilization has become an important issue in a country's economic development. Energy conservation, emission reduction and environmental governance have become the major means to achieve the goal of sustainable development (Xue et al., 2014).

There are a few literatures which study the impact of officials on environmental pollution. In China, under the framework of official promotion champion tournament theory, the governor of local government is considered to be a "political man" who pursues the political promotion only (Li and Zhou, 2005). He is not an "economic man" who pursues the fiscal revenues under the framework of the fiscal federalism explanation (Jia et al., 2015). Likewise, the environmental concerns are not his major consideration. Under the system of political centralization and fiscal decentralization in China, the senior government officers appraise the local officials' performance mainly based on local economic development performance only. The economic performance is the major concern to all levels of personnel appraisal, which makes the local officials shave enthusiasm on local economic growth (Li and Zhou, 2005). In China's political system, as the senior officials can enjoy a number of benefits that the lower rank staff cannot, many of them wish to promote to senior positions. Investment in environmental protection, however, cannot increase their promotion opportunities (Zhang, 2007). Hence, they have no incentive to tackle the environmental problems caused by economic development (Wu et al., 2013).

Despite there are a large number of environmental studies in China, there is a lack of scientific and systematic studies on the relationship between the background of government officials and environmental pollution. Jia (2017) analyzes the impact of promotions according to cities or provinces' economic performance in China on the pollution emissions. It is found that the government officers who work for the city of fast economic growth often prefer to have

heavily polluting industries to cleaner industries. Although this can boost economic growth, it inevitably leads to environmental deterioration. Zheng et al. (2014) examined the political economy of urban leaders' incentives to tackle pollution issues. It showed that the central government and the public were both placing pressure on China's leaders to mitigate externalities. Nevertheless, there is a lack of study on the relationship between environmental performance of a city/province and the officials' background, such as their prior experience in central government. In this paper, we include a panel data of 30<sup>1</sup> provinces and 35<sup>2</sup> large and medium-sized cities in China. This study finds that provinces governors and city mayors who 1) are promoted locally or 2) have prior work experiences in central government usually have more serious environmental degradation problems during their ruling. Cities or provinces with officials who are directly appointed to local government from the central government's environmental pollution is less serious. At the same time, this kind of negative impact to the environment is more significant in developed area with higher per capita GDP.

In this paper, the following sections are arranged as follows: Section 2 is a literature review which sheds light on the research of local officials and environmental pollution, and we then propose the theoretical hypotheses accordingly. Section 3 illustrates the data and variables descriptions as well as the econometric model. Section 4 and Section 5 record the empirical analysis of province and municipal data and the results of the robustness test. Section 6 is the conclusions.

## LITERATURE REVIEW AND HYPOTHESES

In China, junior local officials are appointed directly by the seniors. Since the implementation of various reforms and open policy, the local officials' promotion has significant relationship with the economic performance of their own jurisdiction. The promotion probability of the cadres at the provincial level increases with higher local economic growth rate. Moreover, government officials may lose their jobs if local economic growth is poor (Li and Zhou, 2005). As a result, local officials strive their best to achieve high economic growth (Chen et al., 2005; Su et al., 2012). Local governments have little incentive to provide solutions which deal with environmental externalities as it is considered as public goods and has no relation with their future promotions opportunities. Nevertheless, the pollution generated from economic activities affect both the local and the surrounding areas. The local government lowers the environmental

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<sup>1</sup> Tibet is not included.

<sup>2</sup> Including 4 municipalities directly under the Central Government, 5 cities specially designated in the state plan and 26 provincial capitals.

standards or benchmarking standards so as to attract more investments, create job opportunities and improve local GDP (Fredriksson et al., 2003; Ulph, 2000).

This means that local officials' decision making may indirectly pollute the environment due to the pursuit of strong economic development. Under the fiscal and political pressures, the local government is reluctant to reduce environmental pollution in China. Nevertheless, economic development goal cannot be achieved without the support of local elites. The collusion behavior between the government officials and local elites, which bring mutual benefit, also affect the region's environmental pollution policies and works.

The central government considers the following solutions and reduces the proportion of direct promotion from local government. Firstly, to prevent local officials from a "small political circle" and corruption, the central government seldom promotes local officials to mayors or provincial governors. It directly relates to the central government personnel arrangement. Official promotion system in China is top-down centralized: officials in the central government hire the local government officials directly. In order to enrich and improve the officials' working experiences, the central government usually provides training to junior officials in different regions (Maria, 2003). Job rotation in various regions can also prevent officials to form collusion with local enterprises and officials.

Compared to non-local promoted officials, officers who are promoted to senior positions have closer relationships with local companies. They are more likely to collude with the local companies.

The local officials who are promoted from a junior to a senior position in the same government department / bureau must be supported by local enterprises (Lu et al., 2010). This kind of support is often mutually beneficial. The enterprises have always been the main engine to economic growth. They help the government officers to achieve the target GDP growth rate. Then, the local officials provide rewards to them in return. This kind of reward includes various forms. For example, local government lowers the emission standard or requirement and turns the deaf ear to the pollution emitted by local enterprises (Guo and Zheng, 2012).

Vennemo et al. (2009) evidences that China's economic development depends on heavily polluted industrial enterprises. Many of these which fail to meet the environmental standard issued by the State Council. Nevertheless, they often receive strong support from the government (Kostka and Mol, 2013). Jia (2017) shows that entrepreneurs choose low technology which emitted more pollutants to reduce costs, heavily polluted enterprises which boost economic growth help the officials' promotion in return. Obviously, reducing the pollution standard has become one of the means that the officials give the enterprises in return. Based on the above analysis and data availability, we lay down the following theoretical hypotheses.

