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Centralization or Decentralization of Environmental Governance—Evidence from China

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Abstract: From the perspective of environmental federalism, we extracted the environmental intention words from the work reports of China's central and provincial governments through data mining, and used the instrumental variable method to conduct empirical experiments concerning the dispute between centralization and decentralization of environmental governance in the Chinese context. The results suggest that a negative correlation exists between the intention of the central government's environmental governance and the provincial environmental quality, whereas a positive correlation exists between the intention of the provincial government and the provincial environmental quality. Our interpretation is that environmental centralization, coupled with its political, economic, and cultural factors, has converted provincial governments into supporters of environmental pollution, and that the central government's ongoing environmental protection inspection campaign has forced the provincial government to be somewhat effective. We propose establishing Chinese-style cooperative federalism in environmental authority and not only centralizing or decentralizing in one direction. New transition mechanisms for the central government's authority should be implemented, such as the environmental protection inspection groups mechanism and the ecological gross domestic product based political tournament.

Keywords: environmental federalism; centralization; decentralization; intention words; environmental governance; absolute index; relative index; race to the bottom

1. Introduction

After three decades of rapid economic growth since the mid-1980s, China's environmental pollution is becoming increasingly alarming. According to the 2015 statistics of the Ministry of Environmental Protection [1], China's annual economic losses due to environmental pollution and ecological destruction account for about 6% of its gross domestic product (GDP). Berkeley Earth, a California-based independent non-profit focusing on land temperature data analysis for climate science, published a study showing that around 1.6 million people in China die from $PM_{2.5}$-related diseases each year, accounting for 17% of all deaths [2]. Aware of this severity, Chinese governments have attached increased importance to environmental governance since the 17th National Congress of the Communist Party of China. The 19th National Congress of the Communist Party of China has sworn to treat the environment as a living being, to achieve harmony between humankind and nature and to uphold ecological civilization as the millennium strategy for the sustainable development of Chinese society.

In addition to routine work, China's central government has started continuously sending out environmental protection inspection groups to provincial jurisdictions. As China has maintained political centralization [3], the environmental governance is becoming increasingly centralized; however, according to environmental federalism, tension and certain ambivalence exist in environmental governance about the roles of the different levels of government [4]. As Bednar [5] and Millimet [6] stated, although the issue of environmental federalism is receiving widespread attention around the globe, determining the optimal allocation of environmental authority across levels of government remains a challenge.

Many studies have explored this challenge in environmental governance. Advocates of centralization emphasize that decentralization will lead to a "race to the bottom" due to competition among local governments, ultimately resulting in environmental degradation [7]. Wilson [8] and Kunce and Shogren [9] also stated that local governments will ease environmental control under the dual role of decentralizing both fiscal and environmental issues. However, supporters of environmental decentralization think that local governments should take responsibility for regulating regional pollution [4]. The heterogeneity of environmental public goods implies that the provision of environmental services by local governments can approach the optimization of resource allocation [10]. Therefore, conclusions about the centralization and decentralization of governments' environmental authority and how to determine an optimal environmental decentralization system have not been reached, due to the complexity and diversity of environmental issues [11]. The divergence over decentralization stimulated scholars to seek empirical evidence to support a choice. In terms of negative evidence, Fredriksson et al. used data from 90 developing countries in 2004 to explain the negative impact of decentralization on environmental quality [12]. Based on panel data from 80 countries in 1970–2000, Farzanegan and Mennel confirmed that fiscal decentralization increases pollution [13]. In terms of neutral evidence, based on China's provincial panel data from 1995 to 2010, He found that decentralization has no significant impact on three types of waste (waste gas, wastewater, and industrial residue) [14]. As to the dispute over decentralization or not in the country U.S., Fischel found that there is little or no reason to fear a regulatory race to the bottom [15]. Fredriksson and Millimet, covering 1977 through 1994, found that relatively lax regulations in the U.S. appeared to have no effect on the abatement of spending of neighboring states [16]. Veld and Shogren confirmed that decentralizing the choice between these regimes does not, in general, induce the socially optimal outcome [17].

Relatively more evidence supports decentralization. Besley and Coate presented a model in which decentralization may outperform centralization, even when the central government is allowed to provide non-uniform levels of local public goods [10]. Goklany contended that the U.S. historical record on air quality management is clearly inconsistent with the idea of the race to the bottom [18]. List and Gerking, in an empirical study of the race to the bottom, concluded that the race to the bottom in environmental quality did not appear during the Reagan presidency [19]. Sigman confirmed the traditional view that decentralization allows policies to be more tailored to local conditions, and no race to the bottom regarding water pollution occurs [20]. Generally, most investigations into the environmental regulations conducted during the Reagan presidency in the U.S. found little evidence of a race to the bottom, and some have even found evidence of a race to the top if the bottom-up constraints are sufficiently strong [7,21].

As mentioned above, though numerous studies have been published on centralization and decentralization, the effects of centralization or decentralization on the provincial environmental quality have been neglected to a large extent, especially in China. So, with this study, we wanted to address this gap. To explore this issue, this paper presents a theoretical review of the decentralization and centralization of environmental authority. Hypotheses are developed in Section 2. Section 3 outlines text data mining that was conducted to extract the environmental intention words from the work reports of China's central and provincial governments, and to construct their relative indexes and absolute indexes. Through empirical experiments, Section 4 details how intentions of governments'

environmental governance are correlated with the provincial environmental quality and addresses the hypotheses. Finally, Section 5 draws conclusions and provides some corresponding suggestions.

2. Literature Review and Hypothesis Development

2.1. Concepts and Definitions

Environmental federalism originated from federalism, which is defined as a government system characterized by a pyramid, with the central government at the top and the semiautonomous local governments at the bottom. Its core characteristic is the decentralization of authority, meaning that governmental authority is allocated between levels of government [5]. Essentially, environmental federalism or environmental decentralization is concerned with the distribution of the responsibility of environmental governance between the central and provincial governments.

In this paper, the government's intention to govern the environment refers to the psychological expression and attention allocation that the governments use to regulate and control their own behaviors in a planned and organized way to solve a specific environmental problem [22]. The governments' behavior is a practical form of their intention. Language is the reflection of mental processes, so word frequency is an important variable indicating people's mental motivation and attention allocation [23]. Frequently used words reflect people's cognitive focus and attention configuration as well as peoples' motivation tendency. Governments' annual work reports with statutory effects, and the nature of the policy agenda, are issued as an official policy text during the two sessions [24]. In China, the governments' work reports, together with China's successive Five-Year Plans, are the tools used for the government to allocate resources and devote energy. Inevitably, they embody the government's psychological expression and attention allocation. As the official expression of the government's intention on management, they have a standardized style of writing with rigorous use of vocabulary and syntax. Therefore, these reports are reliable and instructive sources for extracting the central and provincial governments' intention words or expressions and for constructing our intention index system. Generally, the continuous increase or decrease in the government's intention keyword occurrences of environmental governance will influence the provincial environmental quality.

