Does the Construction of National Eco-Industrial Demonstration Parks Improve Green Total Factor Productivity? Evidence from Prefecture-Level Cities in China

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Abstract: This study conducted quasi-natural experiments based on the panel data of 239 prefecture-level cities in China from 2005 to 2017. The difference-in-difference (DID) and mediation effect model are used to test the impact and mechanism of the construction of national eco-industrial demonstration parks (NEDP) on green total factor productivity (GTFP). The results show that: (1) The construction of NEDP has significantly improved the urban GTFP, and the conclusion is still valid after running the robustness test. (2) Mechanism analysis shows that the construction of NEDP has improved GTFP through technological innovation and industrial structure upgrading. (3) The heterogeneity results reveal that NEDP has a significant positive effect on GTFP in the central and western regions, while the effect was insignificant in the eastern region. Moreover, NEDP significantly contributes to GTFP in resource-based and non-resource-based cities, while the contribution of resource-based cities is greater than that of non-resource-based cities. This study provides a reference for China to further promote the construction quality of NEDP and green development.

Keywords: national eco-industrial demonstration park; difference-in-difference; green total factor productivity; heterogeneous analysis

1. Introduction

Over the years, the ‘GDP-only’ performance assessment system and the crude economic growth strategy have brought about rapid economic growth in China [1]. However, as industrialization and urbanization continue to advance, resource consumption continues to increase and environmental pollution becomes increasingly serious, the resource and environmental constraints facing China’s sustainable development are inescapable [2,3]. Since the United Nations Conference on Environment and Development held in Brazil in 1992, China has been an active participant and advocate of global environmental cooperation and compliance [4,5]. Moreover, the Chinese government proposed a 40–45% reduction in carbon intensity by 2020 and a target for non-fossil energy to reach about 15% of primary energy consumption in the framework of the Paris Climate Change Conference in 2015 [6,7]. In September 2015, the United Nations Sustainable Development Summit formulated 17 Sustainable Development Goals (SDGs) and 169 sub-goals which provide the direction for global sustainable development in the next 15 years [8,9]. As a response to the SDGs proposed by the United Nations, China has put forward the concept of ecological civilization, which marks the implementation and innovation of global sustainable development concepts in China and also paves the way to explore sustainable development practices [10,11]. However, this also implies that China’s traditional industrialized development model must be transformed into a new sustainable development model under limited circumstances.
resource and environmental constraints [12]. Against this backdrop, transforming economic development towards a green, efficient, and clean model has become an inevitable and urgent task for China [13,14]. To effectively enhance China’s green development, the 18th Party Congress plan to construct an ecological civilization that also encompasses the economic, political, cultural, and societal dimensions to create a “five-in-one” strategic layout; and the Party’s Fifth Plenary Session of the 18th Party Central Committee put forward the new development concept of “green, innovation, coordination, openness and sharing” [15]. The 19th Party Congress further proposed that the strictest ecological and environmental protection system should be implemented to achieve sustainable economic development [16]. It is evident that the Chinese government has highlighted the importance of green development to an unprecedented degree. Green total factor productivity (GTFP) integrates economic growth, resource conservation, and environmental protection, which can genuinely reflect the green development level of a country or region [17,18]. Therefore, promoting the improvement of GTFP is not only the key for China’s economy to achieve sustainable economic development at its current stage of development, but also an inevitable choice under the hard constraints of scarce resources and the environment [19].

To promote sustainable development in the industrial sector, the Chinese government has implemented several national eco-industrial park construction and renovation projects, aiming to provide an important vehicle for exploring the win–win goals of industrial development and environmental protection. Industrial parks have been one of the crucial engines to promote regional economic growth [20–22]. The White Paper on the Top 100 Research on the Development Competitiveness of China’s National Industrial Parks shows that the GDP growth rates of China’s economic development zones and high-tech industrial development zones are both much higher than the national growth rates during the same period [23]. However, the agglomeration of production in industrial parks results in intensive consumption of resources. Moreover, there are still rough production patterns and layouts in industrial parks due to the lack of foresight in preliminary planning, resulting in the waste of resources in production and transportation, and there are still large gaps in the gradation and recycling of materials. For example, plenty of enterprises gathered in industrial parks are prone to high consumption of resources and energy, as well as high pollution emissions, which has damaged their local ecological environments and led to industrial parks becoming synonymous with highly polluted and energy-intensive areas [24–26]. The report of the 19th Party Congress highlights that China’s economy has shifted from a stage of high growth to a stage of high-quality development, thus balancing economic development with ecological protection has become one of the major concerns of society [27,28]. To promote the development of eco-industries and eco-industrial parks, the Chinese government launched a pilot project for the construction of eco-industrial demonstration parks in 1999, aiming to establish several national eco-industrial demonstration parks (NEDP) during the 10th Five-Year Plan [29].

The NEDP is in line with China’s goal of building a resource-saving and environment-friendly society by focusing on ecological protection and economic development respectively. At the same time, NEDP is a policy testing ground for cities to explore sustainable urban development [30]. Through green industrial clustering, eco-industrial demonstration parks have become an indispensable vehicle for sustainable urban development, contributing to the intensification of resource and environmental use and the cultivation of modern eco-industrial systems [24]. The first national NEDP in China (Guigang) was approved for pilot construction in August 2001, followed by a number of NEDP in various cities [31]. Eco-industrial parks are new types of industrial parks designed and created following the criteria of circular economy, industrial ecology, and clean production requirements. The design of eco-industrial parks relies heavily on eco-evolutionary activities and presents a major upgrade from traditional industrial parks to an eco-development model. The development of eco-industrial parks can speed up the transition of industrial parks to ecological civilisation, stimulate the transformation of industry from the old growth model to a sustainable development model, and spur the development of high–tech industries, which
ultimately alleviates part of the pressure of environmental pollution and consequently influences GTFP. As such, it is pertinent to study whether the eco-industrial park pilot policy can resolve the environmental pollution dilemma of the traditional industrial clustering method, and thus enhance GTFP. In addition, as a new model for resource allocation and green development, scientifically assessing the impact of the implementation of the eco-industrial park pilot policy on the sustainable development of cities provides essential guidance and is of practical significance for the future construction and development of national eco-industrial demonstration parks, and even for the sustainable development of China’s economy.

