Temporal and Spatial Variations in China’s Government-Official-Appointment System and Local Water-Environment Pollution

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Abstract: Environmental governance is one of the priority tasks that is faced by China in its drive for sustainable social development. Environmental protection necessitates an equal focus on pollution-source control and pollution governance, and it shall be safeguarded with sound local economic-development models and long-term environmental-protection mechanisms. In this study, we investigated the government-official-appointment system and the effects of the personal characteristics of government officials and economic variables on the local water-environment pollution, measured by industrial wastewater discharge, using a dataset of Communist Party of China (CPC) municipal committee secretaries and municipal governors covering the period 2003–2012. We found that some temporal and spatial factors of China’s personnel-management system for government officials are correlated to the environment. More specifically, the turnover and interjurisdictional transfer of municipal governors contribute to long-term environmental protection, longer tenures facilitate better environmental protection, municipal governors who serve in their native provinces but not in their native municipalities facilitate better local environment protection, and officials may take different approaches towards environmental maintenance and governance.

Keywords: China’s government-official-appointment system; temporal and spatial variations; China’s policy; water-environment pollution

1. Introduction

The environmental issues that accompany rapid economic development have not only compromised the health and living quality of people, but they have also threatened the sustainable development of economies. Researchers with different perspectives have been trying to answer the question of how to balance economic development and environmental protection. Many have suggested that China’s gradual environmental deterioration is related to its economic-growth model, and that the selection of this economic-growth model is a result of decisions by local officials who are influenced by complex factors, such as personal characteristics and financial, political, and corruption incentives. This means that the personal characteristics of government officials and the personnel-management system for the promotion and turnover of officials are crucial to environmental protection and governance.

The economic growth and social development in China over its long history have a close relationship with government officials (Bai and Jia, 2016; Xu, 2011) [1,2]. Chen et al. (2020) investigated the impact of China’s cadre appointments on economic development, and they found that newly appointed cadres are able to generate better economic performances [3]. Zhou (2007) suggested that China’s economic development is powered by the competition between Chinese officials for the political championship of economic performance [4]. Li and Zhou (2005) found that the likelihood of the promotion of CPC provincial committee secretaries and provincial governors increased by a significant margin.
of 10% with an increase of one percentage point in economic growth. This means that officials tend to make economic growth their top priority during their tenures [5]. Xu (2007) found that the introduction of a new CPC provincial committee secretary resulted in a significant increase of one percentage point in economic growth. This effect is based on the neglected development of the tertiary industry and the accelerated investment in the secondary industry. This phenomenon has prejudiced the balancing and upgrading of local industrial structures and has caused enormous pressure on the environment [6]. Besides promotional incentives and personal characteristics, the source of exchange and the length of tenure of officials also significantly impact local economic development during their tenures, as has been found by many researchers.

Some research has suggested that the turnover and interjurisdictional exchange of officials facilitates local environmental protection. Liang et al. (2014) [7] suggested that the major cause of ineffective environmental-pollution governance lies in the conspiracy between local governments and polluting firms. Local officials with longer tenures tend to have better personal connections with local firms, which weakens local environmental regulation and aggravates environmental pollution. Thus, the interjurisdictional exchange and turnover of officials are positively correlated to local environmental protection. Liang et al. also suggested that the turnover of municipal governors is more often affected by the turnover of CPC provincial committee secretaries. The likelihood of the turnover of a municipal governor increases by a significant margin of 9% if a new CPC provincial committee secretary is introduced in the new tenure. The likelihood increases to 40% if the CPC committee provincial secretary in the preceding tenure is demoted [7]. In such a case, the turnover of a municipal governor is not significantly affected by the local GDP-growth rate. The practice of economic-performance-based personnel promotion is relaxed to some degree at the municipal level, although CPC provincial committee secretaries and municipal governors tend to seek faster economic development for better promotional opportunities in the political championship. The logic is that economic growth affects the promotion and turnover of officials, and the local economic-growth model for promotion affects local environmental protection. In other words, the promotion and turnover of officials indirectly impact local environmental protection and directly impact local environmental governance. If the practice of economic-performance-based promotion is relaxed at the municipal level compared with the provincial level, then the behavior of municipal leaders in environmental protection and governance is influenced by more diversified factors—the perspective of an economic-development model does not provide full insight into the issue. In this study, it is hypothesized that the temporal and spatial variations in China’s government-official-appointment system are closely correlated to local environmental pollution.

The following temporal and spatial factors of China’s personnel-management system for government officials were examined:

1. Temporal factors: (1) The hysteresis of the incentive effect during the tenure: The first year of the tenure is the running-in period for new leaders, which is characterized by political instability that results from political cycles and incentive mechanisms. This instability directly affects the continuity of environmental policy, and it indirectly has a positive effect on the environment by affecting the continuity of the economic policy and by compromising the continual implementation of economic projects. Furthermore, newly appointed officials tend to make active efforts to improve the ecological environment, as catering to the local citizens’ demand for immediate environmental improvement helps them to secure their new jobs. Additionally, the turnover of officials serves to break the existing personal connections between the government and firms, and thus it reduces the chance of corruption-associated environmental-regulation defects. This contributes to better environmental protection. Towards the middle of their tenures, the economic benefit of new projects implemented under the pressure of political performance gradually manifests, but it negatively impacts the environment. Towards the end of their tenures, officials have ideas as to their next appointments and are thus less influenced by fiscal and political incentives.
Consequently, the negative environmental impacts in the middle of their tenures diminish, and the environmental quality improves. However, officials are less devoted to environmental governance towards the end of their tenures. Consequently, the environmental quality towards the end of their tenures is generally better than that in the middle, but it is worse than that at the beginning. In other words, the local environmental quality displays a U-shaped pattern during the tenure; (2) The hysteresis of the effect against environmental governance: both environmental protection and governance affect economic development. The opportunity cost of economic development and the cost of environmental governance are incurred in the middle of their tenures, while the effect of environmental governance does not manifest until towards the end. The hysteresis of the effect against the cost of environmental governance results in officials being less motivated to apply effort to environmental governance, owing to the conception that their efforts are for the benefit of their successors; (3) The hysteresis of the effect against the environmental problem: there exists a hysteresis between the positive effect of economic development and the negative effect of environmental pollution. Consequently, officials tend to leave environmental issues to their successors if quantitative changes in environmental deterioration do not result in qualitative changes;

