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Study on the Effect and Mechanism of Circular Economy Promotion Law on the Utilization Rate of Industrial Solid Waste in Resource-Based Cities

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Abstract: In recent decades, the impact of industrial solid waste (ISW) on the environment is arousing the government's attention. Improving the comprehensive utilization rate of ISW not only reduces environmental pollution, but also promotes the recycling of resources and eases the pressure on resources. This study uses the panel data of 278 prefecture-level cities in China from 2003 to 2015 to establish a DID model then empirically analyze the impact of the Circular Economy Promotion Law (CEPL) on the comprehensive utilization rate of ISW in resource-based cities. It was found that implementation of the CEPL improved the comprehensive utilization rate of ISW in resource-based cities. Furthermore, the higher the city's environmental regulation score, the more obvious the effect of the CEPL on the comprehensive utilization rate of ISW. This study also found that the impact of CEPL on the comprehensive utilization rate of ISW in resource-based cities will change due to variation of city's type and city's location. This study not only enriches the theoretical basis for the research on factors affecting ISW management, but also provides new ideas for transforming the ISW management model and realizing a "win-win" between the economy and the ecological environment.

Keywords: resource-based cities; industrial solid waste; DID; circular economy promote law

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1. Introduction

With rapid population growth, fast urbanization, increasing economic development [1], industrial solid waste (ISW) grows rapidly along with social development and is closely related to the economy [2,3]. According to statistics from the Ministry of Ecology and Environment of the People's Republic of China, in 2019, the general ISW generated in 196 large and medium-sized cities across the country reached 1.38 billion tons, the comprehensive utilization volume was 850 million tons, the disposal volume was 310 million tons, the storage volume was 360 million tons, and the dumping and discarding volume was 42,000 tons. The comprehensive utilization of general ISW accounted for 55.9% of the total utilization, disposal, and storage, 20.4% and 23.6%, respectively. This not only occupies a lot of lands, but also poses a long-term potential threat to air, water, and soil [4]. Despite the increasing use of waste as a renewable resource [5], the prevention and treatment of ISW pollution have received insufficient attention due to the hysteresis of ISW's damage to the environment [6]. Due to the treatment of ISW as an economic activity with positive externalities, the ability of enterprises to deal with ISW is often limited. Consequently, the so-called "market failure" phenomenon will occur, then the government needs to perform its functions to solve the problem of market failure. In China, several environmental regulations have been launched to promote the treatment and prevention of pollution from ISW since the late 1990s. The implementation of the Circular Economy Promotion Law (CEPL) in 2009 is one of the important measures. Understanding the impact of specific policies and regulations on the utilization of ISW in cities is an important way to improve the management level of cities' ISW. However, relevant studies are still scarce today.

In the past few decades, scholars' research on ISW is mainly focused on how to reduce its pollution through technical means. By comparing four different ISW treatment methods, Nouri et al. found that a combination of landfill, incineration, and recycling is the best treatment method [7]. Yao et al. found that the use of lightweight porous concrete as a building material can effectively reduce the impact on the environment [8]. In addition, by comparing the different situations in Finland, France, and China, Dong et al. found that the use of gasification technology for waste-to-energy can effectively reduce the environmental impact of solid waste [9]. Through the method of life cycle assessment, Pérez et al. found that solid waste material separation and improved recycling process can reduce its carbon footprint [10]. Existing studies have also analyzed the effectiveness of solid waste management policies from the perspective of policy evaluation. Taking Brazil as the research object, Cetrulo et al. found that the solid waste management policy did not achieve the expected goal, which was mainly caused by the different focus of the policy [11]. This is consistent with the research results of Periathamby et al. who used Malaysia as the research object [12]. However, unlike Malaysia and Brazil, by analyzing the effect of China's waste charging policy, Wu et al. found that this policy resulted in residents taking the initiative to reduce household waste at source, which in turn curbed waste generation, in other words, China's solid waste management policy is effective [13]. It can be seen that current studies either focus on how different treatments of ISW can prevent and reduce the pollution of ISW or on how policies and regulations can prevent the generation of solid waste, and few studies pay attention to how policy regulations can affect the utilization of ISW. In fact, solid waste and ISW are different.

Therefore, the purpose of this paper is to take China's CEPL, an environmental regulation was launched to promote the treatment and prevention of pollution from ISW, as the research object and apply the difference-in-differences (DID) method and two-way fixed effects model to empirically analyze whether the CEPL has promotion effect on resource-based cities' comprehensive utilization rate of ISW. For each city, the laws and regulations passed and implemented at the national level can be regarded as a quasi-natural experiment that satisfies the condition of homogeneity, while resource-based cities are fixed. Therefore, it is possible to identify the impact of the implementation of the CEPL on the comprehensive utilization rate of ISW in resource-based cities through the DID method. In addition, we use propensity score matching and instrumental variables to accurately identify this impact. Compared with other studies, the contributions of this paper are as follows:

(1) Considering the CEPL as the entry point for the first time, it discusses in detail the impact of the CEPL on the comprehensive utilization rate of ISW in resource-based cities.

(2) Based on the official promotion tournament hypothesis, the specific impact mechanism of CEPL on the comprehensive utilization rate of ISW in resource-based cities is discussed considering the competition for promotion of local officials.

(3) Using a variety of robustness tests, it empirically verifies that when the resource constraint bottleneck is reached, strengthening environmental law enforcement can provide an important direction for resource-based cities to alleviate the pressure from scarcity of resources.

The rest of this paper is arranged as follows: the second section introduces the background of the CEPL, resource-based cities, and the research hypotheses; the third section introduces the data and methodology; the fourth section presents the results of empirical test; finally, the conclusions and policy recommendations are offered in the fifth section.

2. Policy Background and Theoretical Analysis

2.1. Circular Economy Promotion Law (CEPL)

The idea of a circular economy originated from the spaceship theory proposed by American economist Boulding in the 1960s [14], he advocated the establishment of a "circular economy" that does not deplete resources, does not cause environmental and ecological pollution, and can recycle various resources, instead of the "single-program economy" of the past [15]. In the 1990s, sustainable development strategies became a global trend. Environmental protection, cleaner production, green consumption, and waste recycling began to be integrated into a systematic economic development model characterized by recycling resources and avoiding waste generation. Meanwhile, some developed countries, such as Germany and Japan, have started the legislative practice of circular economy [16–18]. Influenced by other countries, the concept of circular economy was initially introduced into China in the 1990s [16,19], and often is discussed through the "3R" principles [20], which include the reduce principle of minimizing input of production factors [21], the reuse principle of putting fewer factors into production [22], and the recycling principle of regarding waste materials as one of the production factors [20]. At the same time, after nearly two decades of unprecedented growth in industrial manufacturing, China started to face a variety of pressing environmental challenges [23], including increasing ISW. To solve this problem, Chinese policymakers had begun to consider circular economy legislation.

In 1996, the former State Planning Commission of China submitted a draft law on the comprehensive utilization of resources to the State Council, but it did not work because of different views on it. At the end of the 20th century, the Environmental and Resource Protection Committee of the National People's Congress, influenced by foreign cleaner production legislation, began to discuss issues related to the formulation of cleaner production laws. In 1999, following the legislative plan of the Ninth National People's Congress Standing Committee, the Environmental Resources Commission established a drafting leading group for the Cleaner Production Promotion Law and entrusted the Economic and Trade Commission of the State Council to draft the law. After 3 years, a draft was formed and submitted to the Standing Committee of the National People's Congress. In June 2002, this law was reviewed and passed at the 28th meeting of the Standing Committee of the Ninth National People's Congress.

Since 2002, influenced by some developed countries' research on waste recycling and the improvement of corresponding legal systems, scholars in China had begun to put forward proposals for the comprehensive utilization of cleaner production and resources. Further, they also considered the development of a circular economy and relative legislative work. Their perspectives received the attention of the legislature. In March 2005, President Hu Jintao clearly proposed to speed up the formulation of the CEPL, then the Standing Committee of the National People's Congress decided to include the formulation of the CEPL into a legislative plan. According to the legislative plan of the Standing Committee of the National People's Congress, the Environmental and Assets Supervision and Administration Commission established the CEPL drafting leading group, formally launched the CEPL legislative work. In August 2008, the Fourth Meeting of the 11th Standing Committee of the National People's Congress deliberated and passed the CEPL, which was formally implemented on 1 January 2009.