Currently, the literature relevant to this investigation mainly focuses on the following two aspects. On the one hand, scholars have carried out a large number of studies on the socio-economic effects of industrial parks from the perspective of enterprise behavior, policy incentives, labor market, import and export, industrial agglomeration and spillover mechanisms, and regional economic development [32–38]. On the other hand, some scholars have evaluated the environmental performance of eco-industrial parks at different levels [39–41]. For example, from a micro level, scholars have mainly emphasized the analysis of specific environmental measures in eco-industrial parks, such as product eco-design, cleaner production technologies, green supply chains, recycled water reuse, energy gradient utilization, and waste resource utilization [42–44]. The performance of eco-industrial parks has mostly been assessed through a life-cycle approach to compare different scenarios regarding economic and environmental aspects [45–47]. For example, Li et al. (2015) demonstrated that an efficient green supply chain in a waterfront industrial park can have significant economic and environmental benefits, using the steel manufacturing, paper and pulp, and petrochemical industries as examples [44]. Moreover, performance assessment at the macro level emphasizes the overall performance of eco-industrial parks regarding resource and energy use and pollutant reduction within a certain time and interval [24,48]. For example, Fan and Fang (2020) analyzed the environmental performance of eco-industrial parks based on waste resource utilization and infrastructure sharing [49]. Tian et al. (2014) confirmed that the construction of eco-industrial parks shows significant suppression of both the total and intensity of sulfur dioxide and chemical oxygen demand emissions in the parks [50]. Liu et al. (2014) suggested that an optimized energy mix and improved energy efficiency can significantly reduce greenhouse gas emissions in the Beijing economic and technological development area [33]. Second is the research on the influencing factors of GTFP. The traditional total factor productivity (TFP) accounts for input factors, such as capital and labor, while energy consumption and environmental pollution are not included in the accounting system, thus failing to accurately measure socio-economic development and environmental changes [51–53]. To address this gap, scholars integrate energy consumption and environmental pollution into the total factor productivity (TFP) accounting system to measure GTFP as a measure of green economic development [13,54]. Parametric and non-parametric methods are the main methods used to measure GTFP. Parametric methods include the Solow residual method and stochastic frontier analysis (SFA), while non-parametric methods include data envelopment analysis (DEA) which is usually used in conjunction with an index method. Some of the commonly used indices include the Malmquist index, Luenberger index, and Malmquist–Luenberger (ML) index [55–57]. In addition, it can be summarized that many scholars have investigated GTFP considering the factors of economic development level, industrial structure, environmental regulation, openness to the outside world, technology level, human capital, and government intervention [57–60]. For example, Lin and Chen (2018) found that factor market distortions lead to lower exports and reduced FDI which has a negative effect on GTFP [59]. Wang et al. (2021) used a spatial Durbin model to confirm that green technology innovation has a significant positive effect on local changes in GTFP and a significant negative effect on changes in GTFP in neighboring regions [61]. Yang et al. (2021) identified a U–shaped relationship between R&D investment and transport GTFP, while cross-provincial technology spillovers consistently inhibit GTFP [62]. Qiu et al. (2021) suggested that innovation investment sig-
nificantly contributes to GTFP in countries along the Belt and Road, and the contribution of innovation investment to GTFP is further enhanced as institutional quality improves [58].

To sum up, most of the research on NEDP has mainly been concerned with an assessment of the performance of the parks themselves. The literature on the impact of NEDP as a policy shock on GTFP is relatively rare. As China is currently undergoing a critical transformation from a phase of high growth to high-quality development, pursuing green development is the key to resolving the paradox of economic development and environmental protection and achieving sustainable development. In this context, how does NEDP affect GTFP, and what are its pathways? What are the heterogeneous characteristics of the role of NEDP on GTFP across different geographical locations, and resource endowments? These questions have yet to be studied in depth, which provides a wide scope for this study. Meanwhile, this study will not only provide some empirical reference for policymakers but also provide a theoretical basis and support for the sustainable development of the ecological environment. Therefore, this paper examines the direct, indirect, and heterogeneous effects of NEDP on GTFP using a quasi-natural experiment (difference-in-difference (DID) and propensity score matching models) and a mediation effects model based on the data of 240 prefecture-level cities in China from 2005 to 2017.

Based on panel data from 239 prefecture-level cities in China from 2005 to 2017, this study tests the impact of the construction of NEDP on GTFP (GTFP) using the difference-in-difference (DID) model and the mediating effects model. This study reveals that eco-industrial parks significantly contribute to the GTFP of the pilot cities, and these findings remain valid after performing robustness checks. Furthermore, the transmission mechanism suggests that the construction of NEDP can enhance GTFP through technological innovation and industrial structure upgrading, which provides evidence for a more precise enhancement of GTFP through the construction of NEDP in the future. This study also identifies a significant heterogeneous effect of national eco-industrial demonstration parks on the promotion of GTFP. Specifically, the promotion effect of NEDP on GTFP is higher in the western than in the central region, while it was found to be insignificant in the eastern region. Moreover, NEDP significantly contributes to GTFP in resource-based and non-resource-based cities, while the contribution of resource-based cities is greater than that of non-resource-based cities. This study can provide a partial theoretical basis and empirical reference for further improvement in the quality of NEDP and enhancing green total productivity.

The potential contributions of this study are mainly in the following dimensions. Firstly, the DID method is adopted to explore the impact of NEDP on GTFP, broadening the literature on NEDP and GTFP. Secondly, the mediating effect model is applied to examine the impact mechanism of NEDP on GTFP in the light of technological innovation and industrial structure upgrading, which provides some reference for the precise implementation of pilot policies. Finally, this study further analyses the heterogeneous effects of NEDP on GTFP under different geographical locations, and resource endowments, in order to provide an empirical reference for future pilot policy formulation based on local conditions.

The rest of the paper is organized as follows. Section 2 provides the theoretical analysis and hypotheses. Section 3 introduces the empirical strategy, variable definitions, and data sources in detail. Section 4 performs a detailed analysis of the empirical results, including the analysis of the benchmark regression results, the analysis of the robustness test results, the analysis of the transmission mechanism, and the analysis of the heterogeneity results. Section 5 gives the conclusions and policy implications of the paper.

2. Theoretical Analysis and Research Hypothesis

The construction of industrial parks has promoted the development of urbanization and industrialization in China, while the rapid economic growth has neglected the protection of the environment [63,64]. With the deepening of reform, the original “rough and loose” economic development model, which relies on high input and consumption of resources and energy, has been criticized for its single industrial structure and overcapacity,
which is not conducive to the sustainable progress of the economy [65–67]. Thus, it is urgent to change the traditional industrial park development model and innovate a new industrial park model with equal emphasis on economic benefits and environmental protection.