*Hypothesis 1: Compared with the non-local promoted officials, cities with locally promoted mayors or provinces with locally promoted governors have more serious environmental pollution.*

Despite we all know that promotion does not only depend on the record of economic growth, the officials need to submit the record of economic growth which will probably affect their promotion. The political connection with various parties is another major factor which cannot be undermined (Li et al., 2008; Shih, 2008). Some of the officials' political network significantly improves the probability of government officers' promotion (Opper and Brehm, 2007). In general, promotion is usually faster among officers with central government working experience, better political networks with the senior government officers (Sheng, 2009). Many of the officers are considered as the future stars of the government and they are posited in the junior level first to allow their seniors to observe their performances. It has become a usual practice that officers who wish to work in Central government must have prior working experience in provincial level. Local government officers who have had central government working experience also have a thorough understanding on the central government. It is usual that these officials are more aggressive and have stronger desire of promotion. Officials with good network among senior officials are also sent to work as junior officers before they assume senior positions. They are more prone to make achievements to increase their chances of promotion. Officials with strong political network can attract more financial resources, implement special policies and create more favorable conditions during their jurisdiction (Kimura, 2014; Wei et al., 2012). As high economic growth has become the top priority of these officials, they may put more resources on primary and secondary industry development and put tertiary industry in low priority. Nevertheless, as the secondary industry is the most polluting industry (Wu et al., 2005; Zhou et al., 2013), development strategy as such will inevitably lead to environmental pollution (Duro and Padilla, 2011). Thus, we lay down the second hypothesis as follows:

*Hypothesis 2: The cities with mayors or provinces with governors with prior central government working experience will have more serious pollution problems.*

How will the results be affected if the local officials have worked in central government before? As stated earlier in this paper, the officials who are locally promoted are more likely to form collusion and relax the emission standard of the local enterprise. Current literature always uses the proxy variable for collusion if the officials are promoted locally from the local government (Persson and Zhuravskaya, 2016). The local official promotion not only promotes officials from local government, but also those who are hired due to local relationships. The officials who have central government working experiences usually make good use of their

political relationships to secure resources to develop the local economy because of their strong desire of promotion. They tend to ignore the adverse impact on the environment when they wish to achieve rapid economic growth. However, as compared to the locally promoted officials, officials who have central government working experience have lower tendency to collude with the local enterprises in short run. Hence, the impact on the environmental pollution will be lower. Thus, we put forward the third hypothesis:

*Hypothesis 3: the negative effects on environment will be weakened if official have the central government working experiences before they are appointed with their airborne background.*

If hypothesis 2 holds true, we then compare the results of cities/provinces with higher per capita GDP and the areas with lower per capita GDP. We argue that there are two important differences. First, as compared with cities or provinces with higher GDP, the development of underdeveloped areas faces more serious resources and geographical location constraints. It is difficult to have a substantial change in these areas in the short run as well as introduction of some preferential advantages, such as capital, investment etc. Therefore, the cities with mayors or provincial governors, who have prior central government working experience, have more serious environmental pollution problems in high GDP per capita areas. Second, the major goal is to obtain the political experience if an official with central government working experience is appointed to work for those underdeveloped areas. The highest priority is to accumulate sufficient political experience. Hence, when they lay down some policies for economic development, mayors or provincial governors with prior central government working experience usually have smaller adverse impact on the environment in underdeveloped areas than those in developed areas. Accordingly, we put forward hypothesis 4:

*Hypothesis 4: Compared with underdeveloped areas with lower per capita GDP, cities with mayors or provinces with officials that have prior central government working experience have more adverse environmental records in high per capita GDP areas.*

## METHODOLOGY

### Models and variable interpretation

To test the hypotheses 1, 2, 3, and 4, we build the following econometric models:

$$e_{it} = \alpha + \beta_1 \cdot source_{it} + \sum \gamma_{1i} \cdot X_{it} + \sum \gamma_{2i} \cdot political_{it} + \mu_i + \varepsilon_{it} \quad (1)$$

$$e_{it} = \alpha + \beta_2 \cdot cen_{it} + \sum \gamma_{1i} \cdot X_{it} + \sum \gamma_{2i} \cdot political_{it} + \mu_i + \varepsilon_{it} \quad (2)$$

$$e_{it} = \alpha + \beta_3 \cdot source_{it} \cdot cen_{it} + \sum \gamma_{1i} \cdot X_{it} + \sum \gamma_{2i} \cdot political_{it} + \mu_i + \varepsilon_{it} \quad (3)$$

$$e_{it} = \alpha + \beta_4 \cdot gdppc_{it} \cdot cen_{it} + \sum \gamma_{1i} \cdot X_{it} + \sum \gamma_{2i} \cdot political_{it} + \mu_i + \varepsilon_{it} \quad (4)$$

in which,  $e_{it}$  is the dependent variable, reflecting the degree of environmental pollution of a city or province  $i$  at year  $t$ ,  $\mu_i$  stands for the unobserved characteristics  $\varepsilon_{it}$  is the residual. It reflects other possible factors that may affect  $e_{it}$  but not be obtained by the model.

We include 3 categories of pollution in general: waste gas, wastewater and dust. We firstly use industrial SO<sub>2</sub> emissions as an example to measure the degree of pollution in an area. The following robust test will be used to measure the pollution level of an area from different perspectives.

Core independent variables:  $source_{it}$  is the variable which illustrates the promotion of the officials: 0 stands for local promoted officials, and 1 stands for officials who have airborne background.  $cen_{it}$  illustrates Central Government experience: 1 stands for the local officials who have central government experiences, and 0 stands for officials who do not have any experience.  $source_{it} \cdot cen_{it}$  represents the interaction of official sources and the central government working experience variables.  $gdppc_{it} \cdot cen_{it}$  represents the interaction of regional per capita GDP with the central government work experience.