The framework design of the CEPL is based on the main line of "reduce, reuse and recycle and resource". In terms of reduction, CEPL specifies that reasonable programs, mining sequences, methods, and beneficiation processes should be developed to extract mineral resources, while encouraging the use of non-toxic and non-hazardous solid waste to produce construction materials. In the term of reuse, recycling, and resourcefulness, CEPL clarifies the comprehensive utilization of ISW, requiring enterprises to comprehensively utilize industrial wastes such as fly ash generated in the production process in accordance with national regulations to improve the level of waste reuse and resource utilization. In addition, if an enterprise does not have the conditions for comprehensive utilization of the waste generated in the production process, it shall provide it to qualified producers and operators for comprehensive utilization.

2.2. Resource-Based City

Resource-based cities are cities that use regional mineral and forestry resources in their leading industries. With the advent of the industrial revolution, resource-based cities have appeared on a large scale worldwide [24]. Resource-based cities, as the major producers of industrial resources, have made great contributions to the country's economic development and wealth accumulation. However, since the main industry is mining and processing mineral resources, more and more resource-based cities are facing serious environmental degradation problems [25–27]. Since 1920s, some scholars have begun to focus on resource-based cities lifecycle which includes formation, development, transformation, and maturity [28,29]. Recently, many pieces of literature pay attention to the transformation of resource-based cities [30]. These studies mainly involve industrial transformation methods, policies, and mechanisms of resource-based cities [28,29,31]. In addition, some research concern about the sustainable development of resource-based cities [26,28,31]. However, in these studies, there is a lack of literature on the recycling of the industrial solid waste in resource-based cities.

Over the past several decades, China has experienced the most rapid development of urbanization in human history [25]. According to data from the National Bureau of Statistics of China, after Reform and Opening in 1978, China's urbanization rate increased from 17.92% in 1978 to 63.89% in 2020, while the population increased from 0.96 billion to 1.41 billion. During this period, more than 200 resource-based cities have played a vital role in promoting China's economic growth [27,31]. Simultaneously, some resource-based cities have gone from prosperity to decline [32]. Different from other countries, China's resource-based cities face more complex challenges [24,33] such as the large numbers and various types of cities [34]. Furthermore, due to resource-dependent industries occupy a larger share of their industrial structure [35], most resource-based cities in China cannot completely change their development models in the short term to achieve sustainable development.

To improve the long-term mechanism of sustainable development and promote the sustainable development of resource-based cities, in 2013, the State Council issued a circular of National Sustainable Development Plan for Resource-based Cities (2013–2020) (NSDPRC). The circular identified 126 prefecture-level cities as resource-based cities among 334 prefecture-level cities and divided these resource-based cities into four growth types: regenerative, grow-up, growing, and recessionary. Drawing on Chen et al.'s research [24], we show the distribution and types of all resource-based cities in Figure 1. It can be seen from Figure 1 that resource-based cities are mainly distributed in the central and western regions of China. Moreover, the main types of resource-based cities in the central region are grow-up, while the types of resource-based cities in the western region are more diverse, including all four types. Moreover, the resource-based cities in the northeastern region are mainly recessionary.

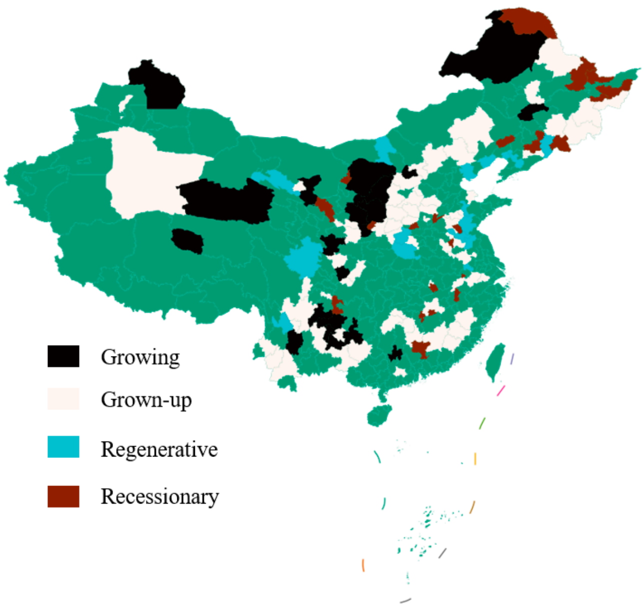

Figure 1. Distribution of resource-based cities in China.

2.3. The Official Promotion Tournament Hypothesis

As one of the measures of environmental governance, the compulsory environmental regulations implemented by the government have gradually become the main means for local governments to complete the assessment of ecological goals in recent years. This is closely related to the transformation of the assessment indicators for the promotion of officials since China's reform and opening up. Since the Qin Dynasty, the Chinese central government has had absolute control over the promotion and removal of local officials [36], due to incomplete and asymmetry of information, the central government often uses key work content as a measurement indicator when considering the promotion of local officials and creates a promotion targeted yardstick competition among subnational governments, which is widely known as the official promotion tournament [37].

Since the reform and opening up, the focus of the Chinese government has shifted to economic construction. Therefore, the gross domestic product (GDP) has become the most important indicator for evaluating the performance of local officials [36,38] and played an important role in the talent evaluation system [39,40]. Such a promotion tournament has made an enormous contribution to Chinese economic growth, making China grown rapidly in the past several decades and became the second-largest economy worldwide [37,41]. Chinese environmental problem is not only the result of economic growth in industrialized developing countries, but also the political issues [42]. Since the reform of the financial system in 1994, Chinese local government tax revenue has decreased. The single official promotion tournament gradually revealed its drawbacks. When officials face competition for resources and face multiple mandatory goals in the short term, they will tend to prioritize the goals that are conducive to obtaining promotion opportunities [43–45]. Therefore, in order to increase the opportunity for promotion, local government officials have to use limited resources to attract capital and other factors to ensure economic development, resulting in a reduction in environmental governance expenditures and environmental pollution has become the price of economic development [37]. This not only poses a serious threat to Chinese long-term development, but also has a profound impact on the global environment. In order to cope with the increasingly serious environmental problems, the central government has begun to consider including environmental performance in the evaluation indicators for official promotion. The proportion of green indicators is increasing [46].

In December 2005, the State Council issued the "Decision on Implementing the Scientific Outlook on Development and Further Strengthening of Environmental Protection", which clearly stated that environmental protection should be included in the assessment of local officials and the assessment situation shall be used as the foundation for officials' promotion. The status of environmental protection in the evaluation indicators for the promotion of officials became more important when the Chinese central authority began to include emission reduction performance as an important part of the promotion assessment system for local officials in 2007 [37]. In 2011, the State Council issued the "Measures for the Assessment of the Total Emissions of Major Pollutants", which implemented the accountability system and the "one-vote veto" system for areas that did not meet the environmental protection assessment standards, and further strengthened the assessment of the performance of local governments in the emission reduction of pollutants. It reshapes the contribution of economic benefits to the officials' promotion [47–49] and makes officials balance the relationship between economic development and environmental protection [50]. This direct incentive way can improve the environment [51].

However, in 2009, when the CEPL was promulgated and took effect, environmental protection had already had a certain status in the promotion and assessment of officials, and local governments would actively promote the implementation of the CEPL. As for resource-based cities, since the main industries are developed based on the mining and processing of minerals, related ISW are generated more than non-resource-based cities and environmental problems are more prominent than other cities, so when the CEPL was promulgated, officials in resource-based cities were more willing to strengthen law enforcement, resulting in the CEPL's promotion of the comprehensive utilization rate of ISW in resource-based cities significantly higher than other cities. In addition, when the original environmental regulation intensity of a resource-based city is relatively high, the implementation of the CEPL will be favorable. The higher the intensity of environmental regulation, the more obvious the promotion of the CEPL on the comprehensive utilization rate of ISW in the city.