In 2000, the State Environmental Protection Administration (SEPA) took the lead in building China’s Eco-industrial Park—developed in 2007 to be jointly constructed and managed by the former three departments of SEPA, Ministry of Commerce, and Ministry of Science and Technology in collaboration. At present, laws, regulations, and policies connected to the development of recycling economy, eco-industry, clean production, energy-saving, and emission reduction have been issued at the national level, such as “Several Opinions of the State Council on Accelerating the Development of Circular Economy”, “Law of the People’s Republic of China on Promoting Circular Economy”, and “Measures for the Management of Recycling Resources”. In addition, some provinces and cities have formulated more suitable regional policies in terms of relevance and operability based on the NEDP, taking into account the development characteristics of the regions themselves [68–70]. With 20 years of construction and development whilst enjoying preferential policies, eco-industrial parks have begun to place more emphasis on the green and recyclable development model, whilst simultaneously vigorously developing high-tech industries which are conducive to the high-quality development of China’s economy. Hypothesis 1 is therefore proposed as follows:

Hypothesis 1 (H1). NEDP has a significant positive effect on GTFP.

In general, the NEDP mainly influences the green development of cities through the following aspects. First of all, eco-industrial gardens enjoy specific preferential policies, which include financial and credit support, tax preferences, financial subsidies, and even land allocation and talent settlement. Theoretically, increasing financial recognition can effectively alleviate the financing constraints of enterprises; a preferential taxation system and financial donations will further attract the inflow of capital and other factors, effectively attracting external investment; policies such as talent settlement will also attract the influx of high-quality human capital, which is conducive to local human capital accumulation [71–73]. Therefore, cities with eco-industrial parks will further change from factor and investment-driven to innovation-driven through measures such as increasing financial investment, raising tax incentives, and encouraging the flow of high-quality talents. Innovation provides green and clean production methods for industry and agriculture, leads the public to green consumption, and promotes green living, thereby developing production, living, and ecology together [74,75]. Endogenous growth theory and new economic geography theory clarify that technological progress can bring technological innovation, which can improve GTFP and promote green economic development [76]. This leads to Hypothesis 2:

Hypothesis 2 (H2). The construction of NEDP can enhance GTFP through technological innovation.

Finally, the uniquely developed model of the NEDP will also shock the regional industrial structure, thus affecting GTFP [77]. The NEDP emphasizes a green and recyclable development model, thereby forcing local governments to transform their traditional industries into high-tech industries [78]. Next, by taking some of the leading enterprises in the NEDP as the core, the development of upstream and downstream enterprises will be driven to form a complete industrial chain to bring about the upgrading effect of the industrial structure [79]. For example, the NEDP carries out industrial restructuring and technological transformation of traditional industries following the requirements of sustainable development, reducing pollutant generation and pressure on the environment [80–82]. Enterprises in the parks are required to adopt modern biotechnology, ecological technology, energy-saving technology, water-saving technology, recycling technology, and information technology, as well as to incorporate internationally advanced standards of production process management and environmental management in the NEDP to achieve the best balance
between economic and environmental benefits [83,84]. In addition, through eco-industrial parks, enterprises are provided with cleaner production and process innovation in production units, minimizing their resource consumption and waste generation and transforming existing industrial operations to promote the upgrading of industrial structures [85–88]. Thus, as the industrial structure in the eco-industrial parks of the country continues to be heightened and rationalized, GTFP rises along with it.

Hypothesis 3 (H3). The construction of NEDP can enhance GTFP through industrial structure upgrading.

3. Model Setting and Data Description
3.1. Model Specification

The DID method is a widely accepted tool for quantitative assessment of the effects of policies. Unlike traditional static comparison methods, the DID method does not directly measure the change in the mean of the sample before and after the policy but instead adds two dummy variables of policy and time and their interaction terms to the regression equation [89]. On the one hand, the DID method can capitalize on the homogeneity of the explanatory variables by effectively controlling for the effects of unobservable individual heterogeneity on the explanatory variables. On the other hand, the DID method allows for unbiased estimation of policy effects without the unpredictable effects of time-varying aggregate factors. This study mainly analyzes the impact of the NEDP on GTFP. Referring to Meng et al. (2021), the setting of NEDP can be seen as a quasi-natural experiment, and the DID method can be used as a valid research tool for the analysis of this study [90].

Cities that set up national industrial parks were used as the treatment group and cities that did not set up national industrial parks were used as the control group in this study. The event effect was evaluated according to the time before and after the NEDP which was set as a reference (defined as 1 if the industrial park was set up in that year and later, and 0 otherwise). The specific model settings are

\[
g_{\text{GTFP}}_{it} = \beta_0 + \beta_1 \text{park}_{it} + \sum_{i=2}^{n} \beta_n X_{it} + \mu_i + \delta_t + \epsilon_{it} \tag{1}
\]

where, i and t denote city and year, respectively. gtfp are the dependent variable in this study which denotes GTFP. park is the core explanatory variable that characterizes the policy effects of national eco-industrial demonstration parks. X is a series of control variables that may affect GTFP of prefecture-level cities, including urban fixed-asset investment (lngdzc), economic development level (lnpgdp), information level (lninternet), financial development (lnfin), and population size (lnrkmd). \(\mu_i\) and \(\delta_t\) denote control individual and time fixed effects respectively. \(\epsilon_{it}\) are random error terms. \(\beta_0 \cdots \beta_n\) denote coefficients to be estimated. The coefficient value \(\beta_1\) is the coefficient that this paper focuses on, and the coefficient is expected to be positive, which represents the impact of the NEDP pilot policy on GTFP.

The theoretical analysis and research hypothesis in the previous section argue that the NEDP can significantly contribute to GTFP. However, it is interesting to find out through what intermediate mechanism does the NEDP promote GTFP? By investigating the intrinsic mechanism, this study can provide insight into the relationship between the NEDP and GTFP. Accordingly, this study analyzes the impact mechanism of NEDP on GTFP by constructing a mediation effect model from the two paths of technological innovation and industrial structure upgrading. Following the study of Wu et al. (2021) [91], this study uses a three-step test of the mediation mechanism to develop the following measurement model.

\[
g_{\text{GTFP}}_{it} = \alpha_0 + \alpha_1 \text{park}_{it} + \alpha_n X_{it} + \mu_i + \delta_t + \epsilon_{it} \tag{2}
\]

\[
M_{it} = \varphi_0 + \varphi_1 \text{park}_{it} + \varphi_n X_{it} + \mu_i + \delta_t + \epsilon_{it} \tag{3}
\]
gtfp_{it} = \theta_0 + \theta_1 park_{it} + \theta_2 M_{it} + \theta_n X_{it} + \mu_i + \delta_t + \epsilon_{it} \quad (4)

Among them, Equations (2) and (3) together with Equation (4) constitute a three-step method for mediation effects. M is an intermediate variable, including the technological innovation effect (Tech) and the industrial structure effect (Ind). Other variable settings are the same as in Equation (1). When \varphi_1 in Equation (3) is significant, this indicates that the NEDP has a significant effect on the mediation variables (industrial structure upgrading and technological innovation). The significance of \varphi_1 in Equation (3) and \theta_2 in Equation (4) is observed, and if both \varphi_1 and \theta_2 are significant, it indicates that the NEDP affects GTFP through these mediating variables.