2. Spatial factors: (1) Inconsistency between the native jurisdictions and the serviced jurisdictions of officials: officials serving in their native jurisdictions tend to be more devoted to local environmental protection, owing to their emotional intimacy with their native jurisdictions; (2) Interjurisdictional transfer: the turnover of officials compromises the continuity of local policies, and officials tend to focus on short-term economic and environmental objectives during their tenures, owing to the hysteresis of the environmental performance. Even the introduction of an environmental-responsibility system fails to solve this problem, owing to the hysteresis of environmental issues against their root causes and, thus, the difficulty in defining the responsibilities for environmental issues; (3) Interjurisdictional environmental pollution: severe environmental pollution, and particularly water pollution, tends to be contagious across jurisdictions. It is often very difficult to define responsibilities for such interjurisdictional pollution, especially when the pollution source has not been identified. The phenomenon of “free riding” may appear.

The governance and maintenance of the local environment necessitate not only the strict control of pollution sources, but also continuous investment and improvement in environmental-protection facilities and long-term environmental-protection mechanisms. This requires that local leaders balance economic development and environmental protection, and that they be committed to far-sighted efforts in ecological environmental maintenance. However, officials are not adequately motivated to take such a far-sighted approach, as it usually means substantial efforts in their current tenures, but with little or no effect until the following ones. Under the present-day situation of an increasingly deteriorating environment, the Chinese government is paying more attention to environmental pollution, and it has integrated environmental performance as a one-vote-veto criterion for the promotion of government officials. However, this move encourages short-sighted behaviors for environmental protection—for example, officials are focused on economic performance, and their efforts in environmental protection are only intended to ensure that there are no qualitative changes in environmental deterioration, such that they can move smoothly to the next tenure. Furthermore, China is a vast and populous country, but environmental pollution often occurs at the microlevel. Provincial leaders can control environmental development through policy instruments at the system level, but they have to rely on municipal leaders to take concrete efforts for environmental governance (Chen, 2012) [8]. Zhang and Gao (2007) and Wang and Xu (2008) found that the introduction of new CPC provincial committee secretaries and provincial governors only has a short-term effect on the local economy, that the economic effect displays a reversed U-shaped pattern during the tenure, and that it is insignificant in the long term [9,10]. This study was intended to
answer the following questions: Do officials under the current personnel-management system have a long-term or short-term effect on the environment? How do their functions, behaviors, personal characteristics, and political experiences influence local ecological environments? Is the discharge of different pollutants policy-dependent?

The rest of the paper is organized as follows: Section 2 presents the literature review; Section 3 presents the theoretical analysis and proposes the testable hypotheses; Section 4 describes our data; Section 5 reports and discusses the main empirical specifications and results; Section 6 concludes.

2. Literature Review

In the literature, there are two main mechanisms that underlie the impact of the personnel-management system on the environment: (1) The current personnel-promotion system is biased towards economic performance and encourages officials to resort to extensive models of local economic development, which negatively impacts the environment; (2) The current practice of the interjurisdictional exchange of officials helps diminish the phenomenon of conspiracy between government and firms, as well as the rent-seeking behaviors of polluting firms, which thereby induces a positive environmental impact. Some researchers have suggested that the interjurisdictional exchange of officials does not facilitate the development and implementation of long-term environmental policy, and thus it has a negative impact on the environment. However, there is limited qualitative research or theoretical evidence to support this argument.

In 1982, the Chinese central government stipulated a maximum age of 65 years for provincial/ministerial officials, and it prepared those above this maximum age to retire or resign from leading posts. Thereby, the practice of de facto life-long tenure was abolished, and a limited-tenure system was established. In the Decision of the CPC Central Committee on the Exchange System for Leaders of Party and National Organs issued in 1990, and the Provisions on the Exchange Practice for Party and Government Leaders formally issued in 2016, the practice of the interjurisdictional exchange of officials was detailed. Consequently, interjurisdictional exchange has become mainstream for the appointment of government officials. The practice of interjurisdictional exchange facilitates the prevention of sectarianism, local personal connections, and local corruption. It gives local officials more incentive to implement the policy of the central government, encourages interjurisdictional and interpersonal exchange and learning, and helps resolve the issue of asymmetric information between the central and local governments (Chen and Zhao, 1996, Huang, 2002) [11,12].