Provincial governments are incentivized both politically and economically by the central government, which is mainly achieved through the combination of the central government's centralization of political and personal power, and the decentralization of economic development and fiscal powers to the provincial government's [25]. This political centralization focuses provincial government officials, not purely on local economic growth, but more on the career promotion controlled by the central government. Consequently, this political centralization system has resulted in the central government's intention for environment governance being assumed to be transmitted to the provincial governments who publish similar work reports in accordance with those of the central government. The central government's intention of environmental governance influences the provincial environmental quality inevitably. So, the continuous increase or decrease in the central government's intention keyword occurrences influence the provincial environmental quality due to the intention transition mechanism.

The governments' absolute index (AI) refers to the total number of environment-related words or expressions in a single work report, whereas the relative index (RI) refers to the percentage of environment-related words or expressions in the total number of words in a single Chinese government work report. AI and RI denote the provincial government's AI and RI respectively; CAI and CRI represent the central government's AI and RI, respectively. The environment-related keywords or expressions concern the natural environment, urban and rural environment, life environment, and nature, which mainly involve expressions about land use, energy control, environmental protection, pollution waste, farmland, forest, grassland and wetland, air noise, soil, rivers and lakes, marine, and desert.

2.2. Centralization of Environmental Governance

The literature has focused on the reasons for and conditions of environmental centralization. There are several reasons for this: First, to address the tragedy of the commons or avoid the race to the bottom that may ensue from decentralized decision-making and interjurisdictional competition [26]; second, to overcome disparities in effective political representation; third, to correct market failures arising from pollution externalities [27], that is, to internalize any externalities amongst local districts [28]; fourth, to benefit from pursuing moral ideals, such as concern with the future quality of the local environment; fifth, federalization of environmental law may reflect industry preferences for unified national standards that would preempt varying state requirements [29]; and finally, the poor performance of states as environmental regulators [30].

In China, some scholars investigated environmental governance from the environmental federalism perspective. Zhang et al., through website searching and staff interviews, concluded that the provincial environmental protection agencies do not fully implement China's environmental information disclosure decree [31]. Ran analyzed the incentives set by the central government regarding environmental policy implementation for provincial governments, and showed that the central government provides more incentive for provincial local governments' non-implementation or poor implementation of environmental policies than for full implementation [32]. Li et al. analyzed the impact of the central government's rules, regulations, and mechanisms for rewards and penalties on provincial governments' policy implementation [33].

As an authoritarian state, China's political centralization means that the superior government has the absolute authority to appoint and remove officials of inferior governments; thus, the superior government can ensure the lower governments act consistently with its values. This political centralization system reshapes the incentive mechanism and guides the value orientation of local governments, forming a regime system typified by pressure. For example, from 2015 to 2017, since their first rounds of inspection and review, the environmental protection inspection groups sent by the central government accepted 212,000 appeals or complaints from the public, solved more than 150,000 environmental problems in people's daily lives, fined 2.46 billion yuan, investigated 2303 cases, detained 2264 people, handed over 509 accountability issues to the judicial organs, and held 4218 people accountable for environmental pollution responsibility [34]. From 10 to 15 July 2019, environment protection inspection groups were stationed in Shanghai, Fujian, Hainan, Chongqing, Gansu, and Qinghai, where they received or published many appeals or complaints from the public. Additionally, more rounds of central government inspection are scheduled. This campaign style governance can be designated as a signal of more environmental centralization.

Given China's political centralization, the resulting GDP championship tournament, and the campaign-style environmental protection inspection, the central government's intention of environment governance is transmitted to the provincial government. Thus, we propose the following hypothesis:

Hypothesis 1 (H1): *The absolute index and relative index of the central government's intention to govern the environment are positively correlated with the provincial environmental quality.*

2.3. Decentralization of Environmental Governance

In response to the race to the bottom problem raised by supporters of environmental centralization, Oates and Schwab proved that if no spillover effect exists and the budget is financed by non-distorted taxes, local governments will provide the best environment for their people [35]. Regarding cross-border pollution, Oates suggested that the cooperation of regional local governments provides a potential efficient solution to the problem of an inter-regional spillover effect in addition to centralized solutions [4]. Saveyn and Proost argued that residents in different regions have different preferences for an environmental quality and that some regions may prefer a high-quality environment whereas others prefer low environmental quality [36]. The central government's one-size-fits-all approach

incurs welfare losses compared with when all regions pursue their own optimal environmental policies. Butler and Macey stated that far from unleashing a welfare-reducing race, interjurisdictional competition pressures governments to regulate efficiently and effectively [37].

Tiebout argued that a decentralized governmental system, with horizontally arranged jurisdictions that are trying to attract residents on the basis of differing tax and benefit structures, produces a Pareto-superior outcome [38]. Oates and Schwab confirmed that it is possible for a decentralized environmental authority to be efficient, even with interjurisdictional competition for capital [35]. However, decentralization and the Tiebout model require numerous assumptions or conditions [39,40]: (1) individuals are homogeneous and immobile across jurisdictions; (2) capital is perfectly mobile across jurisdictions, seeking to maximize after-tax returns and all production profits are earned locally; (3) capital has perfect knowledge concerning the attributes of all jurisdictions, which includes the tax rate on capital and level of public goods and services provided; (4) many jurisdictions take the after-tax return on capital as given; and (5) governments maximize the social welfare of their jurisdiction. Oates stated that violation of any of these conditions can lead to distorted outcomes [41].

China's fiscal decentralization provides provincial governments with more autonomy to manage economic interests and behavior targets [42]. Fiscal federalism has caused environmental decentralization, which can be regarded as a branch of the former. As mentioned above, since provincial governments publish similar annual work reports in accordance with those of the central government, the provincial governments will strengthen their environmental governance in alignment with the actions of the central government. As argued by Oates and Portney, local governments have advantages when collecting local environmental information, so they could have a stronger ability to use information according to circumstances [43]. Thus, we propose the following hypothesis:

Hypothesis 2 (H2): *The absolute index (AI) and relative index (RI) of the provincial government's intention to govern the environment are positively correlated with the provincial environmental quality.*

Due to a lack of reliable data, empirical studies on decentralization or centralization at the aggregate level in China are relatively rare, especially when China has only begun to orient its high-quality economic development toward innovation and green development. So, the question for China is whether to centralize or decentralize. Can the data mining of the provincial governments' work reports provide any support for this decision?