3.2. Variable Selection and Description

3.2.1. Dependent Variable

Green total factor productivity (gtfp)—This paper, with reference to Ran et al. (2020), uses the research framework of non-oriented EBM containing non-desired outputs. There are three indicators for the input variables, which are urban unit employment, capital stock, and energy consumption [92]. The depreciation rate of capital stock is 10.96% [93]. The treatment of capital stock in the base period is borrowed from Young (2003) and expressed as ten times the amount of fixed asset investment in the base year [94]; energy consumption is measured by urban per capita electricity consumption; output contains both desired output and non-desired output, and the desired output is GDP of prefecture-level cities and is discounted by 2004 as the base period; the non–desired output includes industrial wastewater, smoke, and dust, and sulfur dioxide emissions of the prefecture-level city. The GTFP is measured using the MAX–DEA Pro software’s super-efficient EBM model containing non-desired outputs, denoted by gtfp.

3.2.2. Core Explanatory Variables

National eco-industrial demonstration park (park)—Precisely, if city i has an eco-industrial park in year t, then park in year t and later is assigned a value of 1; otherwise, it is 0. It is worth noting that we mainly focus on NEDP approved construction. Guigang and Binzhou eco-industrial parks built in 2001 and 2003, respectively, are excluded because they are not within the time frame of the sample study. Other than that, other eco-industrial parks were established in 2010 at the earliest, and as of 2017, other parks that submitted applications and passed the planning argumentation to start the construction of eco-industrial parks, a total of 45 eco-industrial parks constitute the treatment group in the empirical study of this paper. However, these 45 eco-industrial parks are not all distributed in different cities—i.e., some cities will have more than one NEDP. Therefore, in defining the core explanatory variables, we define cities with only one NEDP according to the year of setting up the eco-industrial park—i.e., the value is 0 before the establishment of the NEDP and one after the establishment of the NEDP; and for cities with multiple eco-industrial parks, we only focus on the earliest year of setting up the eco-industrial park—i.e., the value is 0 before the earliest year of setting up the eco-industrial park and one after that.

3.2.3. Control Variables

To control for the influence of unobservables on the dependent variable that would bias the estimation results, a series of control variables including fixed-asset investment (lngdzc), economic development level (lnpgdp), population size (lnrkmd), information level (lninternet), and financial development (lnfin) are introduced into the baseline regression model. Fixed-asset investment (lngdzc) is expressed as total fixed-asset investment in urban jurisdictions. Economic development level (lnpgdp) is evaluated by per capita GDP. Population size (lnrkmd) indicates the population density of each city. Information level (lninternet) is measured by the number of internet users. Financial development (lnfin) is measured by the balance of deposits and loans as a proportion of GDP.
3.2.4. Mediation Variables

Technological innovation (Tech). Current scholars have two types of approaches to measure technological innovation including single indicator and composite indicator [95]. Considering the limitations of the number of patents and input-output indicators in measuring the innovation level of cities, the innovation index of the China City and Industry Innovation Capability Report is selected to measure technological innovation [89]. This indicator has the following advantages: one is that it uses the patent value as innovation output data, which corrects the bias caused by double-counting of innovation input and output. The second is that the patent renewal model is used to measure the potential value of patents in different years, which overcomes the problem that the direct measurement of innovation level by the number of patents does not reflect the potential value of patents and patent quality.

Industrial structure upgrading (Ind)—Industrial structure upgrading means that the proportion of primary industry will gradually decrease and the proportion of secondary industry and tertiary industry will gradually increase in economic development. Therefore, most scholars nowadays use the sum of the value-added of secondary and tertiary industries as the proportion of GDP to measure the degree by which industrial structure is upgraded. However, with the continuous development of the economy and the continuous adjustment of the industrial structure, the industrial development at this stage shows the phenomenon that the development rate of the tertiary industry has increased significantly. Following Yang et al. (2021), this study uses the ratio of the value-added of the tertiary industry to the value-added of the secondary industry to measure industrial structure upgrading [89].

3.3. Data

This paper selects 239 prefecture-level cities’ balanced panel data from 2005–2017 (for cities with more missing data, this paper does exclusion treatment and uses the interpolation method to fill in the few relevant missing data) as the object of research. The raw data used are all from the China Urban Construction Statistical Yearbook and China Urban Statistical Yearbook. The applicable data descriptive statistics are displayed in Table 1.

Table 1. Variable description statistics.

| Variable | Obs  | Mean  | Std. Dev. | Min  | Max  |
|----------|------|-------|-----------|------|------|
| gftp     | 3107 | 0.658 | 0.215     | 0.059| 1.067|
| park     | 3107 | 0.056 | 0.229     | 0    | 1    |
| lrnrkm   | 3107 | 5.845 | 0.792     | 3.434| 7.165|
| lnpgdp   | 3107 | 10.284| 0.737     | 8.619| 11.903|
| lngdzc   | 3107 | 15.659| 1.024     | 13.281| 17.845|
| internet | 3107 | 3.543 | 1.049     | 1.125| 6.057|
| lnfin    | 3107 | 1.294 | 0.575     | −0.168| 2.728|

4. Analyzing Empirical Results

In this section, this study first uses a parallel trend test to verify the validity of the DID model and then quantifies the impact of the NEDP pilot policy on GTFP using DID model. The propensity score matching model was also applied to test the robustness of the effect of the NEDP pilot policy on GTFP. Next, this study explores the influence mechanism of NEDP pilot policy on GTFP from the perspectives of technological innovation and industrial structure upgrading. Finally, this study analyzes the heterogeneous effects of NEDP pilot policy on GTFP based on city location and urban resource endowment perspectives.