$X_{it}$  is a set of control variables: per capita GDP (gdppc) which measures the regional economic development level; Urbanization, the proportion of urban population; per capita foreign direct investment (fdipc). On the one hand, FDI may have exacerbated the pressure of environmental pollution. Due to the technological spillover effect, FDI has promoted the technical progress in the invested region; per capita (investpc) investment in fixed assets. The influence on the environment from the investment in fixed assets should not be ignored in the economic system. The proportion on pollution control investment of total GDP (pol\_inv\_gdp) is an indispensable control factor when we consider the environmental pollution, like waste gas, wastewater and dust.

$political_{it}$  represents the officials' personal characteristics which includes tenure, the number of years that the officials work for his local government departments. If he starts to work as a governor or mayor before July 1, we calculated the year of tenure from this year. If he assumes duty after July 1, we calculated his tenure from next year. Similarly, if he leaves the post before the first half of the year (July.1), we calculate the tenure by the end of last year. If he leaves the post after the first half of the year (July.1), we calculated the tenure to the end of this year. The variable of age was calculated according to the actual age which the governors / mayors assume his position. The idea is the same as calculating the tenure. Concerning the education background (edu), if the official's final degree is below bachelor degree, we put it as 0, bachelor as 1, 2 for master degree, 3 for Ph.D. degree and professor. If the officers are employed in his place of birth are put as 1 in the variable "native" or else 0.

### Data sources and statistical description

After the 16th National Congress of China's Communist Party held in November 2002, there were major changes in the list of provincial government senior officers. As most of these changes took place from November 2002 to March 2003, we collect the data from 2003 onwards. The province data<sup>3</sup> can be collected till 2011; the 35<sup>4</sup> large and medium-sized cities' level only can be updated to 2010. Therefore, to ensure data consistency of at provincial and municipal level, the data of this paper is calculated up to the end of year 2010. As the governor is the head of a Province, he is responsible for the local economy, we only include the governor as a representative of the local officials in this paper.

All the officials' data (governor, the mayor) included in this paper is obtained from the official data listed in People's Daily online, Xinhua Net, relevant government websites and Baidu encyclopedia.

Other data is obtained from CEIC database, China Statistical Yearbook, China City Statistical Yearbook, China Environment Statistical Yearbook and China Energy Statistical Yearbook. Provincial data variables involved symbols and they are shown in Table 1.

Table 1 Variables, symbols and simple statistics

| Variables  | symbol          | Observations | mean    | std. dev. | mix    | max     |
|--|-----------------|--------------|---------|-----------|--------|---------|
| Waste industrial gas SO <sub>2</sub><br>(1000 ton) | SO <sub>2</sub> | 240          | 59.7059 | 39.5377   | 0.0104 | 170.338 |
| Energy consuming<br>(standard coal/1000 ton)       | energy          | 240          | 1.55613 | 0.79270   | 0.582  | 4.52443 |
| Governor's source<br>(airborne=1, local=0)         | source          | 240          | 0.25833 | 0.43863   | 0      | 1       |
| Governor's central gov<br>experience (yes=1, no=0) | cen             | 240          | 0.32916 | 0.47089   | 0      | 1       |
| Governor's tenure<br>(the th year)                 | tenure          | 240          | 2.99583 | 1.80538   | 1      | 9       |
| Governor's age (years)                             | age             | 240          | 57.8416 | 4.25641   | 45     | 64      |
| Governor's education<br>background                 | edu             | 240          | 1.66666 | 0.71835   | 0      | 3       |
| Governor's native                                  | native          | 240          | 0.36666 | 0.48290   | 0      | 1       |

<sup>3</sup>Provincial data includes 30 provinces except Tibet.

<sup>4</sup>All the pollution governance investment data is only updated to 2010. We end the data to 2010 because we think the pollution governance investment is an ignorable factor in analysis of pollution emissions.

| (local=1, others=0)   |                 |     |         |         |         |         |            |
|---|-----------------|-----|---------|---------|---------|---------|------------|
| Per capita GDP<br>(10000 yuan/person)                       | gdppc           | 240 | 2.14936 | 1.45093 | 0.36855 | 7.45472 | Table 1... |
| Per capita FDI<br>(usd/peson)                               | fdipc           | 240 | 102.726 | 130.796 | 0.80311 | 834.966 |            |
| Per capita fixed asset<br>investment<br>(10000 yuan/person) | investpc        | 240 | 1.12638 | 0.76406 | 0.18968 | 4.83190 |            |
| Urbanization (%)  | urban           | 240 | 0.46759 | 0.14534 | 0.24767 | 0.89264 |            |
| The proportion on pollution<br>governance of GDP (%)        | pol_inv_<br>gdp | 240 | 1.20810 | 0.52042 | 0.46    | 4.16    |            |

### Econometric Test

We use OLS estimation method and control the time variable by using time dummy variables. We then gradually introduce the control variables. First, we test the econometric models 1 and 2 to verify the hypotheses 1 and 2. After that, we introduce the interaction terms to test model (3)and(4), so as to verify the hypothesis 3 and hypothesis 4. The regression results are shown in Table 2 and Table 3.