As for the impact of fiscal incentives on the environment, environmental federalism contends that the environmental pollution of purely public goods or extension beyond jurisdictional borders should be regulated by the central government, while local governments should control the environmental quality of local public goods. Compared with centralized standardization, decentralized decision making for local environmental policy facilitates more targeted solutions, can be better analyzed using the cost–benefit principle of economics, and can generate more social wellbeing. Sigman (2014) analyzed the relationship between decentralization and water pollution, using the water-quality-monitoring data collected under the Global Environmental Monitoring System (GEMS) of the United Nations [13]. Xue et al. (2012) analyzed the relationship between fiscal decentralization and the emissions of sulfur dioxide and solid, liquid, and gaseous industrial wastes using a provincial panel dataset. They concluded that decentralization facilitates local environmental protection [14]. Some researchers have suggested that economic decentralization under the political centralization of China induces local governments to take opportunistic approaches (Blanchard and Shleifer, 2000) [15]. Local governments that enjoy relatively autonomous economic decision making and the ability to share fiscal income with the central government are extremely devoted to driving local economic development if adequate fiscal incentives are in place. Kunce (2007) suggested that fiscal decentralization induces a race to the bottom in environmental regulation—a scenario wherein local governments relax environmental regulation for economic purposes, which thereby results in the deterioration
of the environmental quality. Decentralized environmental policy is subject to the influence of the local legislative environment [16]. Zhang (2011) found evidence in a provincial dataset that decentralization has a significantly negative impact on local environments, and that the environmental-pollution level increases with the decentralization level [17].

As for the impact of political incentives on the environment, Zhou (2007) suggested that fiscal decentralization is a major incentive, but not the principal incentive, for local governments. The GDP-growth-focused ‘job promotion championship’ is a crucial clue for understanding government incentive and economic growth. The model of incentive is detrimental to the transformation of the government function and economic-growth model, as the performance objectives included in the incentive plan for government officials severely conflict with the desired function of the government; the personnel-control model is the major source of the important issues that are being faced by the Chinese economy [1]. Nie et al. (2013) identified noticeable political cycles in a mining-accident dataset. This demonstrates that the current incentive scheme for local officials has a negative impact on the regulation efficiency and governance level. Using Chinese provincial panel data [18], Jia (2012) found that China’s personnel-management system for government officials is a double-edged sword that incurs social costs, such as environmental pollution, while driving economic growth. Further development of the Chinese economy dictates an in-depth reform of the personnel-management system [19]. Yu et al. (2013) found that the political incentive for local officials is a major cause of frequent environmental pollution, and that the economic-growth performance is negatively correlated to pollution—in jurisdictions with slower economic growth, local officials are more politically motivated to drive economic growth at the cost of environmental pollution [20]. Wu et al. (2013) found that investment in transportation infrastructure facilitates GDP growth, which is favored by officials for job-promotion purposes, whereas investment in environmental-pollution cleanup diminishes the likelihood of job promotion [21]. Zhang et al. (2014) suggested that political incentive leads to information asymmetry and induces local government officials to conspire with local firms to gain fiscal income and seek better job-promotion opportunities [22].

Torras and Boyce (1998) found that local governments play an important role in environmental protection, governance, and regulation. Environmental-protection policies in developing countries are relatively weak, while those in developed countries are more conducive to the implementation of environmental-protection policies. Therefore, the decline of the EKC is mainly attributed to the strong will of local governments to implement environmental policies [27]. China’s official campaign on environmental protection can be dated back to 1973, when the Environmental Protection Leading Group was established under the State Council. In the Eight Rules for Environmental Management issued in 1989, environmental protection was added to the responsibilities of local governments and the official government-performance-appraisal system, but the performance indexes for environmental protection remained to be detailed. This issue was resolved in the
Trial Method for Comprehensive Appraisal of Local Party and Government Leadership Teams and Leaders Under the Guiding Principle of Scientific Outlook of Development issued by the State Council in 2006, in which environmental protection was included in the performance-appraisal system for local leadership teams and leaders, and environmental performance was established as a criterion for selecting and exercising rewards and penalties for government officials. In the Notice of the State Council on Publishing the Comprehensive Working Program on Energy Saving and Emission Reduction issued by the State Council in 2007, the achievement of energy savings and emission-reduction targets was included in the comprehensive performance appraisal of government officials as a one-vote-veto item. Using the panel data of 86 major cities of China, Sun (2014) found that the improvement in the urban environmental quality and energy efficiency was positively correlated to the likelihood of the promotion of municipal governors, and to municipalities with better economic development, more competent governments, less energy consumption per unit of GDP, and governors and citizens that are better educated. Less environmental pollution will enter the downward-sloping stage of the EKC earlier [28].

In the literature, the impact of the personnel-management system for government officials on environmental protection has been investigated from the perspectives of the personal characteristics of officials, turnover rate, length of tenure, and type of appointment using provincial or municipal panel data. Conclusions vary with the panel data used and the environmental-pollutant indicators investigated. Still, the following questions have yet to be answered: Do officials take significantly different approaches to environmental maintenance and governance? Do officials take on long-term or short-term behaviors for local environmental protection?

3. Hypotheses

Many researchers have found that local officials who are transferred from the central government are different from other local officials. More specifically, local officials transferred from the central government have less economic-performance pressure for promotion, and so they are more aligned with the policy of the central government and are less inclined to overstimulate the local economy. Therefore, these officials are more environmentally friendly than other local officials (Wang, 2014; Ma, 2013) [29,30]. As discussed above, local leaders are practically more crucial to local environmental protection, as they are, in some sense, dispatched from provincial governments and are the agents for carrying out most of the national and provincial policies through the formulation of detailed rules and regulations for implementing environmental policies according to particular local conditions. Environmental-protection incentives are much more difficult and complicated than economic-growth incentives. This is because, on the one hand, the economic performance of an official during his/her tenure is more visible, whereas the environmental performance is less visible. On the other hand, the environmental-protection and governance-associated information obtained by municipal officials is asymmetrical to that obtained by provincial and central government officials. Therefore, there are far-reaching implications to building the environmental-governance-related behaviors of officials into the personnel-management system and to improving the environmental-performance-appraisal system with better technologies.