4.1. Parallel Trend Test

Since there may be prior differences in the sample between groups before policy implementation, this subsequently causes biased estimates of the effects of policy implementation and makes it difficult to ensure complete randomization in the sample allocation for the
policy treatment and control groups [89]. Consequently, an analytical method that only uses a single before-and-after or cross-sectional comparison would ignore such differences. Thus, an important prerequisite for using the DID method is the need to satisfy the parallel trend hypothesis, i.e., the trends in GTFP in pilot cities and non–pilot cities do not differ significantly before policy implementation [88]. Based on the GTFP of pilot cities (treatment group) and non-pilot cities (control group), Figure 1 depicts the year-to-year dynamic change characteristics of the GTFP of the treatment group and the control group before and after the implementation of the policy. Combined with Figure 1, it is not difficult to find that the green total factors of the treatment group and the control group before policy implementation have a consistent trend of change and no significant systematic differences exist, which satisfies the hypothesis of DID method application. The GTFP of the cities in the treatment group as a whole showed a fluctuating upward trend after the implementation of the pilot policy, while the green total factor of the control group did not show a large fluctuation, which tentatively indicates that the increase in GTFP may be caused by the implementation of the NEDP pilot policy.

\[ \text{gtfp}_{it} = \phi_0 + \phi_k \sum_{k \geq -4} \text{park}_{t_0+k} + \phi_n X_{it} + \mu_i + \delta_t + \epsilon_{it} \]  

(5)

where \( \text{park}_{t_0+k} \) represents the event window dummy variable before and after the establishment of the eco-industrial park. \( t_0 \) is the year when prefecture \( i \) has an eco-industrial park. \( t_0 + k \) is the year before and after the establishment of the eco-industrial park (\( k \) takes the values of, \( 4, -3, -2, -1, 0, 1, 2, 3, 4 \), and the default group is \( t \leq -5 \)). The rest of the control variables are similar to the baseline regression model. The regression results are shown in Table 2. Table 2 reveals that before the setting up of NEDP, there was no significant difference in GTFP in both the treatment and control groups. During the year of NEDP setting up, the NEDP promoted GTFP at a 1% significance level, and the effect of NEDP on GTFP remained significantly positive for four years thereafter. Overall, the regression results of the event study method indicated that the treatment and control groups had parallel time trends before the event. Significant differences in GTFP between the

Figure 1. Parallel trend test chart.

Although depicting parallel trends using figures can visually express the trends in the treatment and control groups, it cannot specifically quantify the specific effects of parallel trends. Furthermore, this study employed an event study method to empirically examine the dynamic changes in GTFP in prefecture-level cities before and after the eco-industrial parks were performed.
treatment and control groups only began to emerge after NEDP was performed, meeting the requirements of the DID method.

Table 2. Event study method regression results.

| Variables | (1)       | (2)        |
|-----------|-----------|------------|
| pre_4     | 0.067     | 0.019 ***  |
|           | (0.053)   | (0.005)    |
| pre_3     | 0.058     | −0.147 *** |
|           | (0.055)   | (0.008)    |
| pre_2     | 0.092     | 0.030 ***  |
|           | (0.066)   | (0.008)    |
| pre_1     | 0.084     | 0.061 ***  |
|           | (0.070)   | (0.007)    |
| current   | 0.136 *** | 0.055 ***  |
|           | (0.040)   | (0.008)    |
| pos_1     | 0.127 *** | 1.301 ***  |
|           | (0.038)   | (0.103)    |
| pos_2     | 0.120 *** |            |
|           | (0.038)   |            |
| pos_3     | 0.147 *** |            |
|           | (0.041)   |            |
| pos_4     | 0.129 *** |            |
|           | (0.067)   |            |

Note: Robust standard errors (city level) in parentheses, *** $p < 0.01$.

4.2. Analyzing Benchmark Regression Results

According to the model (1) setting, this paper first evaluates the impact of the NEDP on GTFP. The estimated results are shown in Table 3. Table 3 reveals that the coefficient of park is significantly positive at the 1% statistical level, implying that the implementation of the NEDP policy can significantly promote GTFP. Our findings are highly relevant to those of Song and Zhou (2021) [96]. NEDP are a new type of industrial park which is based on the requirements of clean production, the concept of circular economy and the principle of industrial ecology, aiming to find the mutual promotion of economic and environmental benefits. For example, NEDP reduces environmental damage by transforming pollutant emissions or by products from different factories into recycled and renewable substances through collaborative environmental management. Moreover, the total amount of pollution emissions of the enterprises in the NEDP must reach the key control targets set by the government, which can undoubtedly significantly promote pollution reduction and thus improve the GTFP. Hypothesis 1 was verified.

Among the control variables, the effect of population size (lnrkmd) on gtfp is significantly positive at the 1% level, implying that an increase in population density can significantly contribute to gtfp. As urbanization levels continue to rise, population and resource dividends are gradually released, which results in scale effects and technology effects that can significantly improve resource allocation efficiency and thus have a significant positive impact on gtfp. Economic development level (lnpgdp) significantly reduces gtfp at the 1% level, indicating that China’s current economic development still relies on traditional factors mainly and has not achieved real economic transformation. Environmental Kuznets theory suggests that economic growth and environmental quality show a U-shaped relationship—i.e., China’s current economic development status still has not reached the inflection point of the environmental Kuznets curve [97]. Fixed asset investment (lngdzc) improves GTFP at the 1% significance level. Green economic development is inseparable from large-scale infrastructure construction. Reasonable investment in fixed assets not only reduces the cost of industrial development and avoid environmental degradation caused by unreasonable investment, but also promotes the construction of municipal infrastructure which paves the way for the improvement of GTFP [98]. Informatization level (lninternet) can significantly enhance GTFP, which is consistent with the findings of
Hao et al. (2021) [99]. As the Internet can enhance environmental information generation, transmission, access, and application capabilities, which are used to trigger, enable, and structure environmental information governance. Environmental regulators can use the Internet for environmental information disclosure, automatic monitoring, and environmental advocacy to reduce environmental pollution and promote the growth of gtfp. Financial development (lnfin) has a significant positive effect on gtfp. With the increasing financial development level, the financial constraints of enterprises for clean production and green technology R&D will also be eased, which will be conducive to the improvement of technological innovation and eventually promote gtfp.