### Officials' sources and pollution

Official sources can be divided into two kinds: locally promoted governors and governors promoted from other province or central government. Estimation (1) in Table 2 shows that the officials who have central government working experience have significantly negative impact on industrial SO<sub>2</sub> emissions during 2003-2010<sup>5</sup>. Hence, it is sufficient to conclude that the local officials have significant impact on industrial SO<sub>2</sub>emissions. The estimation (1) of Table 2 shows that the coefficient of  $gov_{source_{it}}$  is about -6.6864 which is significant at 5% level when we control the time effect and a set of economic controllable variables which include per capita GDP (gdppc), urbanization (urban), per capita FDI (fdipc), per capita fixed asset investment (investpc) and the proportion on pollution governance of GDP (pol\_inv\_gdp). Estimation(2) of Table 2 introduces the control variables of a number of government officials' personal characteristics, the coefficient of  $gov_{source_{it}}$  is about -6.6926. The numerical value doesnot change in size and significance, which proves that the result is quite robust. These results indicate that province

<sup>5</sup>As for the official source variable  $gov_{source_{it}}$  in this paper, the value is 0if local official is local promoted in his origin province;the value is 1 if he is transferred from the central government or other provinces called as airborne. Visaversa, if we give the value 1 to the local promoted official, and 0 for the airborne ones. Variable  $gov_{source_{it}}$  in the empirical test only changedthe symbols. Values and significance are not changed, and also will not change control variables. That is, the local promoted officials have significantly positive influence to environmental pollution emissions.

with governors who are promoted from local government departments have higher level of SO<sub>2</sub> emission as compared to the officials promoted from other province or Central government. This verifies hypothesis 1 of this paper. As stated earlier, local officials' promotion relies on the support of local enterprises (Lu et al., 2010). Local government officials tend to lower the emission standard so as to obtain support from the enterprises to increase the chance of official promotion<sup>6</sup>.

Estimation (1) and (2) are estimated from the economic control variables, the effect of per capita GDP (gdppc) to SO<sub>2</sub> emission pollution is significantly positive. It is consistent with our expectation. Governors who are promoted from local government tend to achieve high economic growth at the expense of environmental needs. Urbanization rate (urban) on the impact of SO<sub>2</sub> emissions is negative at 1% significant level. It shows that pollution emissions level has negative relationship with urbanization rate. These show that city's development under market regulation improves economic benefit but may adversely affect our environment. Thus, the policies of ignoring and restricting urban development will not only hinder the economic development but bring more resources wasting and pollution at the same time. Per capita FDI (fdipc) has significant negative impact on SO<sub>2</sub> emission. The results also show that the hypothesis of "pollution haven"<sup>7</sup> is not found in China. The possible reason is that the enterprises from the outside world use more advanced production technology and pollution discharge system.

Since the technological spillover effects promote technological progress in the invested region, they reduce the resource consumption and pollution emissions by unit output. The more per capita investment in fixed assets (investpc), the more significant positive effects on SO<sub>2</sub> emissions are. The more per capita investment in fixed assets, the greater the SO<sub>2</sub> emissions will be. So far, China's economic growth is mainly powered by investment and the investment direction is mainly concentrated in the secondary industry which is the major source of pollutants (Wu et al., 2005). This kind of development strategy inevitably causes environmental deterioration.

The proportion of pollution treatment investment of total GDP is expected to be negative but insignificant. The possible reason is that investment on pollution control is not enough to change the pollution status quo.

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<sup>6</sup>Li and Zhou (2005) find that the promotion possibility of governors and party secretary increase 10% with the economic growth speed increasing 1%.

<sup>7</sup> pollution haven: when large industrialized nations seek to set up factories or offices abroad, they tend to look for the cheapest option in terms of resources and labor that offers the land and material access they require, often nations with less stringent environmental regulations (Levinson and Taylor, 2008)

The Table 2 shows that official's personal characteristics, year of tenure is significantly negative correlated with the SO<sub>2</sub> emissions. From the statistical calculation during the period of 2003 to 2010 in China, the average tenure of the governor is only 3.805 years<sup>8</sup>. The tenure of local governors is five years. It implies that those who worked for more than 5 years had contract renewal. As the office tenure increase, the probability of promotion gradually reduces beyond certain period of time. The local officials who propose and work for regional economic growth is conditional, motivated by certain incentives such as money and promotion. The longer the office tenure is, the weaker political motivation to him. The SO<sub>2</sub> emissions can also be reduced accordingly.

It is worth to note that the impact of a governor's native on the SO<sub>2</sub> emissions is positive, and passes the 5% significant level. Local promoted officials have local relationships. From a certain perspective, it can be used as a proxy variable conspired with local enterprises (Persson and Zhuravskaya, 2016). After controlling the variable of a governor's native, the influence of the governor's source is still significant. And the numerical is basically close to estimation (1). This result shows that the conspiracy with local relations have positive correlation with SO<sub>2</sub> emission. Officials' age is positive significantly related to SO<sub>2</sub> emissions. The education level to SO<sub>2</sub> emissions is negative, but regression coefficient is not significant.

### **Officials who have central government work experience and the pollution**

Results of (3) and (4) in Table 2 show that the province with local officials who have prior central government work experience has more serious pollution. This supports hypothesis 2. Wang et al. (2014) commented that Chinese stresses the importance of Guanxi instead of individuals. Generally speaking, officials who have central government working experience have larger networks with the senior officials, who plays a key role in their promotion in the future. On the one hand, officials who have central government working experience may be more aggressive and have a stronger desire for promotion as they have better networks with the Central government. These officials have advantages due to their political network. When they work in local governments, they can bring in more financial resources and special policies. Hence, these cities / provinces have more serious pollution.

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<sup>8</sup>Sum the tenure length of the governor in all, and then divide it by the number of governors.