Based on relevant findings reported in the literature, we formulated the following hypotheses on the impact of the personnel-management system for government officials on the environment from the perspectives of their political, fiscal, and corruption incentives:

**Hypothesis 1 (H1).** The turnover of officials has no negative impact on the water environment, but the water-environment quality during the tenure of an official varies in a U-shaped pattern, with a longer tenure resulting in a smaller environmental impact.

**Hypothesis 2 (H2).** Local officials servicing in their native jurisdictions tend to perform better in environmental protection, owing to their special emotional intimacy with their native jurisdictions.
Hypothesis 3 (H3). Under the existing personnel-management system, officials have different motivations and performances in environmental governance and maintenance.

4. Modeling

Using panel data of prefecture-level cities in China from 2003 to 2012, this paper examines the impact of the temporal and spatial changes in Chinese official appointments on the local water pollution. Figure 1 is the study region of our work, and it roughly presents the changes in the mayors and secretaries of each city in the sample window. The darker the color, the higher the total number of officer changes. The empirical results of the study show that the officer turnover year and reassignment have long-term positive effects on the environment, and that the longer the officer is appointed, the more conducive to environmental protection. Serving as officials in the native provinces rather than the native cities is conducive to the protection of the local environment, and there are differences in the behavior of officials in environmental governance and environmental maintenance.

![Figure 1](image_url)

Figure 1. The study region of this work. Source: authors’ calculation based on the Database of CPC Municipal Committee Secretaries and Municipal Governors of the People’s Republic of China.

4.1. Data Source

The data of the environmental and economic metrics of municipalities collected in the China City Statistical Yearbook 2003–2012 were used for the study. The environmental data of major cities come from the China Statistical Yearbook on Environment 2005–2012. The data of CPC municipal committee secretaries and municipal governors mainly comes from the Database of CPC Municipal Committee Secretaries and Municipal Governors of the People’s Republic of China [31], the database of local leaders in people.com, and the search engine Baidu. Data missing critical information, such as the environmental performance and incumbent officials, were rejected. The final data sample consisted of 2799 data, covering CPC municipal committee secretaries and municipal governors of 283 municipalities of 26 provinces who were incumbent during the periods of 2003–2010 and 2003–2012, respectively. As shown in Figure 2, in the data sample, the average turnover of CPC municipal committee secretaries is 69, among which interjurisdictional transfers account for 38.4%, municipal natives account for 4.98%, and provincial natives account for 64.9% (including municipal natives). The average turnover of municipal governors is 82, among which interjurisdictional transfers account for 56.3%, municipal natives account for 7.52%, and provincial natives account for 68.7%.
Figure 2. The number of changes in party secretaries and mayors in China. Source: authors’ calculation based on the Database of CPC Municipal Committee Secretaries and Municipal Governors of the People’s Republic of China.

4.2. Model and Variables

The 10-year panel dataset covering the CPC municipal committee secretaries and municipal governors of 283 municipalities was used to verify the impact of the temporal and spatial factors of China’s personnel-management system for government officials on the local water environment. The variables were selected by referencing the existing studies on the turnover and cross-jurisdictional exchange of officials (Zhang, 2007 [9]; Wang, 2009 [32]; Ding, 2015 [33]). The following model was developed for the empirical examination:

\[ E_{it} = \alpha_0 + \alpha_1 \text{change}_{it} + \alpha_2 \text{transfer}_{it} + \alpha_3 \text{native}_{it} + \alpha_4 \text{tenure}_{it} + \alpha_5 \text{economic}_{it} + \alpha_6 \text{char}_{it} + \gamma_t + \delta_i + \epsilon_{it} \]

where \( E_{it} \) is the environmental quality in the \( i \)th municipality in the \( t \)th year, \( \alpha_0 \) is the intercept term, from \( \alpha_1 \) to \( \alpha_6 \) are coefficients for the independent variables that affect the environmental quality, \( \gamma_t \) represents the local fixed effect, \( \delta_i \) represents the annual effect, and \( \epsilon_{it} \) is the error term.

In this study, industrial wastewater discharge was used as the indicator of the local water environment (\( E \)). The chemical oxygen demand has been used as an indicator of local water-environment pollution by some foreign researchers, but it is difficult to collect chemical-oxygen-demand data at the municipal level in China. The environmental-pollution indicators used by Chinese researchers include industrial waste (wastewater, waste gas, and solid waste), emissions of \( \text{SO}_2 \), industrial dust, and pm10. Water and air pollutants have a stronger split-over effect and cause negative externalities to bordering jurisdictions, whereas the environmental impact of solid pollutants has low visibility in the short term, owing to its weaker split-over effect.

Among the independent variables associated with the turnover of officials, \( \text{change}_{it} \) in the model represents the turnover in the current year, with a value of 1 for the presence of turnover and a value of 0 for the absence of turnover. \( \text{transfer}_{it} \) represents whether the replacement is nonnative or native, with a value of 1 assigned for nonnative and a value of 0 for native. Finally, \( \text{tenure}_{it} \) represents the length of tenure in the current year.