### Table 3. Benchmark regression results.

| Variables | (1)     | (2)     | (3)     | (4)     | (5)     | (6)     |
|-----------|---------|---------|---------|---------|---------|---------|
| park      | 0.134 *** | 0.117 *** | 0.157 *** | 0.127 *** | 0.119 *** | 0.118 *** |
|           | (0.043)  | (0.017)  | (0.044)  | (0.041)  | (0.038)  | (0.037)  |
| Inrkmd    | 0.035 **  | 0.044 *** | 0.023    | 0.010    | 0.021    |         |
|           | (0.005)  | (0.015)  | (0.015)  | (0.015)  | (0.015)  | (0.015)  |
| Inpgdp    | −0.0530 *** | −0.119 *** | −0.139 *** | −0.145 *** |         |         |
|           | (0.013)  | (0.023)  | (0.025)  | (0.025)  | (0.018)  |         |
| Ingdzc    | 0.072 *** | 0.029 *  | 0.021 *  |         |         |         |
|           | (0.017)  | (0.017)  | (0.018)  | (0.018)  |         |         |
| Ininternet| 0.068 *** | 0.063 *** |         |         |         |         |
|           | (0.016)  | (0.016)  | (0.016)  | (0.016)  | (0.016)  | (0.016)  |
| lnfin     | 0.051 **  |         |         |         |         |         |
|           | (0.020)  | (0.020)  | (0.020)  | (0.020)  | (0.020)  | (0.020)  |
| Cons      | 0.650 *** | 0.449 *** | 0.939 *** | 0.615 *** | 1.330 *** | 1.411 *** |
|           | (0.012)  | (0.030)  | (0.163)  | (0.168)  | (0.228)  | (0.229)  |
| Year      | Yes      | Yes      | Yes      | Yes      | Yes      | Yes      |
| City      | Yes      | Yes      | Yes      | Yes      | Yes      | Yes      |
| Observations | 3107     | 3107     | 3107     | 3107     | 3107     | 3107     |
| R-squared | 0.020    | 0.036    | 0.066    | 0.114    | 0.143    | 0.156    |

Note: Robust standard errors (city level) in parentheses, *** p < 0.01, ** p < 0.05, * p < 0.1.

### 4.3. Robustness Test

To test the main regression results, this study further verifies the robustness of the empirical results from the PSM–DID. Although Figure 1 in the previous section can show that the parallel trend hypothesis is largely satisfied for the experimental and control groups, more rigorous treatment and testing are still necessary. To this end, the propensity score matching differences to differences method (PSM–DID) was used to conduct the robustness test, with the idea of matching and screening by covariates in the experimental and control groups, and selecting regions with similar characteristic variables in the two groups, respectively, and conducting the differences to differences process again. The specific operation is to choose the sample data before 2010—i.e., before the policy—and to match the covariates including fixed-asset investment (Ingdzc), economic development level (Inpgdp), population size (Inrkmd), information level (Ininternet), and financial development (lnfin) by caliper 1:4 to select a more balanced sample from the experimental and control groups. Table 4 shows the results of the new sample balance test after matching. It can be seen that none of the deviations after matching for each variable is greater than 10. In contrast, none of the t-statistics are significant—i.e., no systematic differences between the experimental and control groups are considered—indicating that this matching result is valid and suitable for estimation using the double-difference propensity score matching method.

Figure 2 shows the plot of covariate bias after PSM, ♦ represents the degree of difference between the experimental and control groups before PSM, and ✶ represents the degree of difference after matching, the results show that the standardized bias of the variables after matching is reduced, all of them are less than or equal to 10%, although the certain sample size is lost, the accuracy of the coefficients to be estimated is ensured, all
these results can indicate that the data treated by PSM above are suitable for differences to differences empirical tests.

Table 4. Applicability test of the PSM-DID method.

| Variables | Mean | Control | Bias | %Bias | T-Test | p-Value |
|-----------|------|---------|------|-------|--------|---------|
| lnrkmd    | Treated | 6.308 | 5.818 | 76.5 | 7.99 | 0.000 |
|           | Matched | 6.299 | 6.325 | -4.0 | -0.44 | 0.657 |
| lnpgdp    | Unmatched | 11.068 | 10.238 | 120.3 | 14.90 | 0.000 |
|           | Matched | 11.059 | 11.079 | -2.9 | -0.29 | 0.773 |
| lngdzc    | Unmatched | 16.897 | 15.586 | 143.3 | 17.12 | 0.000 |
|           | Matched | 16.886 | 16.878 | 0.9 | 0.09 | 0.928 |
| lninternet | Unmatched | 4.761 | 3.471 | 128.1 | 16.37 | 0.000 |
|           | Matched | 4.746 | 4.748 | -0.2 | -0.02 | 0.983 |
| lnfin     | Unmatched | 1.614 | 1.275 | 65.8 | 7.59 | 0.000 |
|           | Matched | 1.606 | 1.573 | 6.4 | 0.66 | 0.507 |

Figure 2. Plot of covariate deviations after PSM.

Table 5 shows the matched main regression results, and columns (1) and (2) show the regression results without and with control variables, respectively, and it can be seen that the significance and sign of the explanatory and control variables remain following the baseline regression results in Table 3.

4.4. Transmission Mechanism Test

Column 3 of Table 6 reveals that the impact of technological innovation on GTFP is significantly positive at the 1% confidence level, indicating that technological innovation can significantly enhance GTFP. In particular, technological innovation—as a key factor driving economic growth—not only provides a new growth equilibrium for the current economic growth dilemma, but also provides a new solution path to solve the current resource and environmental problems, thus becoming the key to promoting GTFP. Column 2 of Table 6 suggests that the NEDP pilot policy significantly affects the technology innovation level at a 1% confidence level. Therefore, it can be concluded from Columns 1 to 3 of Table 6 that the NEDP pilot policy can improve GTFP by enhancing technological innovation. The NEDP pilot policy is distinguished from the ordinary industrial park policy in that it gives local governments appropriate autonomy in industrial selection through the form
of pilot projects. The local governments, taking into account the actual situation, provide certain tax and fee reduction measures for the enterprises in the park to stimulate the relevant market players to compensate for the environmental cost loss under the strict environmental regulation by increasing R&D investment and improving technological innovation capacity. In addition, NEDP enjoys financial and human resources support from the central government and the local government in the introduction and development of new technologies, which are conducive to the improvement of technological innovation capacity and thus GTFP.

Table 5. Benchmark regression results after PSM.

| Variables | (1)    | (2)    | (3)    | (4)    | (5)    | (6)    |
|-----------|--------|--------|--------|--------|--------|--------|
| park      | 0.104 ** | 0.088 ** | 0.091 ** | 0.080 ** | 0.079 ** | 0.074 ** |
|           | (0.045)  | (0.041)  | (0.042)  | (0.040)  | (0.037)  | (0.035)  |
| lnrkmd    | 0.121 *** | 0.127 *** | 0.096 *** | 0.063 ** | 0.072 *** |
|           | (0.027)  | (0.025)  | (0.028)  | (0.027)  | (0.030)  | (0.027)  |
| lnpgdp    | −0.0189  | −0.113 *** | −0.138 *** | −0.139 *** |
|           | (0.021)  | (0.031)  | (0.030)  | (0.030)  | (0.031)  |
| lngdzc    | 0.109 *** | 0.0477  |
|           | (0.026)  | (0.031)  |
| lninternet|        |        |        | 0.0927 *** | 0.0883 *** |
|           |        |        |        | (0.027)  | (0.027)  |
| Infin     |        |        |        |        |
|           |        |        |        |        | 0.069 ** |
|           |        |        |        |        | (0.030)  | (0.032)  |
| Constant  | 0.678 *** | −0.069  | 0.097  | −0.496 * | 0.588  |
|           | (0.020)  | (0.161)  | (0.276)  | (0.285)  | (0.403)  | (0.382)  |
| Year      | Yes  | Yes  | Yes  | Yes  | Yes  |
| City      | Yes  | Yes  | Yes  | Yes  |
| Observations | 596 | 596  | 596  | 596  |
| R-squared | 0.043  | 0.146  | 0.149  | 0.224  | 0.271  | 0.288  |