3. Materials and Methods

We used data mining methods to extract environment-related intention words from the annual work reports of China's central and local governments, to construct their relative indexes and absolute indexes, and to form the index system of the central and provincial governments' environments.

Some studies have focused on the work reports of the Chinese governments. Taking the reports of all-level governments as a subject, Zhen summarized three functions of the government work reports [44]. Using the provincial and municipal governments' reports as a subject, Wang and Li explored the changing rules of provincial governments' attention to environmental governance through manual text analysis [45]. However, these studies were conducted with no data mining.

3.1. Data Source and Description

The governments' report database collected China's central and provincial governments' annual work reports from 2004 to 2014. Data were mainly obtained from China's State Council's website [46], the provincial government websites, the People Network [47], and Civil Servants' Exam Information [48]. The corpus included 330 annual work reports, among which 319 were sourced from 29 provincial governments and 11 from the central government. The report with the fewest words has more than 7000 Chinese characters, whereas the one with the most words has 28,000 Chinese characters. The average

number of characters per annual work report is 15,000 Chinese characters. Due to a lack of data, Hainan and Xizang provinces were not covered in our research.

3.2. Construction of the Absolute Index and Relative Index

Data mining included four stages: (1) annual report search and download, (2) corpus construction, (3) wordlist initialization and expansion, and (4) corpus search and calculation.

3.2.1. Data Processing

To avoid corrupted characters and enhance visual convenience, all corpus files were UTF-8 encoded and labeled using a "year + province name/central government" system. After application of noise removal procedures, all documents were saved as plain text TXT files. The Chinese paragraphs were segmented at the token level by a powerful engine called Jieba built in the corpus tool SegmentAnt 1.1.0. Sentential segmentation was implemented by the regular expression replacement with support from the corpus tool EmEditor [49]. The regular expression of this tool is "[。 ！ ？ ;]" and the corresponding replacement expression is "\n", placing every sentence in an independent paragraph.

3.2.2. Keyword Extraction and Index

The first version of the keyword list was constructed by the naked-eye full-text reading of 10 annual reports. The second version was produced by querying the search engine Baidu long-tailed keyword generation site with each keyword of the first list [50]. The Baidu long-tailed keywords were obtained from Baidu user keyword input and tended to be infrequent and mutually related. In our process, a single keyword search in this site produced a maximum of 100 related words, and the resulting word list, considered as the second version, was merged with the first version of keywords to obtain the list of 4301 keywords, which was considered the third version. The corpus tool AntConc [51] is a powerful and widely used tool for corpus query in corpus linguistics around the world. So, the third version was tested using the corpus tool AntConc and filtered against the corpus, producing the fourth version of a word list of 1242 words whose context meanings were identified manually.

With the fourth version of the wordlist, the keyword number of every single report was produced by the corpus tool AntConc, whereas the keyword-containing sentence number was determined using the corpus tool EmEditor regular expression operations. This determined the original frequency of keywords in each single annual report of the provincial and central governments in the corpus. The frequency of a certain keyword's occurrence in the text depended on the text length, so to increase robustness and solve the problem created by the results, the standardized frequency was obtained through multiplying the original frequency by the standardization coefficient. Thus, the standardized keyword occurrence frequencies in each text and in the whole corpus were acquired. As the AI and RI are based on the standardized keyword frequency, the use of the two as proxy variables representing provincial governments' intention for environmental governance can be compared.

3.3. Description of Data Results

Among the single work reports, Zhejiang's 2006 work report contains the most keywords with 588 keywords and 231 sentences, whereas Jilin's 2005 work report contains the fewest keywords with only 40 keywords and 27 sentences. A single work report contains an average of 204 keywords related to environmental governance, accounting for 2.18% of the total words in a single work report. Some of the keywords are listed in Table 1, and the full catalogue of keywords, named The Fourth Version of Keywords as mentioned above, can be found in the Supplementary Material.

Table 1. Environment-related intention words and their frequencies (freq.).

Keywords (Translated)	Freq.	Keywords (Translated)	Freq.	Keywords (Translated)	Freq.	Keywords (Translated)	Freq.
ecology	7444	drinking water	891	cultivated land	680	methane	339
land	3037	discharge	884	garbage	672	treatment rate	325
energy conservation	2902	farmland	826	monitor	669	soil	320
pollution	2348	clean	825	disaster	620	water	318
energy conservation	2171	reservoir	821	afforest	611	reduce the consumption	304
green	2107	forest	813	returning farmland	357	cultural tourism	303
water conservancy	1664	sewage	793	shipping	351	sulfur dioxide	298
emission reduction	1617	energy consumption	792	underground	348	drinking	298
environmental protection	1583	eliminate	780	irrigation	346	environmental quality	296
circulation	1412	new energy	737	livable	345	harmless	295
environment preservation	1221	basin	719	soil and water	344	coal combustion	287
biology	945	water conservation	710	wetland	342	human settlement environment	286
sustainability	934	coverage rate	698	irrigated area	341	sewage disposal	286

Appendix A reports the partial result in the period of 2004 to 2014. First, both the AI and RI show irregular fluctuations, and the intention of provincial governments to improve the environment did not seem to be strengthening each year. Second, the government's intention for environment governance displayed short-term changeability mainly due to special incidents occurring in certain years, and the range of fluctuations was determined by characteristics of the stimuli. During the study period, significant fluctuations occurred in 2006, 2008, and 2011. The possible reasons are as follows. The nationwide green Olympics in 2008 pushed environmental governance. However, 2006, 2011, and 2016 were the first years of China's Five-Year Plan. During these first years, the governments formed plans for the next five years, and the information carried in governments' work reports inevitably increased correspondingly, including the concern about environmental issues. This fluctuation over time also indicates that controlling for the variables of time and year in the following quantitative analysis was necessary.

3.4. Evaluation Index for Provincial Environmental Quality

The data in this section were collected from the China Statistics Yearbook (2004–2014), China Environmental Statistics Yearbook (2004–2014), and CEInet Statistics Database [52].

The environment belongs to the oneness or twoness theory, which can be understood as the ecological environment, or the ecology and environment with parallel relationships. In reality, the environment, together with economic and social systems, is a complex ecological system, so environment measurement needs to holistically focus on its coupling and balance. At this starting point, and in accordance with Yuan and Li [53], we established a comprehensive evaluation index system of the environment that was divided into three levels, with a total of 19 indexes (X1–X19), as shown in Table 2. We comprehensively evaluated the environment using the entropy method, and the detailed processes are presented in the following subsection [54].