The characteristics of the officials (\( \text{char}_{it} \)) investigated include age, education, gender, and nativeness to the serviced jurisdiction. The education levels of high school, associate, undergraduate, graduate, and doctorate holders were assigned values of 1, 2, 3, 4, and 5, respectively. Male and female genders were assigned values of 1 and 0, respectively.

The local economic indicators (\( \text{economic}_{it} \)) include GDP, foreign direct investment (FDI), population, and the proportion of the secondary industry (\( \text{Ind}_{per} \)). These indicators are the control variables of the local economic development. Generally, a jurisdiction with...
a more developed economy, larger population, and higher proportion of the secondary industry has a higher level of pollution.

5. Empirical Results and Analysis
5.1. Spatial Factors and Water-Environment Pollution

The impacts of the spatial factors of the personnel-management system—the turnover (change), interjurisdictional transfer (transfer), tenure (tenure), and nativeness (nativework_p) (In the Working Regulations on the Selection and Appointment of Party and Government Cadres issued in January 2014, it is stipulated that ‘cadres are not allowed to hold the principal leadership positions in the CPC committee, government, discipline department, organization department, people’s court, people’s procuratorate, and public security department in their native county (municipality)’) of officials—on the water-environment pollution, as indicated by the discharge of industrial wastewater (iwwater), were examined. The GDP, FDI, and population data were logarithmized. Among the variables, local-native indicates whether an official is native to the jurisdiction that he/she promoted, with a value of 1 assigned for native and a value of 0 assigned for nonnative. Changetransfer is the intercorrelation term for change and transfer, and it is used to investigate the combined effect of the interjurisdictional transfer and turnover. A Hausman test was performed on the data, and it rejected the null hypothesis of no systematic difference between the stochastic-effect model and fixed-effect model. Therefore, the temporal and spatial effects were fixed for the model, as shown in Table 1.

Table 1. Temporal and spatial variations in official appointments and water pollution.

| Variable  | Iwwater (Mayor Data) | Iwwater (Party Secretary Data) |
|-----------|----------------------|--------------------------------|
| change    | −0.062 *             | −0.0499                        |
| local_native | 0.158 ***          | −0.0562                        |
| nativework_p | −0.046 *           | −0.0986 ***                    |
| changetransfer | 0.038               | 0.0438                         |
| transfer  | −0.074 ***           | −0.0139                        |
| tenure    | −0.042 ***           | −0.00726 *                     |
| tenure^2  | 0.002               | −0.00171                       |
| Ln_gdp    | 0.345 ***           | 0.0843                         |
| Ln_people | 0.617 ***           | 0.246                          |
| Ln_fdi    | 0.028 **            | −0.011                         |
| Ind_per   | −0.002              | 0.00780 ***                    |
| gender    | −0.099 **           | 0.112 *                        |
| edu       | −0.011              | 0.0499 ***                     |
| age       | −0.000              | 0.00805 **                     |
| cons      | 0.132               | 5.272 **                       |
| r^2_a     | 0.852               | 0.890                          |

Regional effect | Y | Y |
Time effect      | Y | Y |
F                 | 49.17 | 54.31 |
N                 | 2537 | 1952 |

Note: The data shown in the table are coefficients of independent variables; * statistically significant at 10% level; ** statistically significant at 5% level; *** statistically significant at 1% level. Same as the table below.

The model analysis results in Table 1 show that the model for CPC municipal committee secretaries and municipal governors agrees with the data. The data subset of CPC
municipal committee secretaries yielded insignificant coefficients; among the variables of the turnover and personal characteristics of officials, only the variable of provincial nativeness passed the significance test, at a significance level of 1%. This demonstrates that CPC municipal committee secretaries who serve in their native provinces are positively correlated to their local environments. The data subset of CPC municipal committee secretaries did not pass a significance test on some of the variables, but it yielded very similar model regression results to the data subset of municipal governors. The general insignificance of the impact of the personnel-management system on the water-environment pollution in the data subset of CPC municipal committee secretaries can be explained by the fact that CPC municipal committee secretaries focus more on party affairs in their daily activities and are less involved in local administrative affairs (Zhang, 2011) [34].

The coefficient for the impact of the turnover of municipal governors and CPC municipal committee secretaries on water pollution was negative. This indicates that the local water pollution in the turnover year was alleviated. The turnover year is accompanied by the dismissal of existing leaders and the inauguration of new leaders. In the turnover year, incumbent leaders have secured their next appointments, and they are thus less influenced by political and fiscal incentives. To prevent local hidden environmental issues from surfacing in the near future, they tend to make environmental governance and maintenance a priority over economic development, thereby positively contributing to local environmental development. New leaders also make environmental governance and maintenance a priority over economic development in the first years of their tenures because, on the one hand, the new economic projects for their tenures are still in the decision-making and planning stage and there is less environmental pressure. On the other hand, environmental issues are a concern for local livelihoods and their job security. This supports Hypothesis 1, which states that the turnover of officials has no negative impact on the water environment.