3. Data and Methodology

3.1. Data Source

This study involves the two core variables of the comprehensive utilization rate of urban ISW and whether the city is a resource-based city. The data on the comprehensive utilization rate of ISW can be obtained from the China City Statistical Yearbook, and the data of resource-based cities are from the official website of the Chinese central government. The related data of other variables, mainly come from the CNRDS database and CSMAR database. Among all variables, the actual annual GDP of the city was based on the base period of 2003, adjusted according to the GDP index published by the province where the city is located. The per capita GDP of the city was adjusted by dividing the adjusted real GDP by the year-end population of the city in that year. In addition, the missing values were eliminated from the data sample. We, finally, obtained a sample of 278 cities consisting of 3588 observations from 2003–2015. The data processing software was Stata 16.0.

3.2. Variable Definition

3.2.1. Explained Variable

The explained variable for this study was comprehensive utilization rate of ISW. ISW is a category of solid waste, which refers to solid waste generated in industrial production activities, including various waste residues, dust, and other wastes discharged into the environment during industrial production. It can be divided into general industrial waste (such as blast furnace slag, steel slag, red mud, non-ferrous metal slag, fly ash, coal slag, sulfate slag, waste gypsum, desulfurization ash, calcium carbide slag, and salt mud) and industrial hazardous solid waste. In this study, denote comprehensive utilization rate of ISW by $Rate_{it}$, and its calculation formula is as follows:

$$Rate_{it} = \frac{CUISWA_{it}}{ISWG_{it} + CUS_{it}} \times 100\% \quad (1)$$

where $CUISWA_{it}$ stands for the comprehensive utilization of ISW amount of city i in year t, $ISWG_{it}$ is the amount of ISW generation of the city i in year t, and CUS_{it} represents the comprehensive utilization of previous years' storage of city i in year t.

3.2.2. Explanatory Variable

To analyze the effect of CEPL on the comprehensive utilization rate of ISW, in resource-based cities, the explanatory variable should capture both CEPL and resource-based cities. Since CEPL officially came into effect in 2009, we used the dummy variable T to represent CEPL, if time t was in 2009 and later, CEPL was in effect and T = 1, otherwise T = 0. Similarly, we used the dummy variable C to represent city type, if the city was resource-based, C = 1, otherwise C = 0. Multiplying the dummy variable T with the dummy variable C, we obtained our explanatory variable DID, which can be expressed by the following equation.

$$DID_{it} = \mathrm{C} \times \mathrm{T} \quad (2)$$

If DID_{it}=1, it means that time t is in 2009 and later, and city i is a resource-based city.

3.2.3. Moderating Variable

As analyzed in the second section of this paper, considering the intensity of environmental regulations may have a moderating effect on this process between CEPL and the comprehensive utilization rate of ISW in resource-based cities. We used the city's environmental regulation score as a moderating variable for our analysis. City's environmental regulation score was calculated according to the calculation method of [52,53], specifically, the entropy weighting method was used to assign the SO2 removal rate, smoke removal rate, domestic wastewater treatment rate, and domestic waste disposal rate to the city, and then a comprehensive evaluation was performed to obtain the city environmental regulation score.

3.2.4. Control Variables

Studies have shown that the utilization of industrial solid waste can be influenced by a variety of factors [2,4,7], and based on these studies, we chose the natural logarithm of real GDP (lngdp), per capita GDP (p_GDP), and natural logarithm of the total population at the end of the year (lnpeo) et al. as control variables. The symbol and explanation of all the control variables involved in this study are reported in Table A1.

3.3. Model Specification

The implementation of a particular public policy affects some groups in society, while other groups are not affected or are less affected. For social groups, this exogenous policy was similar to a natural experiment or quasi-natural experiment, and the social groups that were more affected by the policy can be considered as the treatment group and those that are less affected or unaffected by the policy can be considered as the control group. By comparing the gap between the treatment and control groups, the effectiveness of public policy implementation can be evaluated. The DID method was often used, in recent years, to evaluate the effectiveness of public policy implementation. For more discussion and application of the DID method see the work of Agrist and Pischke [54]. In order to test the impact of the CEPL on the comprehensive utilization rate of ISW in resource-based cities, this paper establishes the following DID model:

$$Rate_{it} = \beta_0 + \beta_1 DID_{it} + X_{it}\gamma + d_i + \mu_t + \varepsilon_{it} \quad (3)$$

where $Rate_{it}$ stands for the comprehensive utilization rate of the city i in year t. The independent variable DID_{it} denotes the dummy variable of CEPL, which equals 1 if the city i belongs to resource-based cities and year t $\geq$ 2009, otherwise, it equals 0, the coefficient β_1 represents the impact of the CEPL on ISW in resource-based cities, X_{it} is determined by a matrix composed of a series of control variables, γ is the coefficient vector of the control variables' matrix, d_i represents the fixed effect of the city, μ_t is the fixed effect of the year, and ε_{it} represents the random error term. In Model (3), we focus on the estimated coefficient β_1 of the variable DID_{it}, which indicates a positive effect of CEPL on the comprehensive utilization rate of ISW in resource-based cities if β_1 is significantly positive, and a negative effect if β_1 is significantly negative. If β_1 is not significantly different from zero, it indicates that CEPL has no effect on the comprehensive utilization rate of ISW in resource-based cities.

The coefficient β_1 in model (3) effectively captures the effect of CEPL on the comprehensive utilization rate of ISW in resource-based cities on the premise that there is a common trend between the treatment and control groups before the policy is implemented. In other words, there is no significant difference in the combined utilization of ISW between resource-based and general cities before the implementation of CEPL, but there is a significant difference after the implementation of the policy. Therefore, this study draws on the study of Beck et al. (2010) [55], and uses event analysis to construct the following model for common trend testing.

$$Rate_{it} = \alpha_0 + \alpha_1 D_{it}^{-5} + \alpha_2 D_{it}^{-4} + \ldots \alpha_{10} D_{it}^{4} + \alpha_{11} D_{it}^{5} + X\gamma + d_i + \mu_t + \varepsilon_{it} \quad (4)$$

where the dummy variables, the "$D^{'s}$" equal zero, except as follows: D^{-j} equals one for resource-based cities in the jth year before 2009, while D^{+j} equals one for resource-based cities in the jth year after 2009. If the estimated coefficients of variables D^{-j} are not significantly different from zero, it indicates there was a common trend between resource-based cities and general cities in the comprehensive utilization rate of ISW before the implementation of CEPL.

In order to test whether the moderating effect of the intensity of environmental regulations exists, reference to existing study [56], we established the following model:

$$Rate_{it} = \theta_0 + \theta_1 ER_{it} * DID_{it} + \theta_2 ER_{it} + \theta_3 DID_{it} + X\gamma + d_i + \mu_t + \varepsilon_{it} \quad (5)$$

where ER_{it} stands for the environmental regulation score of cities i in year t, the variable value of ER_{it} is calculated according to the calculation method of Wang et al. [52]. Considering that there may be a lag effect in the role of environmental regulation, we lag the interaction term by one period before estimating. The coefficient θ_1 is the parameter we are mainly concerned about, if θ_1 is significantly different from zero, it indicates that there is a moderating effect of environmental regulation.

4. Results

4.1. Results of Unit Root Test and Descriptive Statistics

The situations of different provinces in China vary a lot, thus the unit root tests are suitable for that they hold the assumption of individual unit root processes in each panel-data series. All the results of the unit root test are listed in Table 1. Based on the results of Table 1, although variable r_asset failed the IPS test, in this test, the *p*-value of r_asset is about 0.11, which is very close to the 10% significance level. At the same time, in the Fisher ADF test, the statistical value of variable r_asset is significant at the 1% level, therefore, we claim that all variables of this study are stationary.

Table 1. Panel unit root test results.

Variables	IPS Test	Fisher ADF Test
Rate	−14.3665 ***	−27.6549 ***
lngdp	−10.3165 ***	−22.2888 ***
p_GDP	−14.0768 ***	−4.2144 ***
lnpeo	−26.7753 ***	−32.4167 ***
r_fan	−5.1645 ***	−27.5820 ***
sec ond_ins	−3.9313 ***	−20.6020 ***
r_asset	−1.1969	−17.2897 ***
lnn_com	−7.1369 ***	−22.5108 ***
r_cons	−2.0661 **	−14.8447 ***

Note: Z statistics in table; *** and ** indicate significance at the levels of 1%, and 5%, respectively.