Table 2 Governor source, central government work experience and SO<sub>2</sub> emission

| Variable                                     | SO <sub>2</sub> (1)   | SO <sub>2</sub> (2)   | SO <sub>2</sub> (3)   | SO <sub>2</sub> (4)   |
|--|-----------------------|-----------------------|-----------------------|-----------------------|
| Governor's source<br>(airborne=1, local=0)   | -6.6864**<br>(-2.46)  | -6.6926**<br>(2.31)   |                       |                       |
| Governor's central gov<br>experience         |                       |                       | 7.67797*<br>(1.79)    | 14.0594**<br>(2.52)   |
| Per capita GDP                               | 9.57132*<br>(1.78)    | 15.0064***<br>(2.77)  | 9.53408*<br>(1.78)    | 14.9070***<br>(2.79)  |
| Urbanization                                 | -87.72***<br>(-2.70)  | -116.65***<br>(-3.58) | -98.808***<br>(-3.09) | -136.94***<br>(-4.30) |
| Per capita FDI                               | -0.1318***<br>(-2.94) | -0.1260***<br>(-2.82) | -0.1179***<br>(-2.65) | -0.1001**<br>(-2.29)  |
| Per capita fixed<br>asset investment         | 23.9437***<br>(2.59)  | 19.2221**<br>(2.06)   | 22.6726**<br>(2.45)   | 17.3966*<br>(1.88)    |
| Proportion on pollution<br>governance of GDP | -5.5096<br>(-1.03)    | -4.8520<br>(-0.92)    | -3.6397<br>(-0.68)    | -3.4319<br>(-0.66)    |
| Governor's tenure                            |                       | -6.0595***<br>(-3.44) |                       | -5.5450***<br>(-3.28) |
| Governor's age                               |                       | 1.78984**<br>(2.47)   |                       | 1.60892**<br>(2.26)   |
| Governor's education<br>background           |                       | -1.0115<br>(-0.26)    |                       | -1.5309<br>(-0.40)    |
| Governor's native                            |                       | 14.1609**<br>(2.49)   |                       | 21.1578***<br>(3.71)  |
| Constant                                     | 79.7529***<br>(6.24)  | -7.0979<br>(-0.16)    | 77.8511***<br>(6.05)  | -0.2877<br>(-0.01)    |
| Time control                                 | Yes                   | Yes                   | Yes                   | Yes                   |
| F  | 2.25***               | 2.93***               | 2.31***               | 3.31***               |
| R <sup>2</sup>                               | 0.1145                | 0.1834                | 0.1173                | 0.2021                |
| Obs  | 240                   | 240                   | 240                   | 240                   |

Note: The standard error in parentheses is the clustering document,

\*p<0.1, \*\*p<0.05, \*\*\*<0.01.

The value in bracket is t value.

### ***Airborne, and officials who have central government working experience and the per capita GDP***

To test the hypotheses 3 and 4, we introduce the variables of official sources, the interaction term of airborne background with central government experience, and the interaction term of central government experience with regional per capita GDP. The results of (2) and (5) in Table 3 the interaction term of airborne background with central government experience has significant negative effects. The results of(3) and (6) show that interaction terms of central government experience with regional per capita GDP has significant positive effect. All these proof that the hypotheses 3 and 4 are true. The results of (5) and (6) introduce the control variables of official personal characteristics on the basis of the results(2) and (3) to examine the robustness of interaction terms. We find that the results are quite robust. The control variable of economic and the official personal characteristic didn't have great impact on the results.

Table 3 Interaction terms

| Variable                                      | SO <sub>2</sub> (1)   | SO <sub>2</sub> (2)   | SO <sub>2</sub> (3)   | SO <sub>2</sub> (4)   | SO <sub>2</sub> (5)   | SO <sub>2</sub> (6)   |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Governor's source<br>(airborne=1, local=0)    | -12.670*<br>(-1.96)   | -1.2934<br>(-0.14)    | -13.433**<br>(-2.08)  | -13.873**<br>(-2.11)  | -0.3252**<br>(-2.09)  | -14.359**<br>(-2.17)  |
| Governor's central gov<br>experience          | 12.7526**<br>(2.14)   | 19.7099***<br>(2.75)  | 2.00979<br>(0.20)     | 18.4246***<br>(3.12)  | 26.5452***<br>(3.63)  | 11.5331<br>(1.14)     |
| Governor's source *<br>central gov experience |                       | -22.268*<br>(-1.73)   |                       |                       | -24.196*<br>(-1.87)   |                       |
| Central gov experience<br>* Per capita GDP    |                       |                       | 5.22924*<br>(1.95)    |                       |                       | 3.30376*<br>(1.82)    |
| Per capita GDP                                | 9.90911*<br>(1.86)    | 8.41856<br>(1.57)     | 8.88687*<br>(1.65)    | 15.9349***<br>(3.00)  | 13.9727***<br>(2.59)  | 15.1988***<br>(2.82)  |
| Urbanization                                  | -88.901***<br>(-2.76) | -74.767*<br>(-2.26)   | -90.316***<br>(-2.81) | -125.23***<br>(-3.90) | -112.30***<br>(-3.44) | -125.39***<br>(-3.90) |
| Per capita FDI                                | -0.1289***<br>(-2.90) | -0.1324***<br>(-2.98) | -0.1239***<br>(-2.78) | -0.1154***<br>(-2.63) | -0.1145***<br>(-2.62) | -0.1127**<br>(-2.56)  |
| Per capita fixed<br>asset investment          | 21.8598**<br>(2.37)   | 23.6908**<br>(2.56)   | 20.3505**<br>(2.19)   | 15.6835*<br>(1.70)    | 17.8075*<br>(1.93)    | 14.7741<br>(1.59)     |
| Proportion on pollution<br>governance of GDP  | -4.3871<br>(-0.82)    | -4.7641<br>(-0.89)    | -5.2151<br>(-0.97)    | -3.6350<br>(-0.70)    | -4.5034<br>(-0.87)    | -4.1818<br>(-0.80)    |
| Governor's tenure                             |                       |                       |                       | -6.4262***<br>(-3.71) | -5.8869***<br>(-3.37) | -6.3188***<br>(-3.64) |