Interjurisdictional transfer has a significant impact on water pollution. This indicates that nonnative officials facilitate better local environmental protection than native officials. This is because the nonnativeness of officials (interjurisdiction transfer) serves to diminish corruption incentives and improve environmental regulation. It was hypothesized above that native officials are focused on local environmental protection owing to their special emotions towards their native jurisdictions. However, the analytic results show that officials who serve in their native municipalities do not facilitate local water-resource protection, whereas officials working in their native provinces facilitate better alleviation of the local water pollution. This can be explained by the fact that officials who serve in their native municipalities are more prone to be connected with local polluting firms, which thereby compromises local environmental regulations. Still, native officials are more motivated to protect their local environments owing to their special emotions towards their native jurisdictions. The analytic results show that officials who serve in their native municipalities are more prone to the personal-network effect, whereas officials who serve in their native provinces (but not in their native municipalities) are more affected by the emotional effect than the personal-network effect (Ang, 2012) [35]. The positive impact of interjurisdictional transfer on environmental protection also contributes to the better environmental performances of officials who work in their native provinces (but not in their native municipalities). In summary, officials who serve in their native jurisdictions are more devoted to local environmental protection, but this positive effect is more than offset by the negative effect of personal networks in cases when they work in their native municipalities. This supports Hypothesis 2.

Table 1 reveals that officials facilitate better environmental protection during their first years of tenure, but the impact of their tenures on the local water pollution varies with the length of the tenure. More specifically, the impact gradually becomes significantly negative as the length of tenure increases; the quadratic coefficient of the tenure variable is positive; with other variables constant, the water-environment quality varies in a U-shaped pattern during the tenure. This supports the second part of Hypothesis 1, which states that the ‘water environment quality varies in a U-shaped pattern during the tenure’ of
municipal leaders, and the impact of the tenure on the environment diminishes with the length of tenure. Furthermore, the variables of GDP, population, FDI, and the proportion of the secondary industry are all positively correlated to the wastewater discharge, as hypothesized above. In the data subset of CPC municipal committee secretaries, personal characteristics, such as education, age, and gender, have a more significant impact on the local water environment, but indirectly, through the decision-making processes of regional strategies and projects. More specifically, female secretaries and younger secretaries make more active efforts in environmental protection, and the education level is not positively correlated to the water-environment quality.

5.2. Temporal Factors and Water-Environment Pollution

The devotion of officials to environmental governance varies with the length of tenure, owing to the hysteresis of the benefit against the cost of environmental governance. Based on estimates from the data sample and the method used by Wang (2009) for analyzing the impact of leadership turnover on the economy, assuming an average tenure of four years, the two variables of turnover (change) and nativeness (transfer) were examined with hysteresis of one, two, and three periods to investigate the different impacts of the variables during the tenure. The data in Table 2 demonstrate that the models of the four periods agree with the data sample, with an \( r^2 \) value of approximately 0.85. Turnover facilitates better water-environment protection during the tenure, except for the second year of the tenure, when water pollution is aggravated. This supports Hypothesis 1, which states that the water-environment quality in a tenure varies in a U-shaped pattern. The major reason is that, in the first year of tenure, policy continuity and economic activity are compromised, which indirectly results in a positive effect on the environment—particularly for the indirect impact of compromised economic activities. With the prospect of being transferred to another jurisdiction, officials tend to deliberately reduce environmental investment towards the end of their tenures. The negative effect of reduced investment does not surface until the third year of the next tenure, owing to the hysteresis of the effect against the investment of environmental governance. New officials pursue new economic and environmental policies after assuming office. The effect of new economic policies begins to manifest in the second year of the tenure, but the effect of new environmental policies does not manifest until the third year of the tenure. Moreover, the impact of turnover gradually diminishes during the four-year tenure.

The nonnativeness (interjurisdictional transfer) of officials contributes to better environmental protection in the first three years of tenure, but it has a negative impact in the last year of tenure. This is because the introduction of nonnative officials serves to break the existing government–firm connections and thus contributes to strengthened environmental regulation. As the length of tenure increases, this positive effect gradually diminishes, with the absolute value of the coefficient decreasing from 0.098 to 0.008. With the prospect of being transferred to another jurisdiction in the last year of tenure, nonnative officials also reduce environmental investment, as do native officials.

The impact of the length of tenure on the water environment is consistent with the data in Table 1. More specifically, the length of tenure is positively correlated to the environmental quality; the linear coefficient and quadratic coefficient of the temporal variable are positive and negative, respectively, and the environmental quality varies in a U-shaped pattern during the tenure. What is different is that the positive effect of the length of tenure on the environment diminishes in the four-year tenure because officials predict the lengths of their tenures. Tenures are generally short, and so the motivations of officials to enforce environmental protection are prone to fluctuations. This supports Hypothesis 1 from another perspective.
Table 2. Temporal and spatial variations in official appointments and comparison of pollution factors of water environment.

| Variable       | Iwwater (Current Period) | Iwwater (Lag Period I) | Iwwater (Lag Period II) | Iwwater (Lag Period III) |
|----------------|--------------------------|------------------------|-------------------------|--------------------------|
| change         | −0.075 **                | 0.038 *                | −0.024                  | −0.021                   |
| transfer       | −0.098 ***               | −0.082 ***             | −0.045 *                | 0.008                    |
| nativework_p   | −0.036                   | −0.035                 | −0.013                  | 0.013                    |
| tenure         | −0.045 ***               | −0.022 *               | −0.022 *                | −0.001                   |
| tenure²        | 0.002                    | 0.001                  | 0.001                   | −0.002                   |
| Ln_gdp         | 0.353 ***                | 0.379 ***              | 0.392 ***               | 0.397 ***                |
| Ln_people      | 0.617 ***                | 0.544 ***              | 0.494 ***               | 0.539 ***                |
| Ln_fdi         | 0.024 *                  | 0.037 ***              | 0.052 ***               | 0.065 ***                |
| Ind_per        | −0.002                   | −0.004 *               | −0.008 ***              | −0.011 ***               |
| gender         | −0.071                   | −0.082 *               | −0.094 *                | −0.076                   |
| edu            | −0.016                   | −0.027                 | −0.032 *                | −0.020                   |
| age            | −0.000                   | −0.002                 | −0.000                  | −0.001                   |
| cons           | 0.019                    | −0.404                 | 0.277                   | −0.688                   |
| $r^2_a$        | 0.845                    | 0.844                  | 0.846                   | 0.844                    |

Regional effect: Y Y Y Y
Time effect: Y Y Y Y

| F            | 48.212 | 43.374 | 39.253 | 34.179 |
| N            | 2610   | 2330   | 2063   | 1798   |

Note: Same as Table 1.