Table 2. A comprehensive evaluation index system of the environment.

Primary Indicator	Secondary Indicators	Third Level Indicators	Unit	X
Ecological Environment	Damage to ecological environment	SO_2 emissions *	ton/10,000 yuan	X1
		Waste water emissions *	ton/10,000 yuan	X2
		Desertification of land area *	m^2/person	X3
		Smoke (powder) emissions *	ton/10,000 yuan	X4
		Industrial waste gas emissions *	m^3/person/yuan	X5
		Common solid waste produced in industry *	ton/10,000 yuan	X6
	Endowment of the environment	Forest coverage	%	X7
		Water resources per capita	m^3/person	X8
		Arable land area per capita	mu/person	X9
		Public green space per capita	m^2/person	X10
		Wetland area accounting for the jurisdiction area	%	X11
		Proportion of nature reserves in the jurisdiction	%	X12
	Governance effect of the environment	Increased areas of soil erosion control or governance in the current year	1000 hectares	X13
		Harmless treatment rate of household garbage	%	X14
		Green coverage percentage of built-up area	%	X15
		Treatment investment in industrial pollution sources	0.1 billion yuan	X16
		Control investment in environmental pollution	0.1 billion yuan	X17
		Garbage collection volume	10,000 tons	X18
		Urban sewage treatment rate	%	X19

Note: * indicates the negative index, and the extreme value method was used for positive dimensionless processing. After the original standardization, some of the data values were 0. To ensure later logarithmic processing, and not to affect the measurement results, these values were substituted with 10^{-10}.

3.5. Evaluation Process with the Entropy Method

For the data standardization treatment, we used the negative index in Equation (1) to convert the generated volume of SO_2 discharge, wastewater discharge, desertification land area, smoke (powder) discharge, industrial waste gas discharge, and general industrial solid waste. We used the positive index in Equation (2) to standardize other positive indicators.

$$\text{Negative index } X'_{tj} = \frac{max\{X_j\} - X_{tj}}{max\{X_j\} - min\{X_j\}} \tag{1}$$

$$\text{Positive index } X'_{tj} = \frac{X_{tj} - min\{X_j\}}{max\{X_j\} - min\{X_j\}} \tag{2}$$

If the original standardized partial data value was 0, it was replaced with 10^{-10} to ensure that the following log-out process and evaluation results were not affected.

Next, Equation (3) was used to calculate the value proportion of indicator j in year t, where m is the number of areas evaluated (that is, 29 provinces in this study, m = 29):

$$Y_{tj} = \frac{X'_{tj}}{\sum_{t=1}^{m} X'_{tj}} \tag{3}$$

Equation (4) was used to calculate the index information entropy, where $k = 1/\ln m$:

$$e_j = -k \sum_{t=1}^{n} (Y_{tj} \times \ln Y_{tj}) \tag{4}$$

Equation (5) was used to calculate the information entropy redundancy:

$$d_j = 1 - e_j \tag{5}$$

Equation (6) was used to calculate the index weight:

$$W_t = d_j / \sum_{j=1}^{n} d_j \quad (6)$$

The single indicator value was calculated with:

$$S_{tj} = W_t \times X'_{tj} \quad (7)$$

Equation (8) was used to calculate the provincial environmental quality:

$$EQ_{it} = S_{tj} \times W_t \quad (8)$$

where X_{tj} represents the value of indicator j in year t; min $\{X_j\}$ and max $\{X_j\}$ are the minimum and maximum values of the evaluation indicator j in all years, respectively; $k = 1/\ln m$, where m is the number of evaluated areas and n is the number of indicators; EQ is the comprehensive level of the provincial environmental quality; i represents a certain province or municipality; and t represents a year from 2004 to 2014.

Then, we combined the panel data of the central and provincial governments in China from 2004 to 2014 with the above index system to conduct empirical experiments with the instrumental variable method.

4. Empirical Models, Results, and Discussion

4.1. Empirical Model Set

As mentioned in Section 2.1, in China, the central government's work reports and their successive Five-Year Plans are the basis for the resources allocation and energy devotion across the whole country, and the provincial governments would demonstrate consistent intention allocation by publishing similar reports in accordance with the central government under the political centralization and GDP tournament chairmanship.

Cognitive motivation theory holds that human behavior depends on the attention attribution of related events [55]; management is only decision-making, the key to which is how decision-makers effectively allocate their limited attention [22]. Subsequently, Jones introduced attention study into the field of government management and proposed an attention-driven policy choice model, which articulates that the choice of government behavior mainly depends on the factors that most attract government decision-makers' attention to specific matters. As analyzed in Section 2.1, language is a reflection of mental processes [23]; frequently used words that are in the center of people's cognition can reflect people's cognitive tendencies and the most active part of their thinking [56]. Correspondingly, the AI and RI derived from environment-related keyword occurrence can reflect Chinese governments' attention allocation, motivation tendencies, and their intention or will regarding environmental governance. We observed a correlation between governments' absolute intention or relative intention and the provincial environmental quality (EQ) which acted as the dependent variable in our empirical specification. Due to the usually regular transfer of officials, the policy is not necessarily continuous, so there was no lag.

Based on the above data, results, and analyses, we present the empirical equations as follows. All data were processed logarithmically.

$$\mathrm{LnEQ}_{it} = \alpha_{it} + \beta_1 \mathrm{LnAI}_{it} + \beta_2 \mathrm{LnCAI}_t + \beta_3 \mathrm{LnIS}_{it} + \beta_4 \mathrm{LnRPGDP}_{it} + \beta_5 \mathrm{LnEGP}_{it} + \beta_6 \mathrm{LnEF}_{it} + \beta_7 \mathrm{LnES}_{it} + \beta_7 \mathrm{LnPD}_{it} + \varepsilon_{it} \quad (9)$$

$$\mathrm{LnEQ}_{it} = \alpha_{it} + \beta_1 \mathrm{LnRI}_{it} + \beta_2 \mathrm{LnCRI}_t + \beta_3 \mathrm{LnIS}_{it} + \beta_4 \mathrm{LnRPGDP}_{it} + \beta_5 \mathrm{LnEGP}_{it} + \beta_6 \mathrm{LnEF}_{it} + \beta_7 \mathrm{LnES}_{it} + \beta_8 \mathrm{LnPD}_{it} + \varepsilon_{it} \quad (10)$$

where EQ_{it} is used as described in Section 3.5; AI and RI represent the absolute index and relative index of provincial governments' intention to govern the environment, respectively; CAI and RI represent the absolute index and relative index of the central government's intention to govern the environment, respectively; and the absolute value and direction of the coefficients β_1 and β_2 were observed in relation to the provincial environmental quality. RPGDP represents the real GDP per capital of provinces or municipalities. We used the GDP per capita in 2004 as the base to deal with inflation. IS is for the provincial industrial structure; EF is for the provincial energy efficiency; ES is for the provincial energy structure; EGP denotes the proportion of provincial environmental proposals among 10,000 people, reflecting people's environment appeal; and PD is the provincial population density. All other variables were used to control the equations. α is the constant term, and ε is the error term.