In addition, Table 2 shows the descriptive statistics for main variables, the results show that the mean of the comprehensive utilization rate of ISW (Rate) is 77%, indicating that China's ISW management is at a relatively high level. However, the median value of the variable Rate is 88%, while the maximum value is 100% and the minimum value is 0. This indicates the comprehensive utilization rate of ISW in different cities and different years varies greatly. Likewise, the secondary industry's share of GDP shows a situation similar to that of the comprehensive solid waste utilization rate. Although the country's secondary industry's share of GDP is at a relatively high level as a whole, there are still large differences between regions.

Table 2. Descriptive statistics for main variables.

Variable	Obs	Mean	SD	Min	Median	Max
Rate	3614	0.77	0.25	0	0.88	1
lngdp	3612	6	0.91	3.5	5.9	8.8
p_GDP	3593	14,785	13,038	0.47	10,853	148,298
lnpeo	3593	5.9	0.86	2.8	5.9	16
r_fan	3612	0.5	0.23	0	0.47	1.5
second_ins	3612	0.49	0.11	0.09	0.5	0.91
r_cons	3612	0.09	0.17	0	0.071	9.4
r_asset	3612	0.63	0.69	0	0.58	39
lnn_com	3607	6.4	1.1	2.9	6.4	9.8

4.2. Impact of CEPL on Resource-Based Cities' Comprehensive Utilization Rate of ISW

The estimation results of Model (3) that CEPL on the resource-based cities' comprehensive utilization rate of ISW are shown in Table 3. Column (1) shows that the value of the estimated coefficient β_1 is 0.089 and significant at a 1% significance level, which indicates that there is a significant positive promotion effect of CEPL on comprehensive utilization rate of ISW in resource-based cities. However, the result of column (1) is not robust and there may be measurement errors caused by missing variables. Therefore, adding year fixed effects, city fixed effects and control variables in order in column (2)–(4) of Table 3, the results show that CEPL still has a significant and robust promotion effect on the comprehensive utilization rate of ISW in resource-based cities.

Table 3. The impact of CEPL on the resource-based cities' comprehensive utilization rate of ISW.

Variable	(1)	(2)	(3)	(4)
DID	0.089 ***	0.101 ***	0.064 ***	0.064 ***
	(0.014)	(0.015)	(0.019)	(0.019)
_cons	0.755 ***	0.752 ***	0.681 ***	0.477
	(0.012)	(0.003)	(0.009)	(0.601)
City FE	No	Yes	Yes	Yes
Year FE	No	No	Yes	Yes
control variables	No	No	No	Yes
Observations	3614	3614	3614	3588
Within-R-Squared	0.0441	0.0441	0.0922	0.103

Note: Robust standard errors in parentheses; *** indicates significance at the levels of 1%.

The results of Table 3 show that the CEPL has significantly improved the comprehensive utilization of ISW in resource-based cities. In theory, the law will promote the comprehensive utilization of ISW in all cities. However, the industries of resource-based cities mainly rely on the utilization of local mineral resources. Once a national law of promoting circular economy is enacted, resource-based cities have obvious advantages to ensure law enforcement.

4.3. Robustness Test

4.3.1. Common Trend Test

The result of the common trend test using Model (4) is shown in Figure 2, in this figure, all of the coefficients before 2009 (current) are not significantly different from zero, indicating that before the implementation of CEPL, there is no significant difference in changes in the comprehensive utilization rate of ISW in all cities. After 2009 (current), all of the coefficients are significantly different from zero and positive. This shows that the changes in the comprehensive utilization rate of ISW between the treatment group and the control group are different due to the implementation of CEPL. In other words, the common trend test passes, and it is feasible to use the DID method to estimate.

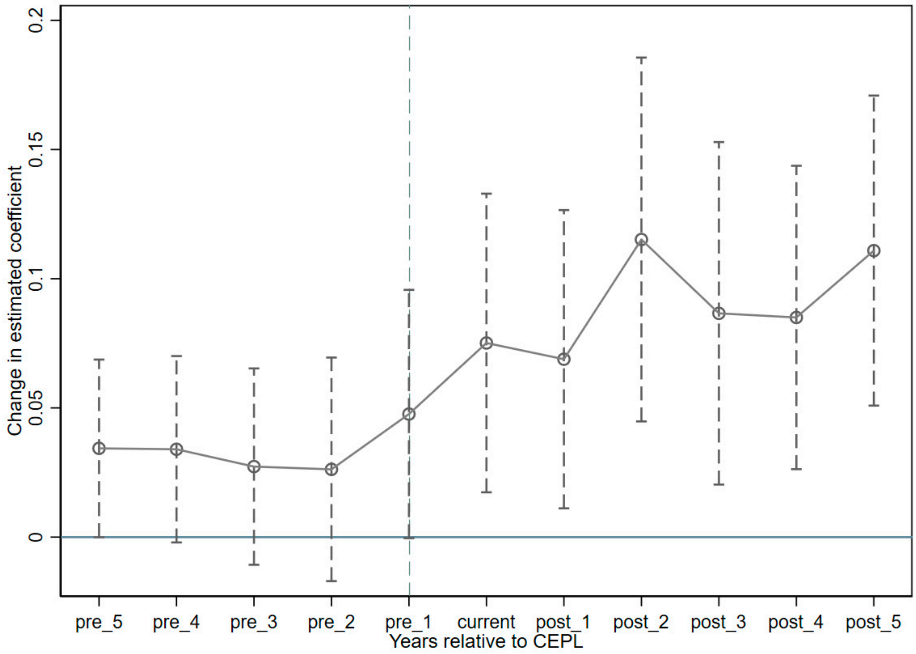

Figure 2. Common trend test.

4.3.2. Placebo Test

The term "placebo" comes from a randomized experiment in medicine. For example, to test the efficacy of a certain new drug, at this time, the people participating in the experiment can be randomly divided into two groups, one of which is the treatment group, taking the real drug; and the other group is the control group, taking a placebo and not allowing participants know whether they are taking the real medicine or a placebo, so as to avoid subjective psychological effects from affecting the experimental effect, which is called the "placebo effect".

During the period from 2003 to 2015, as China has also implemented or revised other laws and regulations on environmental protection such as the Environmental Information Disclosure Method (2007) and the Law of the People's Republic of China on Environmental Prevention and Control of Solid Waste Pollution (2013), these policies are likely to have an impact on the utilization of ISW in cities, the above identification methods cannot eliminate the impact of other policies on ISW in each city. Placebo testing is needed to eliminate the impact of other policies and regulations on ISW in each city. In this study, we refer to Chen et al. (2021) [57] and retain a sample of non-resource-based cities, then randomly selecting 50 cities as the "pseudo−treatment group". Furthermore, we randomly selected 1 year as a virtual policy implementation point from 2003 to 2015. In order to ensure the robustness of the results, we repeated it 10,000 times, the results of the placebo test are reported in Figure 3. It can be seen from the figure that the coefficients estimated for these 10,000 times approximately obey a normal distribution with a mean value of zero, and the corresponding p values are all lower than 5%. The result of the placebo test indicates that the increase in the comprehensive utilization rate of ISW in resource-based cities is due to the implementation of CEPL.

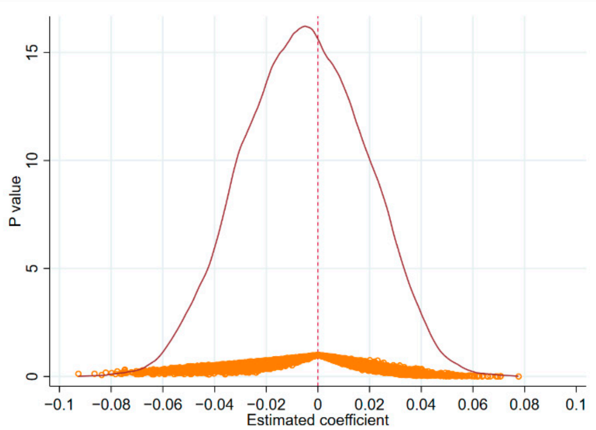

Figure 3. Placebo test.