|                                 |            |            |            |            |            |            |
|---------------------------------|------------|------------|------------|------------|------------|------------|
| Governor's age                  |            |            |            | 1.78587**  | 1.59643**  | 1.76895**  |
|                                 |            |            |            | (2.51)     | (2.24)     | (2.49)     |
| Governor's education background |            |            |            | -1.2936    | -0.94755   | -1.0046    |
|                                 |            |            |            | (-0.34)    | (-0.25)    | (-0.26)    |
| Governor's native               |            |            |            | 18.7317*** | 21.2374*** | 18.4333*** |
|                                 |            |            |            | (3.24)     | (3.60)     | (3.19)     |
| Constant                        | 75.6126*** | 69.9390*** | 80.3090*** | -11.104    | -7.9320    | -7.8157    |
|                                 | (5.89)     | (5.30)     | (6.02)     | (-0.25)    | (-0.18)    | (-0.18)    |
| Time control                    | Yes        | Yes        | Yes        | Yes        | Yes        | Yes        |
| F                               | 2.45***    | 2.50***    | 2.40***    | 3.42***    | 3.46***    | 3.27***    |
| R <sup>2</sup>                  | 0.1322     | 0.1435     | 0.1385     | 0.2178     | 0.2300     | 0.2203     |
| Obs                             | 240        | 240        | 240        | 240        | 240        | 240        |

Table 3...

Note: The standard error in parentheses is the clustering document, \*p<0.1, \*\*p<0.05, \*\*\*<0.01. The value in bracket is t value.

### Robustness test

#### *Analysis on 35 large and medium-sized cities<sup>9</sup>*

We collect data of 35 large and medium-sized cities in China from 2003 to 2010. The empirical results are shown in Table 4 and Table 5.

Table 4 Mayor source, central government work experience and SO<sub>2</sub> emission

| Variable                                | SO <sub>2</sub> (1)  | SO <sub>2</sub> (2)  | SO <sub>2</sub> (3)  | SO <sub>2</sub> (4)  |
|---|----------------------|----------------------|----------------------|----------------------|
| Mayor's source<br>(airborne=1, local=0) | -4.3000**<br>(-3.08) | -3.4373**<br>(-2.53) |                      |                      |
| Mayor's central gov<br>experience       |                      |                      | 9.38942***<br>(4.80) | 6.54764***<br>(3.39) |
| Per capita GDP                          | -0.1886<br>(-0.32)   | -0.0575<br>(-0.10)   | -0.1906<br>(-0.33)   | -0.0584<br>(-0.11)   |
| Urbanization                            | -0.1055**<br>(-2.10) | -0.0754<br>(-1.58)   | -0.0809*<br>(-1.64)  | -0.0644<br>(-1.36)   |
| Per capita FDI                          | 0.04855<br>(0.91)    | 0.01788<br>(0.35)    | 0.02499<br>(-2.65)   | 0.00971<br>(0.19)    |
| Per capita fixed<br>asset investment    | -0.5860<br>(-0.50)   | 0.10670<br>(0.10)    | -0.4165<br>(-0.36)   | 0.02921<br>(0.03)    |

<sup>9</sup> Including 4 municipalities directly under the Central Government, 5 cities specially designated in the state plan and 26 provincial capitals.

|   |                      |                      |                      |                      | Table 4... |
|---|----------------------|----------------------|----------------------|----------------------|------------|
| Proportion on pollution governance of GDP | 2.00919<br>(1.34)    | 1.95093<br>(1.38)    | 1.49133<br>(1.04)    | 1.52961<br>(1.12)    |            |
| Mayor's tenure                            |                      | 0.03927<br>(0.10)    |                      | 0.25269<br>(0.68)    |            |
| Mayor's age                               |                      | 0.56603***<br>(3.59) |                      | 0.47444***<br>(3.00) |            |
| Mayor's education background              |                      | 0.64625<br>(0.73)    |                      | 0.19357<br>(0.22)    |            |
| Mayor's native                            |                      | 9.06026***<br>(4.83) |                      | 8.03684***<br>(4.24) |            |
| Constant                                  | 17.8303***<br>(5.71) | -16.569*<br>(-1.77)  | 12.7728***<br>(4.15) | -14.742<br>(-1.58)   |            |
| Time control                              | Yes                  | Yes                  | Yes                  | Yes                  |            |
| F   | 1.44                 | 3.68***              | 2.51***              | 4.04***              |            |
| R <sup>2</sup>                            | 0.0658               | 0.1926               | 0.1094               | 0.2078               |            |
| Obs                                       | 280                  | 280                  | 280                  | 280                  |            |

Note: The standard error in parentheses is the clustering document, \*p<0.1, \*\*p<0.05, \*\*\*<0.01. The value in bracket is t value.

Table 4 shows that, Mayors' sources and central government working experiences have not changed. Cities with mayors who are directly hired from central government on SO<sub>2</sub> emission is negative at 5% significant level. The city with local promoted mayor has more serious SO<sub>2</sub> pollution. Cities with mayors who have central government working experience have significantly higher SO<sub>2</sub>emissions. Compared with Table 2, variables which are 1% significant level is consistent with the hypotheses 1 and 2. In the control variables, the impact of urbanization rate on the SO<sub>2</sub>emissions is significant in few cases. The effect of other variables is not significant. Mayors' personal characteristics, age and native have significantly positive impact on SO<sub>2</sub> emissions. Tenure and education background are not significant.

The results in Table 5 illustrate that mayors who have central government work experience to the effect of SO<sub>2</sub> emissions weakens with the airborne background. The estimated results are passing 1% significant level.

At the same time, mayors who have central government work experience to SO<sub>2</sub> emission in high GDP per capita areas is larger, the effect of the estimated results significantly positive.