5.3. Different Impacts on the Water Environment

What follows is an analysis of the combined effect of the temporal and spatial factors on water-environment pollution, based on the above analysis of the separate effects of the temporal and spatial factors on water-environment pollution.

(1) The long-term effects of temporal and spatial factors on the water environment

As discussed, the turnover and nonnateness of officials contribute to better water-environment protection. However, the frequency of the turnover is negatively correlated to the water-environment quality. To understand whether these factors have long- or short-term impacts on local water environments, the variables of the water-environment pollution in the two subsets of the data samples were divided into two groups (volatility terms and trend terms) by referencing the method used by Xu (2009) for analyzing the impact of personnel turnover on the local economy, and by using filtering analysis. As shown in Table 3, in the data subset of municipal governors, the turnover has a negative impact in the short term, but a significant and positive effect in the long term. This is because turnover results in fluctuations in environmental factors in the short term, but it is effective in the long term. Interjurisdictional transfer has a positive effect on the water-environment quality in the short term and long term, with the effect in the short term being stronger than in the long term. This is because interjurisdictional transfer weakens government–firm connections and there are fewer corruption incentives in the short term; thus, there is more effective environmental regulation in the short term. The length of tenure is positively related to the water-environment quality in the short term and long term, with a stronger effect in the long term.
Table 3. The short-term and long-term analyses of water pollution caused by temporal and spatial variations in official appointments.

| Variable    | Mayor Data Fluctuation Term | Trend Term | Party Secretary Data Fluctuation Term | Trend Term |
|-------------|-----------------------------|-----------|--------------------------------------|-----------|
| change      | 0.022                       | −0.053 ** | −0.722                               | −0.018    |
| nativework  | 0.206                       | 0.022     | −0.251                                | −0.070 ** |
| transfer    | −0.835 **                   | −0.010    | 0.080                                 | −0.003    |
| time        | −0.064                      | −0.022 ** | −0.280                                | −0.015 ** |
| Ln_gdp      | 0.349                       | 0.057     | 2.991 *                               | 0.057     |
| Ln_people   | 0.905                       | −0.012    | 3.556                                 | 0.163     |
| Ln_fdi      | −0.287                      | 0.011     | 0.023                                 | −0.020 ** |
| Ind_per     | 0.041                       | 0.002     | 0.007                                 | 0.011 *** |
| edu         | −0.540 **                   | 0.004     | 0.124                                 | 0.035 *** |
| age         | 0.059                       | 0.003     | 0.101                                 | 0.005 *   |
| cons        | −11.426                     | 8.668 *** | −83.871 **                            | 7.283 *** |

\( r^2 \) | 0.090                       | 0.873     | 0.129                                 | 0.956     |

Regional effect | Y | Y | Y | Y |
Time effect     | Y | Y | Y | Y |
F               | 0.743                       | 51.561    | 0.851                                 | 124.762   |
N               | 2537                       | 2537      | 1951                                  | 1951      |

Note: Same as Table 1.

(2) Different approaches taken by officials to environmental maintenance and governance

In this paper, the two terms (environmental maintenance and environmental governance) are distinguished in the sense that environmental governance is proactive and long-term oriented, and it aims to establish long-term environmental-protection systems through continuous investment in environmental-governance facilities. Environmental maintenance is the temporary control of pollution sources and, compared with environmental governance, it is more focused on an immediate effect (i.e., it is more short-term oriented). To examine whether local officials take different approaches towards environmental maintenance and governance under the current personnel-management system, we investigated the effects of the variables in the personnel-management system on environmental governance, as indicated by the investment in environmental infrastructure.

Table 4 reveals that the effect of the personnel-management system on the investment in environmental facilities is different from that on water-environment pollution. In the data subset of municipal governors, turnover, interjurisdictional transfer, and intrajurisdictional promotion are all negatively correlated to environmental-infrastructure investment. A longer tenure does not contribute to positive environmental-facility investment, and the local economic-development levels and population are positively correlated to environmental-infrastructure investment. Therefore, the current personnel-management system does not provide an incentive for government officials to establish long-term environmental-protection mechanisms. This supports Hypothesis 3.