4.3.3. PSM−DID

In order to resolve the systematic differences in trend changes between the treatment group and the control group and reduce the estimation error of the DID method, we used the propensity score matching (PSM) method proposed by Heckman (1998) [58] for the robustness test. Before estimation, the PSM−DID applicability test needs to be performed, that is, whether there is a significant difference between the treatment group and the control group after matching. The test results are shown in Figures 4 and 5. It can be seen from Figure 4 that the standardization deviation of most variables is reduced after matching, and most observations in the control group and the treatment group achieved a uniform distribution and the goal of "balanced data". This proves that the PSM−DID method can effectively reduce the deviation of the DID assessment caused by the trend difference. In the specific matching method, this paper uses one-to-one nearest neighbor matching with a caliper range of 0.05. PSM−DID matching results are shown in column (1) of Table 4. The results are consistent with the DID regression results of Table 3, which further supports the theoretical hypothesis of this study.

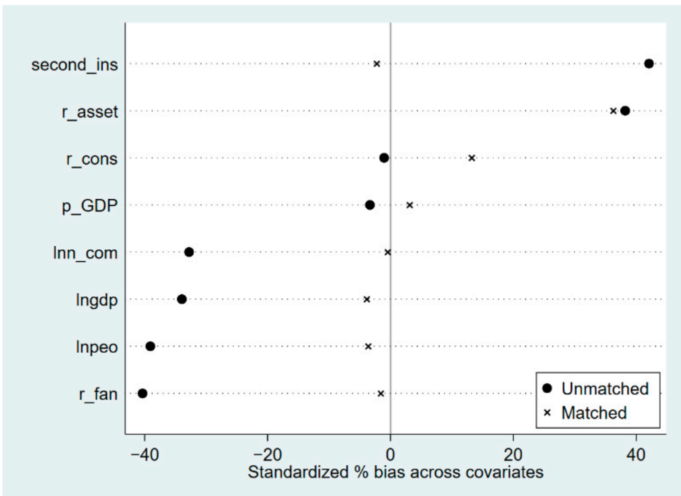

Figure 4. Variables' standardized deviation.

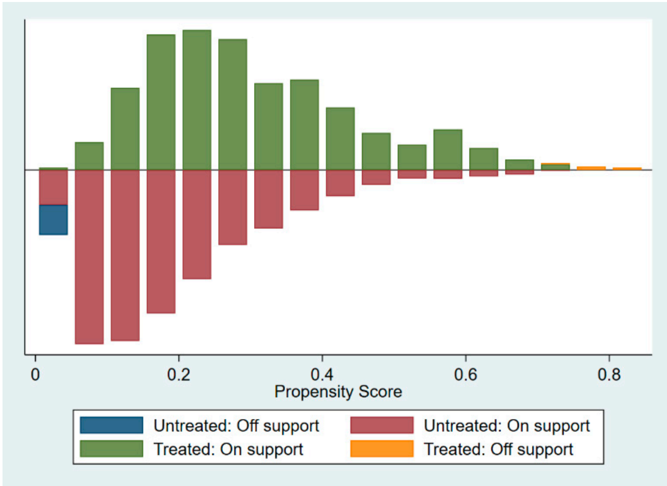

Figure 5. Common support for propensity scores.

Table 4. Robustness test.

Variable	(1) PSM+DID	(2) IV	(3) Change Sample	(4) Add Variables	(5) Tobit
DID	0.0602 **	0.2853 *	0.0676 ***	0.0653 ***	0.0506 ***
	(0.0301)	(0.1655)	(0.02)	(0.0198)	(0.0184)
_cons	−0.4014		0.4692	0.41	0.1591
	(1.1762)		(0.597)	(0.6173)	(0.1041)
Kleibergen–Paap rk LM statistic		9.878 ***			
Kleibergen–Paap rk Wald F statistic		10.376			
City FE	Yes	Yes	Yes	Yes	No
Year FE	Yes	Yes	Yes	Yes	Yes
control variables	Yes	Yes	Yes	Yes	Yes
Observations	1168	3588	3575	3588	3588
Within-R-Squared	0.0988		0.0981	0.1033	

Note: Standard error in parentheses of column (5) is obtained by bootstrap sampling 300 times. ***, **, and * indicate significance at the levels of 1%, 5%, and 10%, respectively.

4.3.4. Instrumental Variable Method

Although the results estimated by the DID method exclude some of the endogenous problems caused by the omitted variables, the method cannot eliminate the endogenous problem caused by the mutual cause and effect between the CEPL and the comprehensive utilization rate of ISW. In other words, there may be a phenomenon that local governments strengthen the implementation of the CEPL in order to improve the comprehensive utilization rate of local ISW. Therefore, it is necessary to find a suitable instrumental variable for the implementation of CEPL. According to the previous analysis, this study selected the number of county-level administrative districts under each city as an instrumental variable. The reason is as follows: For the comprehensive utilization rate of ISW in each city, the number of county-level administrative districts under the jurisdiction of prefecture-level cities is basically a fixed value, which will not affect the changes in local ISW, satisfying the exogenous assumption of an effective instrumental variable. Regarding whether to strengthen the implementation of the CEPL, the greater the number of county-level administrative districts under the jurisdiction of a prefecture-level city, the more intense the competition for promotion of officials. Therefore, the greater the number of prefecture-level cities in the city, the more likely it is for local officials to strengthen the implementation of the CEPL to increase the comprehensive utilization rate of local ISW. The selected instrument variable satisfies the correlation assumption of effective instrumental variables.

The regression result of IV estimation is shown in column (2) of Table 4. The Kleibergen–Paap rk LM statistic of IV is 9.878 and is significant at a significance level of 1%, indicating that there is no problem of insufficient identification of instrumental variable. In addition, the Kleibergen–Paap rk Wald F statistic of IV is 10.367, which is greater than the 15% critical value of 8.96, indicating that there is no problem of weak instrumental variables. Furthermore, the regression result of IV estimation is consistent with DID regression results of Table 3, indicating that the CEPL is the reason for the increase in the comprehensive utilization rate of ISW in resource-based cities.

4.3.5. Other Robustness Tests

As the industry of forest industry cities is mainly based on the exploitation of forest resources, we remove it from the sample of resource-based cities to change the composition of the sample, then use the DID method to estimate again. The estimated result is reported in column (3) of Table 4. The estimated coefficient of the core explanatory variable is 0.0676 and is significant at a significance level of 1%, indicating that the implementation of the CEPL has significantly improved the comprehensive utilization rate of ISW in resource-based cities. The estimated result of changing sample is consistent with the result estimated by the benchmark regression in Table 3.

In addition, considering that technological innovation is an important variable that affects the utilization of ISW, we add the logarithm of the number of green patent applications in each city to the control variables and then use the DID method to estimate again. The estimated result is reported in column (4) of Table 4. The estimated coefficient of the core explanatory variable is 0.0653 and is significant at a significance level of 1%, indicating that the implementation of the CEPL has significantly improved the comprehensive utilization rate of ISW in resource-based cities. The estimated result of the changing sample is consistent with the result estimated by the benchmark regression in Table 3.

Furthermore, since the explained variable, the comprehensive utilization rate of ISW, is a continuous variable between 0 and 1, the results estimated by OLS may not be a consistent estimate. Therefore, we use the Tobit model to re-estimate the Model (1). The estimated result is reported in column (5) of Table 4. The estimated coefficient of the core explanatory variable is 0.0506, and is significant at a significance level of 1%, indicating that the implementation of the CEPL has significantly improved the comprehensive utilization rate of ISW in resource-based cities.

4.4. Mechanism Analysis

The previous analysis results show that the implementation of the CEPL can significantly improve the comprehensive utilization rate of ISW in resource-based cities and this effect is robust. What is the mechanism or process of this effect is also a question worth exploring. As analyzed in the second section of the article, the intensity of environmental regulations may have a moderating effect on this process between CEPL and the comprehensive utilization rate of ISW in resource-based cities. We use Model (5) to test whether the moderating effect of the intensity of environmental regulations exists and the estimation results are reported in Table 5.

Table 5. Moderating effect of environmental regulation score.