4.2. Results

We first used pooled regression. Table 3 shows the results of the pooled regression. In Table 3, Models (1) and (3) show the results of general pooled regression and Models (2) and (4) show the results of regression using the province as the clustering variable. Model (1) shows that the coefficient of AI is significant, which means that provincial governments' AI positively influences the provincial environmental quality. Other columns show that RPGDP, EF, ES, and PD also play important roles. However, the general result is not as satisfactory as expected; in particular, some key variables, such as CAI and CRI, are not significant. Comparing the general standard error with the cluster-robust standard error, the former is about half of the latter. Therefore, the pooled regression seems to be unideal, though several results can be used.

Table 3. Results of pooled regression.

	Model			
	(1)	**(2)**	**(3)**	**(4)**
Variable	**lnEQ**	**lnEQ**	**lnEQ**	**lnEQ**
LnAI	0.254 **	0.254		
	(0.105)	(0.187)		
LnCAI	−0.116	−0.116		
	(0.104)	(0.145)		
LnRI			0.263 **	0.263
			(0.105)	(0.190)
LnCRI			−0.124	−0.124
			(0.102)	(0.143)
LnIS	−0.245	−0.245	−0.247	−0.247
	(0.515)	(0.600)	(0.515)	(0.601)
LnRPGDP	0.263 ***	0.263	0.260 ***	0.260
	(0.0605)	(0.159)	(0.0606)	(0.160)
LnEGP	−0.0301 *	−0.0301	−0.0300 *	−0.0300
	(0.0174)	(0.0244)	(0.0174)	(0.0245)
LnEF	0.704 ***	0.704 ***	0.704 ***	0.704 ***
	(0.0763)	(0.239)	(0.0762)	(0.238)
LnES	−0.481 ***	−0.481 **	−0.476 ***	−0.476 **
	(0.0827)	(0.222)	(0.0826)	(0.221)
LnPD	0.0680 ***	0.0680	0.0696 ***	0.0696
	(0.0261)	(0.0676)	(0.0262)	(0.0674)
Constant	−7.467 ***	−7.467 ***	−6.245 ***	−6.245 ***
	(0.749)	(1.813)	(0.841)	(2.204)
Observations	319	319	319	319
R^2	0.414	0.414	0.415	0.415

Note: Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Next, we considered the existence of fixed effects or random effects in the model. Then, the statistical software package STATA was employed for testing by using the command xtoverid. We took the Hausman test to compare the random effect model with the fixed effect model, and included the constant terms when comparing coefficient estimates. The regression results were as follows. *For CAI and AI, testing of over identifying restrictions: fixed* vs. *random effects, cross-section time-series model: xtreg re robust cluster (province code), Sargan–Hansen statistic 26.99* χ^2 *(8), p-value = 0.0007. For CRI and RI, testing of over identifying restrictions: fixed* vs. *random effects, cross-section time-series model: xtreg re robust cluster (province code), Sargan–Hansen statistic 26.45* χ^2 *(8), p-value = 0.0009.* Here, *(8)* refers to 8 independent variables which are AI, CAI, IS, RPGDP, EGP, EF, ES, PD for testing AI or CAI, and RI, CRI, IS, RPGDP, EGP, EF, ES, PD for testing RI or CRI, respectively.

The *p*-values were 0.0007 and 0.0009, respectively, so the random effect is strongly rejected and the fixed effect model should be used. The situations of each province are different and some variables that do not change with time may be missing, so the fixed effect (within estimator) and the least square dummy variable (LSDV) methods were used for regression. The results are shown in Table 4.

Table 4. Models (1) and (3) are the results of the regression using the fixed effect method, whereas models (2) and (4) are the results of the regression using the LSDV (least square dummy variable) method.

	(1)	(2)	(3)	(4)
Variable	**lnEQ**	**lnEQ**	**lnEQ**	**lnEQ**
LnCAI	−0.0779	−0.0779		
	(0.0522)	(0.0641)		
LnAI	−0.0746	−0.0746		
	(0.0606)	(0.105)		
LnRI			−0.0759	−0.0759
			(0.0596)	(0.107)
LnCRI			−0.0820	−0.0820
			(0.0508)	(0.0630)
LnEGP	−0.0246 ***	−0.0246	−0.0247 ***	−0.0247
	(0.00900)	(0.0156)	(0.00897)	(0.0155)
LnEF	0.155	0.155	0.153	0.153
	(0.109)	(0.111)	(0.109)	(0.112)
LnES	0.110	0.110	0.114	0.114
	(0.124)	(0.169)	(0.124)	(0.169)
LnPD	−1.138 ***	−1.138 ***	−1.144 ***	−1.144 ***
	(0.290)	(0.231)	(0.289)	(0.232)
LnRI			−0.0759	−0.0759
			(0.0596)	(0.107)
LnCRI			−0.0820	−0.0820
			(0.0508)	(0.0630)
Constant	2.326	2.961	1.022	1.662
	(2.014)	(1.898)	(2.043)	(2.346)
Observations	319	319	319	319
R-squared	0.123	0.892	0.126	0.892
Number of province code	29		29	

Note: Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

In Table 4, the regression results are still unsatisfactory, regarding significant results. We think that an unobservable relationship to error terms in CAI and CRI may exist. So, we tried to find the instrument variable that is not related to the error term but affects the CAI and CRI variables. Then, we tried to use provincial governments' fiscal investment (FI) in the environmental governance, which can somewhat reflect their intention and effort regarding environmental governance. Due to the political centralization system, provincial governments' FI can also reflect the central government's CAI and CRI somewhat, but are not related to the error term in the environmental governance. Therefore, FI was used as the instrument variable. The specific operation process used was as follows.

First, the deviation transformation of the fixed effect model was completed, then the instrument variable FI was used to estimate CAI and CRI. Next, the results, which are displayed in Tables 5 and 6, were acquired by the two-step least square (2SLS) regression. The results of the two tables were derived using different control variables, and the coefficients were found to be relatively significant.

Table 5. Fixed effects instrumental variables (FE-IV) estimators for the absolute intention.