Note: Robust standard errors (city level) in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 6. Transmission mechanism test.

| Variables | (1)    | (2)    | (3)    | (4)    |
|-----------|--------|--------|--------|--------|
| park      | 0.118 *** | 24.49 *** | 0.0956 *** |
|           | (0.037)  | (8.837)  | (0.035)  |
| Tech      | 0.001 *** |
|           | (0.000)  |
| Ind       | 0.201  |
|           | (0.015)  |
| lnrkmd    | 2.862 *  |
|           | (1.652)  |
| lnpgdp    | −0.145 *** | 6.521 ** |
|           | (0.025)  | (3.038)  |
| lngdzc    | −2.419  |
|           | (2.343)  | (0.017)  |
| lninternet| 0.063 *** | 7.805 *** |
|           | (0.016)  | (2.892)  |
| Infin     | 0.0512 ** |
|           | (0.020)  | (1.029)  |
| Cons      | −0.151  |
|           | (0.151)  |
| Year      | 1.411 *** |
|           | (0.229)  | (17.240) |
| City      | Yes  |
|           | Yes  |
| N         | 3107  |
|           | 3107  |
| R-squared | 0.156  |
|           | 0.192  |

Note: Robust standard errors (city level) in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. 
As shown in Column 4 of Table 6, the coefficient of park is significantly positive at the 1% confidence level, which means that the NEDP pilot policy can significantly promote industrial structure upgrading. Column 5 of Table 6 indicates that the impact of industrial structure upgrading on GTFP is significantly positive at a 1% confidence level, which proves that industrial structure upgrading can significantly enhance GTFP. In general, the NEDP pilot policy can significantly improve GTFP through industrial structure upgrading. One possible explanation is that GTFP highlights the pursuit of economic development quality. Industrial structure upgrading underlines the continuous evolution of industrial development to tertiary, technology-intensive, and high value-added types of industries. The development of the above-mentioned industries can help solve the problem of sustainable economic growth under resource and environmental constraints, which can substantially improve GTFP. One of the core objectives of the NEDP is to eliminate outdated industries with high energy consumption, high pollution, and high emission, and to develop the green industries represented by ecological technology, energy-saving technology, modern biotechnology, water-saving technology, and recycling technology, thus realizing industrial structure upgrading. These industries with high technology use and high added value not only provide new growth drivers for economic development but also solve the problem of resource constraints and environmental pollution, ultimately fulfilling the improvement of GTFP.

4.5. Analyzing Heterogeneous Results
4.5.1. Analyzing City Geographic Location Heterogeneity Results

Limited by factors such as geographical location and factor endowment, there are significant differences in the economic development levels of prefecture-level cities in different regions and their support for national eco-industrial demonstration parks. Referring to Yang et al. (2021) [100], this study divided 239 prefecture-level cities into eastern, central, and western regions based on their geographical locations to explore the heterogeneous effects of NEDP on GTFP under sub-regional scenarios (see Table 7). Table 7 reveals that NEDP significantly contributes to GTFP in the central and western regions, but insignificantly in the eastern region. In addition, this study also finds that NEDP has the strongest contribution to GTFP in the western region, while the lowest in the eastern region. Our findings are consistent with Song and Zhou (2021) that economic growth pressure weakens the positive effect of NEDP on GTFP [96]. One potential interpretation is that the heterogeneous implementation effects of NEDP policies can be influenced by a combination of local government and central government actions. First, the central government comes to environmental governance goals and eco-industrial park master plans from the national level. However, the consequence of this behavior is that it is difficult for the central government to develop a reasonable eco-industrial park plan based on the actual situation of each region [101]. Second, local governments—who know the actual level of local economic development better than the central government—are the actual implementers of the NEDP pilot policy. When economic development and environmental management goals conflict, local governments tend to focus on economic development and neglect environmental protection (local officials’ promotion depends on performance assessment indicators such as local economic growth rate) [102]. For the eastern region which has higher economic assessment targets, ecological industrial parks may be given much less attention than in the central and western regions. Local governments in the eastern region may selectively implement pilot policies for eco-industrial parks, as well as reduce policy subsidies and tax support for eco-industrial parks to respond to economic performance assessment by their superiors. Therefore, the effect of NEDP on GTFP in the eastern region is not significant. As for the central and western regions, their economic assessment targets are much less than those of the eastern regions. Coupled with the more fragile natural ecology in the central and western regions, the pressure on local governments to protect the environment is greater than the economic growth target assessment. Local governments in central and western regions will enforce environmental regulations.
more strictly through environmental performance assessment and have stronger incentives to improve environmental governance in eco-industrial parks, which in turn will enhance GTFP. Therefore, the effect of NEDP on GTFP is also more significant in the central and western regions.

Table 7. City geographic location heterogeneity results.

| Variables | (1) Eastern Region | (2) Central Region | (3) Western Region |
|-----------|--------------------|--------------------|--------------------|
| park      | 0.019              | 0.180 ***          | 0.186 ***          |
|           | (0.050)            | (0.047)            | (0.064)            |
| lnrkmd    | 0.112 ***          | −0.00199          | 0.0201             |
|           | (0.026)            | (0.022)            | (0.027)            |
| lnpdgdp   | −0.0434            | −0.200 ***         | −0.131 **          |
|           | (0.039)            | (0.024)            | (0.059)            |
| lngdzc    | 0.004              | 0.026              | 0.020              |
|           | (0.028)            | (0.023)            | (0.026)            |
| lniinternet | 0.041 *        | 0.103 ***          | 0.039              |
|           | (0.022)            | (0.022)            | (0.033)            |
| lnfin     | 0.023              | 0.072 **           | −0.003             |
|           | (0.037)            | (0.028)            | (0.035)            |
| Cons      | 0.137              | 1.829 ***          | 1.478 ***          |
|           | (0.350)            | (0.381)            | (0.456)            |
| Year      | Yes                | Yes                | Yes                |
| City      | Yes                | Yes                | Yes                |
| N         | 1.170              | 1.118              | 819                |
| R-squared | 0.149              | 0.329              | 0.188              |

Note: Robust standard errors (city level) in parentheses, *** p < 0.01, ** p < 0.05, * p < 0.1.