Variable	(1)	(2)	(3)	(4)
ER*DID	0.034 (0.024)	0.036 (0.024)	0.059 * (0.031)	0.066 ** (0.031)
ER	0.440 *** (0.043)	0.409 *** (0.045)	0.477 *** (0.055)	0.472 *** (0.057)
DID	0.0030 (0.015)	0.015 (0.015)	0.020 (0.021)	0.018 (0.022)
_cons	0.4921 *** (0.033)	0.508 *** (0.029)	0.442 *** (0.032)	−0.094 (0.584)
City FE	No	Yes	Yes	Yes
Year FE	No	No	Yes	Yes
control variables	No	No	No	Yes
Observations	3312	3312	3312	3286
Within-R-Squared	0.1104	0.1111	0.1360	0.1405

Note: ***, **, and * indicate significance at the levels of 1%, 5%, and 10%, respectively.

Columns (1) of Table 5 shows that the coefficient of the interaction term is 0.034, indicating there is a positive moderating effect of the environmental regulation score on the process of CEPL to the comprehensive utilization rate of ISW in resource-based cities, but this result is not significant and there may be measurement errors caused by missing variables. Therefore, in the columns (2)–(4) of Table 5, year fixed effects, city fixed effects, and control variables are added in sequence, the results show that the coefficient of interaction term changed from 0.034 to 0.066, and is significant in the level of 5% significance level. The results of Table 5 indicate that the stronger the intensity of environmental regulations in resource-based cities, the more obvious the promotion of the CEPL on the comprehensive utilization rate of ISW.

4.5. Heterogeneity Analysis

In order to test whether the CEPL has a differential impact on the comprehensive utilization rate of ISW in resource-based cities, this study analyzes the heterogeneity of the resource-based cities' type and the region where the city is located.

4.5.1. Difference in Cities' Growth Type

Considering that different growth types of resource-based cities may lead to heterogeneity in the impact of CEPL on ISW, according to NSDPRC's classification of growth types of resource-based cities, we have analyzed the situation of four different types include growing, grow-up, recessionary, and regenerative of resource-based cities. The estimation results are reported in Table 6. Column (1) is the estimated result of growing resource-based cities, the estimated coefficient is 0.094 and is not significant. Column (2) is the estimated result of grow-up resource-based cities, the estimated coefficient is 0.059 and is significant at 5% significance level. Column (3) is the estimated result of recessionary resource-based cities, the estimated coefficient is 0.095 and is significant at 1% significance level. Column (4) is the estimated result of regenerative resource-based cities, the estimated coefficient is 0.019 and is not significant. The results of heterogeneity analysis of cities' type indicate that CEPL significantly improves the comprehensive utilization rate of ISW in grow-up and recessionary resource-based cities. Although it was also promoted in the other two types of cities, it failed the significance test.

Table 6. Heterogeneity analysis of cities' growth type.

Variable	(1)	(2)	(3)	(4)
	Growing	Grow-Up	Recessionary	Regenerative
DID	0.094	0.059 **	0.095 ***	0.019
	(0.064)	(0.024)	(0.033)	(0.026)
_cons	0.138	0.902	0.033	0.318
	(0.689)	(0.667)	(0.614)	(0.665)
City FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
control variables	Yes	Yes	Yes	Yes
Observations	2285	2942	2426	2322
Within-R-Squared	0.0699	0.0913	0.0898	0.07

Note: *** and ** indicate significance at the levels of 1% and 5%, respectively.

This phenomenon is mainly caused by resource constraints. Growing resource-based cities are in the early stage of resource development, with abundant resources and have not reached the bottleneck of resource utilization, so they will not actively consider the issue of resource recycling. Regenerative resource-based cities have basically got rid of resource dependence, and the recycling of resources is no longer a major issue for them. Compared with the first two types of resource-based cities, grow-up and recessionary resource-based cities have reached the bottleneck of resource development and improving the recycling rate of resources is the most urgent problem they face. In this circumstances, local government officials are more willing to promote the implementation of the CEPL.

4.5.2. Difference in Region of Cities' Location

In order to test whether the impact of CELP on the comprehensive utilization rate of ISW in resource-based cities is regionally heterogeneous, we carried out a group regression on the eastern, northeastern, central, and western regions according to the Model (3). The estimated results of the regression are reported in Table 7. Column (1) is the estimated result of eastern resource-based cities, the estimated coefficient is 0.034 and is not significant. Column (2) is the estimated result of central resource-based cities, the estimated coefficient is 0.081 and is significant at 5% significance level. Column (3) is the estimated result of western resource-based cities, the estimated coefficient is 0.056 and is not significant. Column (4) is the estimated result of northeastern resource-based cities, the estimated coefficient is −0.029 and is not significant.

Table 7. Heterogeneity analysis of cities' region.

Variable	(1)	(2)	(3)	(4)
	Eastern Region	Central Region	Western Region	Northeastern Region
DID	0.034	0.081 **	0.056	−0.029
	(0.029)	(0.038)	(0.039)	(0.046)
_cons	0.901	1.961	3.203	1.681
	(1.419)	(1.534)	(2.116)	(6.197)
City FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
control variables	Yes	Yes	Yes	Yes
Observations	1118	1009	1019	442
Within-R-Squared	0.0722	0.1658	0.179	0.1477

Note: ** indicate significance at the levels of 5%, respectively.

The results indicate that due to the change of the city's geographic location, the effect of the CEPL on the comprehensive utilization rate of ISW in resource-based cities has changed. The main reason for this phenomenon is that there are differences in the main types of resource-based cities in different regions. It can be seen from Figure 1 that the type of resource-based cities in the central region is mainly grow-up, while the other three regions are diverse in types of cities, covering almost four types of resource-based cities. In the previous heterogeneity analysis, we have proved that in grow-up and recessionary resource-based cities, the CEPL has significantly promoted the comprehensive utilization of ISW. Therefore, in the central region, the CEPL also has a significant role in promoting ISW in resource-based cities. In addition, due to the complex types of resource-based cities in the other three regions, the role of the CEPL is not obvious.

5. Conclusions

Improving the comprehensive utilization rate of ISW not only reduces environmental pollution, but also promotes the recycling of resources and ease the pressure on resources. This paper argues that the improvement of the comprehensive utilization rate of urban ISW can be achieved through the implementation of environmental policies and regulations. Using panel data of 278 prefecture-level cities in China from 2003 to 2015, this paper confirms the above view by building a DID model to analyze the impact that the implementation of CEPL would have on the comprehensive ISW utilization rate of resource-based cities. In addition, this paper also conducts a deeper analysis and obtains three main conclusions as follows.

(1) The implementation of the CEPL improved the comprehensive utilization rate of ISW in resource-based cities. The empirical results of the DID model show that when other conditions remain unchanged, after the implementation of the CEPL, the comprehensive utilization rate of ISW in resource-based cities has been significantly increased. After selecting instrumental variable, changing the estimation model, using PSM+DID and other methods to re-estimate, the results are still robust. This finding confirms that environmental regulations and policies have a positive impact on the utilization of ISW and also expands the field of research on the factors influencing ISW.

(2) After analyzing the mechanism, it was found that the higher the city's environmental regulation score, the more obvious the effect of the CEPL on the comprehensive utilization rate of ISW. This is mainly because the higher the environmental regulation score of a city, the stronger the environmental law enforcement of the city, the more likely it is to ensure the smooth implementation of the CEPL in the local area. Combined with the results of the instrumental variable method in the robustness test, this finding confirms the applicability of the "political tournament" theory to environmental management issues, that is, the inclusion of environmental performance in the promotion assessment system of officials is effective in improving environmental quality.

(3) The promotion effect of CEPL on comprehensive utilization rate in resource-based cities is heterogeneous. From the perspective of resource-based cities, the CEPL has a significant effect on the comprehensive utilization rate of ISW in grow-up and recessionary resource-based cities, but it has no significant promotion effect on growing and regenerative resource-based cities; from the perspective of different region, the CEPL has a significant effect on the comprehensive utilization rate of ISW in resource-based cities in the central region, but this effect is not obvious in the eastern, western, and northeastern regions of China. This finding provides an important reference for developing the policies to manage ISW in different cities' type.