	(1)	(2)	(3)	(4)	(5)
Variable	**LnEQ**	**LnEQ**	**LnEQ**	**LnEQ**	**LnEQ**
LnCAI	−1.505 **	−1.184 ***	−1.278 ***	−0.853 ***	−0.873 ***
	(0.681)	(0.456)	(0.472)	(0.211)	(0.209)
LnAI	0.804 *	0.585 **	0.646 **	0.340 ***	0.324 **
	(0.425)	(0.282)	(0.292)	(0.131)	(0.128)
LnIS	1.465 **	1.105 **	1.311 **	0.924 **	1.376 ***
	(0.723)	(0.523)	(0.548)	(0.370)	(0.391)
LnRPGDP	0.781 **	0.522 **	0.523 **	0.176	0.193
	(0.336)	(0.222)	(0.232)	(0.163)	(0.161)
LnEGP		−0.0531 **	−0.0583 ***	−0.0372 ***	−0.0493 ***
		(0.0216)	(0.0224)	(0.0131)	(0.0136)
LnEF			0.308 *	0.303 **	0.0533
			(0.174)	(0.135)	(0.149)
LnES				0.444 **	0.640 ***
				(0.202)	(0.213)
LnPD					−1.524 ***
					(0.402)
Constant	−6.871 ***	−4.479 ***	−5.910 ***	−3.034 **	5.863 **
	(2.407)	(1.568)	(1.770)	(1.530)	(2.857)
Observations	319	319	319	319	319
Number of province code	29	29	29	29	29

Note: Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 6. Fixed effects instrumental variables (FE-IV) estimators for the relative intention.

	(1)	(2)	(3)	(4)	(5)
Variable	**LnEQ**	**LnEQ**	**LnEQ**	**LnEQ**	**LnEQ**
LnCRI	−1.341 **	−1.080 ***	−1.171 ***	−0.811 ***	−0.829 ***
	(0.565)	(0.398)	(0.413)	(0.198)	(0.196)
LnRI	0.696 **	0.516 **	0.578 **	0.316 **	0.298 **
	(0.353)	(0.247)	(0.256)	(0.124)	(0.122)
LnIS	1.276 **	0.983 **	1.194 **	0.873 **	1.315 ***
	(0.619)	(0.474)	(0.501)	(0.361)	(0.380)
LnRPGDP	0.767 **	0.532 **	0.532 **	0.206	0.223
	(0.306)	(0.212)	(0.222)	(0.159)	(0.157)
LnEGP		−0.0484 **	−0.0535 ***	−0.0355 ***	−0.0473 ***
		(0.0193)	(0.0202)	(0.0127)	(0.0132)
LnEF			0.331 **	0.318 **	0.0727
			(0.165)	(0.133)	(0.146)
LnES				0.408 **	0.600 ***
				(0.193)	(0.203)
LnPD					−1.496 ***
					(0.394)
Constant	−12.40 ***	−9.508 ***	−11.31 ***	−7.692 ***	0.736
	(4.114)	(2.779)	(2.959)	(1.762)	(2.717)
Observations	319	319	319	319	319
Number of province code	29	29	29	29	29

Note: Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.3. Discussion

Tables 5 and 6 show that the absolute index (AI) and relative index (RI) of the central government's intention to govern the environment were negatively correlated with the provincial environmental quality, at least at an 5% significant level, indicating that the intensification of the central government's intention negatively impacts the environment. Specifically, the central government's intentionality has a destructive effect on the provincial environment, and a 1% increase in intentionality will cause the environmental index to decline by about 0.8%. This is in contrast to our H1 that the AI and RI of the central government's intention to govern the environment are positively correlated with the provincial environmental quality. The possible causes of this are as follows. First, China's political centralization has resulted in a GDP-oriented political tournament, which ensures the central government's strong control of the local administration. As GDP is the key indicator used by the upper-level government to appraise officials, and residents' mobility across jurisdictions is very low due to China's Hukou system [57], provincial officials are not controlled like in other countries and can be indulgent in their pursuit of economic growth and career promotion. In developed countries, local residents who have higher mobility across states can indicate their preferences in elections, so officials must strike a balance between a resident's environmental utility and economic growth to achieve their political objectives. This can force officials to implement higher environmental standards to win more elections [58], so local government officials seeking economic development to the detriment of the environment can be curbed. However, in China, provincial governments with no constraint from the bottom inevitably race to the bottom in environmental regulation [59], which means that officials usually maintain economic growth during their tenure by easing environmental regulations.

Second, in China, the power of economic development is decentralized to provincial governments through fiscal decentralization. With its strong political control, the growth rate of the provincial economy [60] or revenue collection [61] are used by the central government to evaluate and promote the local officials. Fiscal decentralization provides provincial governments more independence to address and manage economic interests and behavior targets [43]. As a result, provincial governments, as interested individuals, pursue economic growth at the expense of the environment and even secretly protect some high-pollution and high-energy-consuming enterprises who may be major taxpayers in their jurisdiction. As more stringent environmental measures increase the costs of firms and deflect capital elsewhere, this naturally motivates provincial governments to choose excessively lax standards for local environmental quality [62].

Environmental performance and economic performance play extremely different roles in the evaluation (promotion) system, which generates dually asymmetric incentives to the conduct of provincial government officials [63]. Usually, officials are blamed or punished for environmental incidents, but they are seldom promoted for improving the environment, and the default outcome of this is that GDP is the only key indicator of the career promotion championships. This can be designated as a mismatch of power structure or incentives of China's institution system. As provincial officials are perversely motivated [32], provincial governments may indulge in the GDP championship again when environmental inspectors leave.

Third, environmental regulation in China has been centralized. This is also reflected in the statement that environmental centralization has been a significant and long-term by-product of China's political centralization [64,65]. However, decisions at higher and more distant levels of government undermine local governments' self-determination and reflect a lower diversity than local decisions [30]. Additionally, environmental centralization increases the cost of inspection; the higher the cost, the more difficult or the less detailed the inspection. This also contributes to the negative influence of the central government.

Fourth, from the perspective of economics, China, while undergoing its middle or later industrialization, is faced with the environmental Kuznets curve issue, which implies that a positive correlation exists between economic growth and pollution emissions. This also partly explains why

local government officials strive for faster growth at the expense of environmental quality and protect, instinctively or secretly, emission-intensive industries and enterprises.