4.5.2. Analyzing City Type Heterogeneity Results

Due to the diversity of resource type, resource endowment and utilization, resource-based cities and non-resource-based cities may face different pressures in the process of NEDP construction and the effectiveness of its implementation may be significantly different. To verify whether the green development driving effect of NEDP on resource-based cities and non-resource-based cities remains the same, the study sample is further divided into resource-based cities and non-resource-based cities for comparative analysis based on the division of the National Sustainable Development Plan for Resource-Based Cities (2013–2020). Table 8 reflects that the NEDP pilot policy has a significant positive impact on GTFP in both non-resource-based cities and resource-based cities, while the contribution of resource-based cities is greater than that of non-resource-based cities. It is not difficult to understand that resource-based cities are cities that have, as their leading industries and economic activity, the exploitation and processing of natural resources such as minerals and forests in the region. The economic development of resource-based cities depends on local natural resources and is influenced by factors such as material base and technological capability. Such cities have lower resource utilization efficiency and more serious environmental pollution in the early production process, and the local government is particularly keen to change the economic development model. Therefore, under the guidance of the NEDP pilot policy, resource-based cities would design and operate eco-industrial demonstration parks closely around their local natural conditions, industry advantages, and location advantages, and thus realize the transformation from a rough economic development model to an intensive development model. Moreover, resource-based cities, which usually have higher pollutant emissions compared to non-resource-based cities, also have stronger incentives to reduce emissions and to implement the NEDP pilot policy. The promotion of GTFP in resource-based cities is also stronger under the pilot policy of NEDP that combines the introduction of high technology and improvement of economic growth quality with regional transformation and industrial restructuring and with ecological protection and comprehensive regional environmental improvement.
Finally, compared with resource-based cities, non-resource-based cities undergo a smaller pollutant emission base and less pressure to reduce emissions in the process of NEDP construction and have relatively strong technical strength and a more reasonable industrial layout. This makes eco-industrial parks in non-resource-based cities confront less pressure and challenges, and thus their contribution to GTFP is relatively weak.

Table 8. City type heterogeneity results.

| Variables | (1) Resource-Based City | (2) Non-Resource-Based Cities |
|-----------|-------------------------|------------------------------|
| park      | 0.191 *** (0.028)       | 0.0765 ** (0.038)           |
| lnrdc     | −0.012 (0.020)          | 0.053 *** (0.020)           |
| lnpgdp    | −0.152 *** (0.034)      | −0.154 *** (0.034)          |
| lngdzc    | 0.012 (0.027)           | 0.045 ** (0.021)            |
| lninternet| 0.023 (0.024)           | 0.0640 *** (0.019)          |
| lnfin     | 0.067 *** (0.025)       | 0.044 (0.028)               |
| Cons      | 1.884 *** (0.334)       | 0.937 *** (0.281)           |
| City      | Yes                     | Yes                          |
| Year      | Yes                     | Yes                          |
| N         | 1222                    | 1885                         |
| R-squared | 0.192                   | 0.176                        |

Note: Robust standard errors (city level) in parentheses, *** p < 0.01, ** p < 0.05.

5. Conclusions and Managerial Implications

5.1. Conclusions

Eco-industrial parks emphasize a green, low-carbon, and circular development model, which is under China’s vision of building an environment-friendly and resource-saving society and is one of the crucial ways to practice the concept of green development in the industrial field. Therefore, accurately assessing the impact of construction of national eco-industrial demonstration park (NEDP) on regional green economic growth is a crucial issue of concern for all sectors of society. In this paper, using panel data of prefecture-level cities from 2005 to 2017, the empirical research concludes that the construction of NEDP enhances green total factor productivity (GTFP). The findings remain valid after a series of robustness tests were performed. The mechanism analysis shows that the construction of NEDP significantly improves GTFP through technological innovation and industrial structure upgrading. Besides, NEDP has a significant positive effect on GTFP in the central and western regions, while the insignificant effect is in the eastern region. NEDP also significantly contributes to GTFP in resource-based and non-resource-based cities, while the contribution of resource-based cities is greater than that of non-resource-based cities. Compared with other industrial parks, eco-industrial parks emphasize a green, low-carbon, and circular development model that balances economic development and ecological protection which is of great importance for achieving sustainable development. The findings of this paper expand the understanding of the construction of NEDP, and the policy inspirations brought about are as follows.
5.2. Managerial Implications

5.2.1. Academic Implications

The policy implications derived from the conclusions of this paper are also more intuitive. How to accelerate the transformation of old and new dynamics and strengthen the quality of economic development in the context of supply-side structural reform is a vital concern of all sectors of society. The construction of NEDP not only focuses on the protection of the regional ecological environment, but also promotes local technological innovation and industrial structure upgrading, realizes green growth, brings a significant positive effect on regional economic development, and achieves the dual goals of ecological protection and sustainable economic development. However, in reality, the number of domestic cities that have set up eco-industrial parks is relatively small at present and the construction of eco-industrial parks has not received enough attention. Therefore, in future policy design, China should further increase support and publicity for the construction of eco-industrial parks and encourage other industrial parks that meet the conditions to declare and transform into eco-industrial demonstration parks actively. Efforts should also be taken to increase policy support for NEDP—such as preferential, industry, and commerce—and supporting infrastructure construction so that eco-industrial parks can be constructed in more cities. In addition, it is necessary to further optimize the management methods for the constructing of NEDP and eliminate eco-industrial parks that do not meet the needs of green environmental protection. By vigorously promoting the construction of NEDP and improving the supervision system of eco-industrial parks, a solid foundation will be laid for the green development of China.

5.2.2. Future Considerations

Although this study systematically assesses the impact of the NEDP pilot policy on GTFP, there are still limitations in this study that may be a direction for continued attention in the future. First, this study only uses DID and mediation effect models to analyze the impact of the NEDP pilot policy on GTFP. However, some scholars have begun to try to incorporate spatial factors into the DID model to analyze the results. Therefore, future scholars can use the spatial DID model to analyze the studies relating to the subject of this study in detail. In addition, this study only examines the impact of the NEDP pilot policy on GTFP from the perspectives of technological innovation and industrial structure upgrading, while there may be multiple channels of impact of the NEDP policy on GTFP. Therefore, the impact of NEDP pilot policies on GTFP can be analyzed from the perspectives of optimizing resource allocation, optimizing pollution agglomeration and improving energy structure in future studies.

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