5.4. Regional Heterogeneity

To examine how other city level-factors might influence the results, we further subdivided the city sample for regression. As shown in Table 5, Column 1 is the subsample after removing all provincial capital cities. Because provincial capital cities are generally considered to enjoy more economic preferential policies and higher environmental control because of policy reasons (Chen, 2005; Peesson, 2016) [36,37]), they may not be random
enough. The regression results after removing the provincial capitals show that the change in mayor has a significant negative impact on the industrial wastewater; that is, it effectively inhibits the discharge of pollution. This result is consistent with the benchmark regression conclusion. In addition, considering the differences in the economic-development levels between the eastern, central, and western regions due to the unstable reform and opening-up process in China (Xu, 2018) [38], we subdivided the eastern, central, and western cities for analysis. The results are reported in Columns 2, 3, and 4 of Table 5. The results show that the change in mayor has a more significant effect on the pollution control in the cities in the central region. Moreover, it is generally believed that the level of governance is related to the level of economic development. The positive results in the eastern region have verified this conjecture. From this point of view, the level of governance in the eastern region is generally relatively higher, which results in the change in officials positively impacting the pollution control.

Table 4. Temporal and spatial variations in official appointments and environmental governance.

| Variable       | Facilityinvest | Facilityinvest |
|----------------|----------------|----------------|
| change         | −0.126 *       | −0.025         |
| local_native   | −0.576 *       | −0.598         |
| nativework     | 0.402          | 0.195          |
| transfer       | −0.137 *       | 0.042          |
| time           | −0.029         | −0.012         |
| Ln_gdp         | 1.057 ***      | 0.610 *        |
| Ln_people      | 0.608 *        | −1.476 *       |
| Ln_fdi         | −0.103 ***     | −0.092 **      |
| Ind_per        | −0.033 ***     | −0.028 ***     |
| edu            | 0.053          | −0.017         |
| age            | 0.003          | −0.004         |
| cons           | −6.440 ***     | 15.558 **      |
| \( r^2 \_a \)  | 0.750          | 0.758          |
| Regional effect| Y              | Y              |
| Time effect    | Y              | Y              |
| F              | 13.505         | 13.860         |
| N              | 1215           | 1179           |

Note: Same as Table 1.

Table 5. Regional heterogeneity.

| Excluding Provincial Capital Cities | Eastern Cities | Central Cities | Western Cities |
|------------------------------------|----------------|----------------|----------------|
| (1)                                | (2)            | (3)            | (4)            |
| mayor change                       | −0.213 *       | 1.054          | −0.121 **      | −0.006         |
| local_native                       | −0.349 *       | 0.101          | 0.685          | 0.541          |
| nativework                         | 0.212          | 0.375          | 0.211          | 0.810          |
| transfer                           | −0.027 *       | −0.011         | 0.624          | 0.673          |
| time                               | 0.003          | 0.012          | −0.439         | −0.012         |
| Ln_gdp                             | 2.176 ***      | 1.195 ***      | 2.095 ***      | 1.839 ***      |
Table 5. Cont.

|                      | Excluding Provincial Capital Cities | Eastern Cities | Central Cities | Western Cities |
|----------------------|------------------------------------|----------------|----------------|----------------|
|                      | (1)                                | (2)            | (3)            | (4)            |
| Ln_people            | 0.208                              | 0.193          | 0.174          | 0.283          |
| Ln_fdi               | 0.218 *                            | −0.037 *       | 0.382          | 0.026          |
| Ind_per              | −0.704 **                          | −0.201         | −0.175 *       | −0.184 *       |
| edu                  | −0.053 *                           | −0.284 *       | −0.103 *       | 0.819          |
| age                  | 0.104                              | 0.088          | 0.653          | 0.639          |
| cons                 | −1.976 ***                          | 0.753 **       | 10.654 ***     | 6.491 ***      |
| $r^2_a$              | 0.812                              | 0.538          | 0.639          | 0.615          |
| Regional effect      | Y                                  | Y              | Y              | Y              |
| Time effect          | Y                                  | Y              | Y              | Y              |
| N                    | 2210                               | 1252           | 761            | 524            |

Note: Same as Table 1. Eastern provinces: Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, and Hainan; central provinces: Shanxi, Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan; western provinces: Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang, Guangxi.

6. Conclusions

(1) The turnover of CPC municipal committee secretaries and municipal governors facilitates water-pollution reduction. Municipal governors who serve in their native provinces facilitate local water-environment protection, except for those municipal governors who serve in their native municipalities, where they do not facilitate local water-resource protection;

(2) Water-environment pollution varies in a U-shaped pattern during the tenures of officials. More specifically, officials facilitate a positive environmental impact during the turnover year. As the duration of the tenure increases, the local water pollution gradually lessens, and the linear coefficient and quadratic variable for the temporal variable are negative and positive, respectively;

(3) The turnover of officials facilitates a positive environmental impact during the average four-year tenure, except for in the second year of the tenure, when water pollution is exacerbated. The nonnativeness of officials (interjurisdictional transfer) facilitates positive water-environment protection during the first three years of the tenure, but it induces a negative environmental impact during the last year of tenure. The effects of the turnover and nonnativeness of officials gradually diminish during the tenure;

(4) More frequent turnovers induce a negative impact on the water environment, while less frequent turnovers induce a positive impact. This is because shorter tenures cause fluctuations in environmental factors, while longer tenures facilitate better effects. Although nonnative officials induce positive environmental impacts irrespective of the length of tenure, those holding longer tenures induce greater effects than those holding shorter tenures. The effect of the length of tenure on the water-environment quality is more evident in the long term;

(5) Officials take different approaches towards environmental maintenance and governance, as revealed by the finding that variables such as turnover, interjurisdictional transfer, nativeness, and the length of tenure of officials are all positively correlated to environmental maintenance but insignificantly correlated to the investment in environmental facilities. The major factors that impact the investment in environmental infrastructure include the local economic-development level and population. This suggests the further encouragement of officials to establish long-term environmental-protection mechanisms.
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