As for the second hypothesis, Tables 5 and 6 show that the AI and RI of the provincial governments' intention were positively correlated with the environmental quality at a significant level, indicating that the intensification of the provincial governments' intention to govern the environment positively impacts the environment. Column 5 of Tables 5 and 6 shows that after controlling other variables, the coefficients of the AI and RI of the provincial governments' intention are both approximately 0.3. In other words, when the provincial governments' intention increases by 1%, the environmental quality improves by 0.3%. This is consistent with H2, which stated that the AI and RI of the provincial governments' intention to govern the environment are positively correlated with the provincial environmental quality. The possible reasons for this are as follows.

First, from the perspective of environmental federalism, China's central authority has fought to reverse China's environmental Kuznets curve by sending environmental governance inspection groups to the provincial jurisdictions and encouraging high-quality and green development. This ongoing transformation necessitates a painful industry structure adjustment and updating, which may undermine some official careers since their tenure is usually short in one jurisdiction. So, a conflict exists between the central and provincial governments. Models (4) in the above last two tables show that the coefficients of lnRPGDP are about 0.2, which shows that, though not significant, the real GDP per capita is positively correlated with the environmental quality. This may indicate that the central government has authority in this conflict in which the provincial governments have somewhat progressed in their efforts to reverse their environmental Kuznets curve.

Second, as economics teaches, when environmental background conditions, emissions levels, climate, weather, risk preferences, policy priorities, and income levels diverge, only regulations tailored to localized circumstances improve social welfare [66]. The central government' one-size-fits-all policies may not be appropriate for all provinces. The process of environmental governance should be free flowing with openness and positive interactions from the public, and should exploit all kinds of knowledge and information. In present China, ecological civilization has been upheld by a central authority, which has been involved in all kinds of propaganda; accordingly, the public's ecological awareness is increasing. In combination, the provincial governments and their chief officials have been tasked to continuously provide ecological public goods. As a result, the environmental governance of provincial governments has been somewhat effective. Therefore, the provincial governments' AI and RI have had positive impacts on the provincial environmental quality.

When the control variables are considered, the industrial structure has a positive effect on the provincial environment. The higher the proportion of the tertiary industry, the better the environmental quality. This implies that optimizing the provincial industrial structure is crucial for environmental governance. The energy structure (here, the proportion of coal consumption is the main reference object) and energy use efficiency have a relatively positive effect on the provincial environment. As expected, the population density significantly negatively influences the environment. Notably, the coefficient of people's environmental appeal is approximately 0.05, which, though negative, indicates that people's appeal has a small impact on the environment governance and that the governments have not paid much attention to people's appeal. China's top-down governance has resulted in a lack of being accountable for the bottom. However, the public's environmental appeal should be carefully considered, since, in November 2017, the 19th National Congress of the Communist Party of China declared that China is now mainly facing a contradiction between China's unbalanced and inadequate development and the people's ever-growing needs for a better and high-quality life. That is, the Chinese people are not just fighting for food and clothing but for high-quality lives, including their need for high-quality environmental public goods.

5. Conclusions and Suggestions

5.1. Conclusions

In this study, we qualitatively and quantitatively explored the influence of environmental governance centralization or decentralization from the perspective of the central and provincial governments' intentions. The results showed that (1) a negative correlation existed between the intention of the central government's environmental governance and the provincial environmental quality, indicating that the top-down environmental governance approach of the central government's centralization cannot achieve a satisfactory effect; (2) a positive correlation existed between the intention of provincial governments' environmental governance and the provincial environmental quality; (3) at the provincial level, the industrial structure, the energy structure, and the real GDP per capita were positively correlated with their provincial environment; the population density or distribution negatively influenced the provincial environment; and the public's environmental appeals had no clear influence on the provincial environmental quality.

5.2. Suggestions

For the above-mentioned problems and conclusions, several policy suggestions are proposed. First, opposite to the ongoing tendency of environmental centralization in present China, we propose that cooperative federalism be applied with Chinese characteristics, rather than only centralizing or decentralizing in one direction. To be specific, for national environmental public goods, centralization should still be strengthened under China's political centralization and fiscal decentralization circumstances, but new authority transmission mechanisms for the central government's environment governance intention should be established, such as the central government's environmental protection inspection groups. This campaign-style governance has considerably improved the provincial leaders' pressure for environmental governance in their jurisdiction and, consequently, has advanced the nationwide environmental governance in a short period of time, which is another exercise in China's institutional advantage of concentrating the power and resources to quickly achieve nationally important goals. However, how should this campaign-style governance be institutionalized in accordance with China's political centralization system and fiscal decentralization? This will be a new research area.

Second, decentralizing the environmental authority is somewhat necessary, especially for the detailed environmental affairs confined to provincial jurisdiction. This is a bottom-up or grassroots type of governance that can avoid the one-size-fits-all problem. More bottom-up information channels should also be established so that governments can address the environmental problems with democratic openness and cooperation. So, environmental governance may be a joint action in which provincial governments exercise control over environmental affairs specific to their jurisdictions, while the central government assumes responsibility for national pollution regulation, for example, by providing support for technological research and nationwide programs of environmental governance, and providing necessary information and guidance to provincial governments. However, more empirical investigation is needed concerning this cooperative and bottom-up federalism in China's context to push this proposal beyond mere speculation.

Third, ecological politics should be introduced and integrated into China's political centralization and GDP-based political tournament. Correspondingly, ecological GDP should be introduced into the evaluation of officials' performance and promotion, which should include the ecological economy index, ecological security index, ecological society index, and ecological politics index. Ecological GDP should be regarded as an important indicator for evaluating provincial chief officials' performance so that environmental objectives become one of the most important indicators that governments at the provincial level need to achieve.

Finally, China's governments should pay more attention to people's environmental demands, promote public participation in environmental governance, and establish ex- or post-project

environmental inspection mechanisms. The role of population density or distribution needs to be reconsidered. Attention should be paid to the optimization and upgrading of the provincial industrial and energy structures. The government should make stronger efforts to adjust North China's energy structure, which is dominated by coal and electricity, to reduce the impact of the energy structure on the environment.

However, our research can be furthered in the following two aspects. On one hand, the public's appeal for high environmental goods may not be well reflected by the proportion of provincial environmental proposals among 10,000 people since the public's appeal can be pervading in all kinds of propaganda and posing pressure on chief provincial officials. On the other hand, the panel data are not so recent, so more recent data are desired. However, since the developing countries are faced with the similar dilemma between the urgent need for rapid economic development and the resulted simultaneous pollution as China has been experiencing, this research can shed light on their sustainable development.

Supplementary Materials: The following are available online at http://www.mdpi.com/2071-1050/11/24/6938/s1, Excel panel data before and after ln processing; 330 work reports of China's central and provincial governments and the resulted keywords and their index.

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Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Table A1. The Absolute Index (AI) and Relative Index (RI) of Governments' Intention for Environmental Governance in Years From 2004 to 2014.