6. Discussion

Based on the empirical finding that the implementation of CEPL improves the combined utilization of cities' ISW, to improve the level of solid waste management in cities, environmental policies and regulations are indispensable tools. The market-led solid waste management sometimes fails due to the defects of the market itself and the government needs to formulate relevant policies and regulations as a supplement to improve the level of municipal solid waste management. Meanwhile, environmental law enforcement is the cornerstone of ensuring the effectiveness of policies and regulations. The stronger the environmental law enforcement, the more obvious the role of policies and regulations in improving the level of solid waste management. Therefore, the government should strengthen environmental law enforcement to ensure the implementation of relevant policies and regulations. In addition, to ease the pressure on resources, speeding up the industrial transformation of resource-based cities is the fundamental way. Local governments should take into account local conditions and formulate sustainable development plans that are in line with local conditions.

The contribution of this research to the literature on ISW management is to enrich the theoretical foundation of the research on the factors affecting the management of municipal solid waste. It has a strong reference value for the practice of municipal solid waste management. Moreover, this study provides new ideas for changing the urban solid waste management model and realizing the "win−win" between the economy and the ecological environment. That is, in addition to the market and technical means, strong policies, and regulations are also effective tools to improve the level of municipal solid waste management.

Nevertheless, limitations exist. First, Although the robustness test was carried out by changing the sample, selecting the instrumental variables, and changing the estimation method, etc., however, there may be some important variables that have not been considered and have not been controlled. Further, although this study analyzes the impact of CEPL on the comprehensive utilization rate of ISW in resource-based cities and its impact mechanism, the analysis is not comprehensive due to there may be other mechanisms that have not been considered. Future studies should extend the framework to a more comprehensive context.

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Appendix A

Table A1. Symbols and explanation of each control variable.

Variables	Explanation
lngdp	natural logarithm of real GDP
p_GDP	per capita GDP
lnpeo	natural logarithm of the total population at the end of the year
r_fan	fiscal revenue divided by fiscal expenditure
sec ond_ins	percentage of secondary industry in GDP
r_asset	fixed asset investment as a percentage of GDP
lnn_com	natural logarithm of the number of industrial enterprises
r_cons	the output value of the construction industry as a percentage of GDP

References

1. Lu, C.; Ji, W.; Hou, M.; Ma, T.; Mao, J. Evaluation of efficiency and resilience of agricultural water resources system in the Yellow River Basin, China. *Agric. Water Manag.* **2022**, *266*, 107605. [CrossRef]
2. Guan, Y.; Huang, G.; Liu, L.; Huang, C.Z.; Zhai, M. Ecological network analysis for an industrial solid waste metabolism system. *Environ. Pollut.* **2018**, *244*, 279–287. [CrossRef] [PubMed]
3. Liu, L.; Huang, G.; Baetz, B.; Huang, C.Z.; Zhang, K. A factorial ecologically-extended input-output model for analyzing urban GHG emissions metabolism system. *J. Clean. Prod.* **2018**, *200*, 922–933. [CrossRef]
4. Zhang, X.; Zhou, M.; Li, J.; Wei, L.; Dong, Y.; Hou, H.; Chen, C.; Wang, Z. Analysis of driving factors on China's industrial solid waste generation: Insights from critical supply chains. *Sci. Total Environ.* **2021**, *775*, 145185. [CrossRef]
5. Lu, C.; Pan, X.; Chen, X.; Mao, J.; Pang, J.; Xue, B. Modeling of Waste Flow in Industrial Symbiosis System at City-Region Level: A Case Study of Jinchang, China. *Sustainability* **2021**, *13*, 466. [CrossRef]
6. Guan, Y.; Huang, G.; Liu, L.; Zhai, M.; Zheng, B. Dynamic analysis of industrial solid waste metabolism at aggregated and disaggregated levels. *J. Clean. Prod.* **2019**, *221*, 817–827. [CrossRef]
7. Nouri, D.; Sabour, M.R.; GhanbarzadehLak, M. Industrial solid waste management through the application of multi-criteria decision-making analysis: A case study of Shamsabad industrial complexes. *J. Mater. Cycles Waste Manag.* **2016**, *20*, 43–58. [CrossRef]
8. Yao, X.; Wang, W.; Liu, M.; Yao, Y.; Wu, S. Synergistic use of industrial solid waste mixtures to prepare ready-to-use lightweight porous concrete. *J. Clean. Prod.* **2018**, *211*, 1034–1043. [CrossRef]
9. Dong, J.; Tang, Y.; Nzihou, A.; Chi, Y.; Weiss-Hortala, E.; Ni, M.; Zhou, Z. Comparison of waste-to-energy technologies of gasification and incineration using life cycle assessment: Case studies in Finland, France and China. *J. Clean. Prod.* **2018**, *203*, 287–300. [CrossRef]
10. Pérez, J.; de Andrés, J.M.; Lumbreras, J.; Rodríguez, E. Evaluating carbon footprint of municipal solid waste treatment: Methodological proposal and application to a case study. *J. Clean. Prod.* **2018**, *205*, 419–431. [CrossRef]
11. Cetrulo, T.B.; Marques, R.C.; Cetrulo, N.M.; Pinto, F.S.; Moreira, R.; Mendizábal-Cortés, A.D.; Malheiros, T.F. Effectiveness of solid waste policies in developing countries: A case study in Brazil. *J. Clean. Prod.* **2018**, *205*, 179–187. [CrossRef]
12. Periathamby, A.; Hamid, F.S.; Khidzir, K. Evolution of solid waste management in Malaysia: Impacts and implications of the solid waste bill, 2007. *J. Mater. Cycles Waste Manag.* **2009**, *11*, 96–103. [CrossRef]
13. Wu, J.; Zhang, W.; Xu, J.; Che, Y. A quantitative analysis of municipal solid waste disposal charges in China. *Environ. Monit. Assess.* **2015**, *187*, 60. [CrossRef] [PubMed]
14. Boulding, K.E. The economics of the coming spaceship earth. In *Environmental Quality in a Growing Economy: Essays from the Sixth RFF Forum*; Jarrett, H., Ed.; Routledge: Abingdon-on-Thames, UK, 1966; pp. 3–15.
15. Liu, J.; Wang, Y.; Zhu, S.; Ran, L. Construction and Application of Evaluation Index System of Circular Economy in Sichuan Province. In Proceedings of the 2019 Asia-Pacific Forum on Economic and Social Development (APFESD), Seoul, Korea, 19–21 September 2019; Volume 2, pp. 30–35.
16. McDowall, W.; Geng, Y.-J.; Huang, B.; Barteková, E.; Bleischwitz, R.; Türkeli, S.; Kemp, R.; Doménech, T. Circular Economy Policies in China and Europe. *J. Ind. Ecol.* **2017**, *21*, 651–661. [CrossRef]
17. Wang, N.; Lee, J.C.K.; Zhang, J.; Chen, H.; Li, H. Evaluation of Urban circular economy development: An empirical research of 40 cities in China. *J. Clean. Prod.* **2018**, *180*, 876–887. [CrossRef]
18. Fan, Y.; Fang, C. Circular economy development in China-current situation, evaluation and policy implications. *Environ. Impact Assess. Rev.* **2020**, *84*, 106441. [CrossRef]
19. Hu, Y.; He, X.; Poustie, M. Can Legislation Promote a Circular Economy? A Material Flow-Based Evaluation of the Circular Degree of the Chinese Economy. *Sustainability* **2018**, *10*, 990. [CrossRef]
20. Ranta, V.; Aarikka-Stenroos, L.; Ritala, P.; Mäkinen, S.J. Exploring institutional drivers and barriers of the circular economy: A cross-regional comparison of China, the US, and Europe. *Resour. Conserv. Recycl.* **2018**, *135*, 70–82. [CrossRef]
21. Su, B.; Heshmati, A.; Geng, Y.; Yu, X. A review of the circular economy in China: Moving from rhetoric to implementation. *J. Clean. Prod.* **2013**, *42*, 215–227. [CrossRef]
22. Castellani, V.; Sala, S.; Mirabella, N. Beyond the throwaway society: A life cycle-based assessment of the environmental benefit of reuse. *Integr. Environ. Assess. Manag.* **2014**, *11*, 373–382. [CrossRef]
23. He, G.; Wang, S.; Zhang, B. Watering Down Environmental Regulation in China. *Q. J. Econ.* **2022**, *135*, 2135–2185. [CrossRef]
24. Chen, W.; Chen, W.; Ning, S.; Liu, E.-N.; Zhou, X.; Wang, Y.; Zhao, M. Exploring the industrial land use efficiency of China's resource-based cities. *Cities* **2019**, *93*, 215–223. [CrossRef]
25. Yan, D.; Kong, Y.; Ren, X.; Shi, Y.; Chiang, S. The determinants of urban sustainability in Chinese resource-based cities: A panel quantile regression approach. *Sci. Total Environ.* **2019**, *686*, 1210–1219. [CrossRef] [PubMed]
26. Jing, Z.; Wang, J. Sustainable development evaluation of the society–economy–environment in a resource-based city of China: A complex network approach. *J. Clean. Prod.* **2020**, *263*, 121510. [CrossRef]
27. Wu, X.; Zhang, J.; Geng, X.; Wang, T.; Wang, K.; Liu, S. Increasing green infrastructure-based ecological resilience in urban systems: A perspective from locating ecological and disturbance sources in a resource-based city. *Sustain. Cities Soc.* **2020**, *61*, 102354. [CrossRef]