Table 5 Mayor source, central government work experience and SO<sub>2</sub> emission

| Variable                                     | SO <sub>2</sub> (1)   | SO <sub>2</sub> (2)   | SO <sub>2</sub> (3)   | SO <sub>2</sub> (4)   | SO <sub>2</sub> (5)   | SO <sub>2</sub> (6)   |
|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Mayor's source<br>(airborne=1, local=0)      | -5.0822***<br>(-3.80) | -1.8438*<br>(-1.75)   | -4.4253***<br>(-3.46) | -4.1816***<br>(-3.12) | -1.0357*<br>(-1.71)   | -3.7298***<br>(-2.89) |
| Mayor's central gov<br>experiences           | 10.1938***<br>(5.30)  | 25.4494***<br>(2.75)  | 25.5433***<br>(7.51)  | 7.40906***<br>(3.86)  | 22.2547***<br>(7.94)  | 21.4787***<br>(6.22)  |
| Mayor's source *<br>central gov experience   |                       | -25.022***<br>(-6.92) |                       |                       | -24.003***<br>(-6.84) |                       |
| Central gov experience                       |                       |                       | 4.7022***<br>(5.35)   |                       |                       | 4.2048***<br>(4.82)   |
| * Per capita GDP                             |                       |                       |                       |                       |                       |                       |
| Per capita GDP                               | -0.4429<br>(-0.79)    | 0.07787<br>(0.15)     | 0.75111<br>(1.30)     | -0.2713<br>(-0.50)    | 0.22431<br>(0.44)     | 0.80171<br>(1.42)     |
| Urbanization                                 | -0.0721<br>(-1.49)    | -0.0257<br>(-0.57)    | -0.0742<br>(-1.62)    | -0.0556<br>(-1.19)    | -0.0122<br>(-0.28)    | -0.0634<br>(-1.41)    |
| Per capita FDI                               | 0.05472<br>(1.08)     | 0.02761<br>(0.59)     | 0.02785<br>(0.57)     | 0.02592<br>(0.51)     | 0.00518<br>(0.11)     | 0.01122<br>(0.23)     |
| Per capita fixed<br>asset investment         | -0.1797<br>(-0.16)    | 0.01031<br>(0.01)     | -0.5025<br>(-0.47)    | 0.31275<br>(0.29)     | 0.33526<br>(0.33)     | -0.0688<br>(-0.07)    |
| Proportion on pollution<br>governance of GDP | 2.72089*<br>(1.90)    | 2.27683<br>(1.40)     | 2.2942*<br>(1.68)     | 2.46775*<br>(1.79)    | 2.17372<br>(1.60)     | 2.06408<br>(1.56)     |
| Mayor's tenure                               |                       |                       |                       | 0.05260<br>(0.14)     | -0.0522<br>(-0.15)    | -0.0260<br>(-0.07)    |
| Mayor's age                                  |                       |                       |                       | 0.47615***<br>(3.07)  | 0.47928***<br>(3.34)  | 0.33265**<br>(2.19)   |
| Mayor's education<br>background              |                       |                       |                       | 0.68270<br>(0.79)     | 0.10145<br>(0.13)     | 0.35627<br>(0.43)     |
| Mayor's native                               |                       |                       |                       | 7.49652***<br>(4.01)  | 6.13171***<br>(3.53)  | 7.32771***<br>(4.08)  |
| Constant                                     | 14.4994***<br>(4.77)  | 10.2752***<br>(3.58)  | 11.5731***<br>(3.93)  | -13.748<br>(-1.50)    | -16.574*<br>(-1.96)   | -7.9084<br>(-0.89)    |
| Time control                                 | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   | Yes                   |
| F  | 3.48***               | 7.02***               | 5.50***               | 4.48***               | 7.45***               | 5.83***               |
| R <sup>2</sup>                               | 0.1554                | 0.2852                | 0.2381                | 0.2362                | 0.3527                | 0.2989                |
| Obs  | 280                   | 280                   | 280                   | 280                   | 280                   | 280                   |

Note: The standard error in parentheses is the clustering document, \*p<0.1, \*\*p<0.05, \*\*\*<0.01. The value in bracket is t value.

### **Measure the pollution from another perspective**

There are other ways of pollution, such as sewage, dust apart from air pollutants. The more energy consumed, the more pollutants will be generated. Energy consumption of per unit GDP equivalent index can partially reflect local officials' attitude on energy consumption when they plan for economic development. At present, GDP is the major concern in China's senior officers' promotion, indirectly encouraging senior officials to choose low technology, energy-intensive, high polluting enterprises to reduce costs (Jia, 2017). There is no doubt that environmental constraints and resources scarcity will endanger the future development of China's economy. In the "11th five-year plan" (2006-2010), the central government set the target per unit GDP's energy consumption in 2010 by 20% lowered as compared to that in 2005 but failed. We will analyze the reason in this article from governors' promotion perspective. We use per unit GDP energy consumption (unit: tons of standard coal/RMB10000yuan) to represent the energy consumption index of an area to consider the officials' impact on pollution from the perspective of energy consumption. The estimation results are shown in Table 6 and Table 7.

Table 6 Energy consumption

| Variable                                   | energy(1)            | energy(2)            | energy(3)            | energy(4)            |
|--|----------------------|----------------------|----------------------|----------------------|
| Governor's source<br>(airborne=1, local=0) | -0.1011**<br>(-2.25) | -0.1008**<br>(-2.23) |                      |                      |
| Governor's central gov experience          |                      |                      | 0.01556*<br>(1.92)   | 0.05992<br>(1.40)    |
| Constant                                   | 1.57312***<br>(7.69) | 2.29698***<br>(6.18) | 1.56657***<br>(7.51) | 2.38668***<br>(6.09) |
| Economic variable control <sup>a</sup>     | Yes                  | Yes                  | Yes                  | Yes                  |
| Officials' characteristic control          | No                   | Yes                  | No                   | Yes                  |
| Time control                               | Yes                  | Yes                  | Yes                  | Yes                  |
| Area control <sup>b</sup>                  | Yes                  | Yes                  | Yes                  | Yes                  |
| F  | 14.69***             | 12.84***             | 13.96***             | 12.47***             |
| R <sup>2</sup>                             | 0.1411               | 0.0524               | 0.1718               | 0.0416               |
| Obs  | 240                  | 240                  | 240                  | 240                  |

Note: The standard error in parentheses is the clustering document, \*p<0.1, \*\*p<0.05, \*\*\*<0.01. The value in bracket is t value.