Province/Central	AI	RI	AI	RI	AI	RI	AI	RI	AI	RI	AI	RI	AI	RI	AI	RI	AI	RI	AI	RI	AI	RI
	2004	2004	2005	2005	2006	2006	2007	2007	2008	2008	2009	2009	2010	2010	2011	2011	2012	2012	2013	2013	2014	2014
Anhui	64	1.09%	64	1.08%	118	1.93%	116	1.89%	133	2.23%	109	1.86%	106	1.79%	126	2.13%	130	2.19%	142	2.32%	144	2.42%
Beijing	83	1.44%	134	2.30%	144	2.43%	158	2.69%	134	2.28%	132	2.26%	145	2.44%	128	2.17%	135	2.26%	168	2.80%	173	2.88%
Fujian	86	1.44%	104	1.72%	108	1.77%	123	2.05%	134	2.22%	161	2.69%	149	2.50%	138	2.26%	145	2.36%	169	2.77%	176	2.88%
Gansu	81	1.39%	93	1.56%	114	1.92%	112	1.88%	164	2.73%	121	2.03%	129	2.15%	137	2.25%	174	2.87%	155	2.54%	184	3.06%
Guangdong	102	1.76%	116	2.00%	120	2.02%	149	2.51%	125	2.12%	140	2.43%	122	2.04%	150	2.48%	147	2.53%	146	2.44%	155	2.60%
Guangxi	69	1.20%	87	1.49%	94	1.59%	102	1.73%	110	1.82%	109	1.81%	128	2.09%	169	2.74%	171	2.80%	153	2.44%	148	2.38%
Guizhou	87	1.45%	130	2.18%	150	2.51%	164	2.81%	165	2.80%	172	2.92%	166	2.83%	141	2.31%	117	1.90%	144	2.30%	141	2.23%
Hebei	89	1.45%	83	1.37%	120	1.99%	97	1.61%	127	2.12%	101	1.70%	100	1.63%	105	1.65%	127	2.11%	128	2.11%	170	2.78%
Henan	97	1.63%	105	1.77%	111	1.85%	133	2.21%	169	2.78%	117	1.93%	114	1.89%	122	2.02%	97	1.61%	100	1.68%	143	2.41%
Heilongjiang	83	1.39%	93	1.56%	131	2.18%	142	2.36%	196	3.25%	178	2.87%	176	2.82%	122	1.94%	131	2.02%	125	2.00%	152	2.49%
Hubei	51	0.85%	67	1.11%	104	1.72%	151	2.51%	127	2.09%	122	1.99%	140	2.32%	119	1.97%	143	2.34%	95	1.55%	142	2.35%
Hunan	78	1.29%	101	1.65%	109	1.81%	142	2.39%	140	2.34%	137	2.29%	126	2.11%	151	2.48%	153	2.51%	163	2.71%	171	2.87%
Jilin	66	1.12%	54	0.89%	77	1.30%	92	1.53%	107	1.80%	89	1.48%	107	1.79%	127	2.11%	121	2.02%	152	2.52%	155	2.46%
Jiangsu	60	0.98%	79	1.33%	107	1.77%	120	1.99%	146	2.47%	128	2.17%	130	2.21%	132	2.24%	135	2.29%	134	2.25%	156	2.64%
Jiangxi	63	1.04%	61	1.01%	90	1.44%	119	1.92%	138	2.21%	145	2.36%	181	2.95%	189	3.02%	184	3.02%	172	2.83%	156	2.61%
Liaoning	74	1.22%	81	1.33%	103	1.73%	122	2.04%	137	2.28%	105	1.70%	118	1.91%	149	2.39%	147	2.38%	136	2.23%	168	2.74%
Inner Mongolia	76	1.30%	113	1.95%	123	2.10%	137	2.33%	153	2.62%	120	2.02%	158	2.68%	161	2.75%	155	2.62%	159	2.69%	157	2.67%
Ningxia	87	1.44%	97	1.63%	87	1.44%	123	2.07%	137	2.19%	111	1.78%	114	1.81%	156	2.47%	124	1.95%	126	1.98%	121	1.92%
Qinghai	96	1.64%	90	1.51%	192	3.21%	126	2.09%	191	3.19%	144	2.38%	193	3.23%	170	2.76%	147	2.39%	146	2.37%	200	3.28%
Shandong	64	1.07%	102	1.70%	112	1.91%	149	2.51%	119	2.01%	137	2.33%	110	1.85%	139	2.33%	117	1.95%	133	2.23%	122	2.02%
Shanxi	105	1.76%	105	1.75%	105	1.76%	173	2.90%	181	2.95%	158	2.59%	151	2.49%	168	2.76%	144	2.32%	154	2.51%	173	2.85%
Shaanxi	90	1.51%	108	1.82%	165	2.75%	142	2.35%	154	2.50%	151	2.51%	161	2.59%	151	2.49%	136	2.22%	134	2.17%	154	2.54%
Shanghai	89	1.54%	82	1.40%	110	1.87%	83	1.43%	83	1.43%	94	1.63%	102	1.75%	88	1.49%	78	1.33%	84	1.41%	122	2.07%
Sichuan	78	1.27%	80	1.32%	125	2.03%	149	2.47%	130	2.14%	177	2.96%	153	2.50%	165	2.76%	150	2.48%	137	2.25%	156	2.57%
Tianjin	82	1.36%	96	1.61%	112	1.91%	150	2.50%	137	2.33%	121	2.04%	137	2.33%	138	2.29%	148	2.46%	147	2.46%	143	2.38%
Xinjiang	77	1.31%	89	1.50%	138	2.32%	111	1.87%	169	2.95%	122	2.08%	111	1.88%	133	2.23%	150	2.54%	170	2.85%	155	2.67%
Yunnan	90	1.48%	109	1.82%	123	2.09%	118	1.95%	145	2.42%	135	2.24%	127	2.11%	176	2.88%	161	2.67%	180	3.00%	149	2.48%
Zhejiang	105	1.84%	126	2.13%	206	3.48%	152	2.60%	142	2.42%	129	2.19%	118	2.03%	139	2.31%	132	2.23%	120	2.05%	204	3.40%
Chongqing	125	2.07%	110	1.83%	146	2.41%	115	1.89%	112	1.81%	95	1.51%	131	2.15%	138	2.25%	103	1.67%	142	2.33%	146	2.40%
Central	54	0.91%	72	1.23%	98	1.65%	137	2.37%	112	1.94%	104	1.77%	109	1.86%	118	2.03%	130	2.20%	85	1.45%	129	2.14%

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