28. Li, Q.; Zeng, F.; Liu, S.; Yang, M.; Xu, F. The effects of China's sustainable development policy for resource-based cities on local industrial transformation. *Resour. Policy* **2020**, *71*, 101940. [CrossRef]
29. Chen, W.; Shen, Y.; Wang, Y. Evaluation of economic transformation and upgrading of resource-based cities in Shaanxi province based on an improved TOPSIS method. *Sustain. Cities Soc.* **2018**, *37*, 232–240. [CrossRef]
30. Liu, B.; Wang, J.; Jing, Z.; Tang, Q. Measurement of sustainable transformation capability of resource-based cities based on fuzzy membership function: A case study of Shanxi Province, China. *Resour. Policy* **2020**, *68*, 101739. [CrossRef]
31. He, S.Y.; Lee, J.; Zhou, T.; Wu, D. Shrinking cities and resource-based economy: The economic restructuring in China's mining cities. *Cities* **2017**, *60*, 75–83. [CrossRef]
32. Long, R.; Chen, H.; Li, H.; Wang, F. Selecting alternative industries for Chinese resource cities based on intra- and inter-regional comparative advantages. *Energy Policy* **2013**, *57*, 82–88. [CrossRef]
33. Ruan, F.; Yan, L.; Wang, D. The complexity for the resource-based cities in China on creating sustainable development. *Cities* **2019**, *97*, 102571. [CrossRef]
34. Zhang, H.; Xiong, L.; Li, L.; Zhang, S. Political incentives, transformation efficiency and resource-exhausted cities. *J. Clean. Prod.* **2018**, *196*, 1418–1428. [CrossRef]
35. Li, H.; Long, R.; Chen, H. Economic transition policies in Chinese resource-based cities: An overview of government efforts. *Energy Policy* **2013**, *55*, 251–260. [CrossRef]
36. Li, H.; Zhou, L.-A. Political turnover and economic performance: The incentive role of personnel control in China. *J. Public Econ.* **2004**, *89*, 1743–1762. [CrossRef]
37. Zhang, Z.; Jin, T.; Meng, X. From race-to-the-bottom to strategic imitation: How does political competition impact the environmental enforcement of local governments in China? *Environ. Sci. Pollut. Res.* **2020**, *27*, 25675–25688. [CrossRef]
38. Liu, L.; Li, L. Effects of fiscal decentralisation on the environment: New evidence from China. *Environ. Sci. Pollut. Res.* **2019**, *26*, 36878–36886. [CrossRef]
39. Edin, M. Why do Chinese local cadres promote growth? Institutional incentives and constraints of local cadres. *Forum Dev. Stud.* **1998**, *25*, 97–127. [CrossRef]
40. Blanchard, O.; Shleifer, A. Federalism with and without political centralization: China versus Russia. *IMF Staff Papers* **2001**, *48*, 171–179. [CrossRef]
41. Jiang, J. Making Bureaucracy Work: Patronage Networks, Performance Incentives, and Economic Development in China. *Am. J. Pol. Sci.* **2018**, *62*, 982–999. [CrossRef]
42. Wu, M.; Cao, X. Greening the career incentive structure for local officials in China: Does less pollution increase the chances of promotion for Chinese local leaders? *J. Environ. Econ. Manag.* **2021**, *107*, 102440. [CrossRef]
43. Ma, L. Performance Feedback, Government Goal-Setting and Aspiration Level Adaptation: Evidence from Chinese Provinces. *Public Adm.* **2015**, *94*, 452–471. [CrossRef]
44. Kostka, G.; Nahm, J. Central–Local Relations: Recentralization and Environmental Governance in China. *China Q.* **2017**, *231*, 567–582. [CrossRef]
45. Tang, P.; Zeng, H.; Fu, S. Local government responses to catalyse sustainable development: Learning from low-carbon pilot programme in China. *Sci. Total Environ.* **2019**, *689*, 1054–1065. [CrossRef]
46. Lü, X.; Landry, P.F. Show me the money: Interjurisdiction political competition and fiscal extraction in China. *Am. Polit. Sci. Rev.* **2014**, *108*, 706–722. [CrossRef]
47. Zheng, S.; Kahn, M.E.; Sun, W.; Luo, D. Incentives for China's urban mayors to mitigate pollution externalities: The role of the central government and public environmentalism. *Reg. Sci. Urban Econ.* **2014**, *47*, 61–71. [CrossRef]
48. Zheng, L.; Na, M. A pollution paradox? The political economy of environmental inspection and air pollution in China. *Energy Res. Soc. Sci.* **2020**, *70*, 101773. [CrossRef]
49. Zheng, W.; Chen, P. The political economy of air pollution: Local development, sustainability, and political incentives in China. *Energy Res. Soc. Sci.* **2020**, *69*, 101707. [CrossRef]
50. Tang, P.; Jiang, Q.; Mi, L. One-vote veto: The threshold effect of environmental pollution in China's economic promotion tournament. *Ecol. Econ.* **2021**, *185*, 107069. [CrossRef]
51. Wang, J.; Lei, P. The tournament of Chinese environmental protection: Strong or weak competition? *Ecol. Econ.* **2020**, *181*, 106888. [CrossRef]
52. Lu, C.; Liu, Z.; Liu, Y.; Mao, J. Spatial-temporal patterns and influencing factors of industrial ecologization in the Yellow River Basin. *Chin. J. Ecol.* **2022**, *41*, 1–13. [CrossRef]
53. Wang, F.X.; Mao, A.H.; Li, H.L.; Jia, M. Quality measurement and regional difference of urbanization in Shandong province based on the entropy method. *Sci. Geogr. Sin.* **2013**, *33*, 1323–1329.
54. Angrist, J.D.; Pischke, J.S. *Mostly Harmless Econometrics: An Empiricist's Companion*; Princeton University Press: Princeton, NJ, USA, 2009.
55. Beck, T.; Levine, R.; Levkov, A. Big Bad Banks? The Winners and Losers from Bank Deregulation in the United States. *J. Finance* **2010**, *65*, 1637–1667. [CrossRef]
56. Villa, J.R.; Howell, J.P.; Dorfman, P.W.; Daniel, D.L. Problems with detecting moderators in leadership research using moderated multiple regression. *Leadersh. Q.* **2003**, *14*, 3–23. [CrossRef]

57. Chen, H.; Guo, W.; Feng, X.; Wei, W.; Liu, H.; Feng, Y.; Gong, W. The impact of low-carbon city pilot policy on the total factor productivity of listed enterprises in China. *Resour. Conserv. Recycl.* **2021**, *169*, 105457. [CrossRef]
58. Heckman, J.J.; Ichimura, H.; Todd, P. Matching As An Econometric Evaluation Estimator. *Rev. Econ. Stud.* **1998**, *65*, 261–294. [CrossRef]