<sup>a</sup> In order to save the space, we have not listed the detail estimation results of economic controllable variable and personal characteristics. Pls feel free to contact the author to post if you need. <sup>b</sup>We make the area control in this regression since there is great difference in energy consumptions among cities

In Table 6 and Table 7, the symbols of the governor's source and governor's central government working experience in the estimation are consistent with the above estimation, but the statistical significant level is lower. Local officials' promotion increases the energy consumption and the officials who have central government work experience will also increase energy consumption. Interaction terms are consistent with the above context at 10% significance level.

Table 7 Analysis on interaction term

| Variable                                      | energy(1)            | energy (2)            | energy (3)           | energy (4)            | energy (5)           | energy (6)            |
|---|----------------------|-----------------------|----------------------|-----------------------|----------------------|-----------------------|
| Governor's source<br>(airborne=1, local=0)    | -0.1166**<br>(-2.48) | -0.1410**<br>(-2.19)  | -0.1212**<br>(-2.52) | -0.1411***<br>(-3.01) | -0.1286**<br>(-1.98) | -0.1445***<br>(-2.96) |
| Governor's central gov<br>experience          | 0.04471*<br>(1.65)   | 0.09412*<br>(1.73)    | 0.02146<br>(0.33)    | 0.02481<br>(0.57)     | 0.03616<br>(0.61)    | 0.01222<br>(0.18)     |
| Governor's source *<br>central gov experience |                      | -0.0279*<br>(-1.69)   |                      |                       | -0.0240*<br>(-1.72)  |                       |
| Central gov experience *                      |                      |                       | 0.01273*<br>(1.83)   |                       |                      | 0.00704*<br>(1.81)    |
| Per capita GDP                                |                      |                       |                      |                       |                      |                       |
| Constant                                      | 1.60727***<br>(7.78) | 1.93812***<br>(10.83) | 1.62480***<br>(7.72) | 2.55528***<br>(6.87)  | 2.54755***<br>(6.81) | 2.56059***<br>(6.85)  |
| Control of economic<br>variable <sup>a</sup>  | Yes                  | Yes                   | Yes                  | Yes                   | Yes                  | Yes                   |
| Control of Officials'<br>characteristic       | No                   | No                    | No                   | Yes                   | Yes                  | Yes                   |
| Time control                                  | Yes                  | Yes                   | Yes                  | Yes                   | Yes                  | Yes                   |
| Area control                                  | Yes                  | Yes                   | Yes                  | Yes                   | Yes                  | Yes                   |
| F   | 13.74***             | 21.47***              | 12.79***             | 17.36***              | 15.85***             | 15.84***              |
| R <sup>2</sup>                                | 0.1582               | 0.4595                | 0.1623               | 0.4897                | 0.4899               | 0.4898                |
| Obs   | 240                  | 240                   | 240                  | 240                   | 240                  | 240                   |

Note: The standard error in parentheses is the clustering document, \*p<0.1, \*\*p<0.05, \*\*\*<0.01. The value in bracket is t value.

<sup>a</sup> The controllable variables are the same as Table6.

## CONCLUSIONS

Most of the existing researches think that local officials play an important role in Chinese economic development (Zhang et al., 2012). However, it is seldom to see quantitative test on local officials' impact on regional environmental pollution. To further study the local officials'

characteristics on the impact of the regional pollution level, we analyse the mayors and the governors' background information and the central government work experience according to the samples of 30 provinces and 35 large and medium-sized cities in China from 2003 to 2010. This paper provides a new perspective on China's environmental pollution analysis. This study finds that: (1) compared with the nonlocal promoted officials, local promoted officials will lead to more environment pollution, holding other factors constant; (2) the provinces with governors who have central government working experience have higher level of pollution; (3) the officials with central government working experience will weaken the impact on pollution when they are directly hired from the central government; (4) compared with the underdeveloped areas with lower per capita GDP, officials who have central government working experience will bring more environmental pollution to high per capita GDP areas.

Based on the abovementioned analysis, we argue that the current system of "political centralization and economic decentralization" and "top-down" yardstick competition which give priority to the achievements appraisal system according to GDP record. As economic growth of local government is linked with the chance of promotion to senior position, individual's greed to move up their career ladders to maximize their own interests provide the incentives to promote regional economic growth (Zhang et al., 2012). This strategy powers economic growth, however, at the expense of environment.

The limitations of the paper are: the local promoted officials may bring more environmental pollution due to the factors such as mutual benefit and collusion with local enterprises, this aspect needs to be further studied. The officials who have central government working experience usually link with more serious environmental pollution when they assume local governors/mayors positions because of their strong desire for promotion. They might use their senior political relationships get more resource to develop local economy and ignore the impact of development on the environment, this also needs further research.

The results of this paper tell us that under the current Chinese system of fiscal decentralization and official promotion, reducing the pollution emissions may not only depend on introducing of advanced technology, equipment and increasing pollution control investment. At present, the key point of transforming the mode of economic growth, reducing pollution emission and improving environment quality is to change the existing financial system, and brings the pollution control factors into official promotion assessment mechanism. Scientific performance evaluation is then implemented. Gradual reduction on the importance of assessing government officials based on economic growth will be the next step. Finally, putting an end to "sacrificing environment for growth" and establishment of a market-oriented incentive trading system to reduce pollutant emissions may be the final destination to solve our present environmental

problem. Collusion between the local government officials and enterprises should be prevented. Implementation of environmental tax and carbon tax, stricter environmental protection system, increase the transparency of environmental protection information; establish public supervision system and empower our citizens on environmental protection and quality control may improve our environment.

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