

# Ecological Legal Construction and Green Total Factor Productivity

## -- Based on an Environmental Court Perspective

Liyong Xu, Yumeng Liu

School of Business, Shandong Normal University, Jinan 250014, China

### Abstract

**The construction of an ecological rule of law is of great significance to the improvement of green total factor productivity of enterprises. The project takes the establishment of the environmental protection court as a quasi-natural experiment, selects all A-share listed companies from 2007 to 2021 as the research object, uses the SBM-GML model to measure the green total factor productivity of each enterprise, and employs the difference-in-differences method to explore the impact of ecological rule of law construction on the green total factor productivity of enterprises. The research shows that there is a positive correlation between the green total factor productivity of enterprises and the establishment of environmental courts. In addition, we also find that the establishment of environmental courts in the eastern region has a more obvious effect on the improvement of green total factor productivity of enterprises. Based on the above conclusions, this paper puts forward relevant policy recommendations on improving the environmental court system and the construction of ecological rule of law in China, and helps to improve the green total factor productivity of enterprises.**

### Keywords

**Environmental Court; Green Total Factor Productivity; Ecological Legal Construction.**

## 1. Introduction

In the context of carbon peaking, carbon neutrality becoming a national strategy, and the country's clear "30·60" dual-carbon goals and action plans, the task of comprehensively improving resource utilization efficiency around the theme of promoting high-quality economic and social development is more urgent. Green total factor productivity is an important indicator for quantifying high-quality development. In the stage of high-quality development in China, how to upgrade and optimize the environmental regulation system and promote the stable and sustained growth of China's green total factor productivity has become a key issue, which is of great significance for promoting sustainable economic development.

Since 2007, intermediate people's courts in various parts of China have successively established environmental protection courts, starting from Guizhou and gradually covering the whole country. The environmental protection court is China's "from bottom to top, from point to surface" environmental justice specialization exploration practice. By the end of 2020, 152 intermediate environmental courts have been set up across the country, and only a few provinces have not been set up, excluding Hong Kong, Macao, and Taiwan. Strengthening the legal governance environment and improving the efficiency of environmental justice has become the key to improving the ecological environment and promoting the green and high-quality development of the economy [1]. As an important environmental regulation, the environmental protection court is an important part of constructing ecological rule of law. Its establishment has improved the efficiency of handling environmental violations and is

significant for promoting sustainable development. However, the existing literature has not studied the impact of the establishment of intermediate environmental courts on the green total factor productivity of enterprises. This paper draws on the research methods of many scholars, uses the SBM-GML model to measure the green total factor productivity data at the enterprise level, takes the establishment of the environmental protection court as a quasi-natural experiment, and uses the multi-time point difference method to study the establishment of the environmental protection court. The impact of this environmental regulation method on corporate green total factor productivity. The empirical results show that the establishment of environmental courts can effectively improve the green total factor productivity of enterprises. Further analysis shows that the policy effect in the western region is not obvious through the heterogeneity test.

## 2. Related Literature and Hypothesis Development

### 2.1. Related Literature

#### 2.1.1. Research on Measuring Green Total Factor Productivity

The calculation methods of green total factor productivity mainly include the algebraic index method, Solow residual method, Stochastic Frontier Analysis (SFA), Data Envelopment Analysis (DEA), and so on.

Chung et al. (1997) proposed a new directional distance function (DDF) and Malmquist-Luenberger (ML) productivity index based on the Shephard distance function [2]. Tone (2001) proposed a SBM model that does not require year-on-year changes in input or output and can also take into account the input-output relaxation problem for productivity measurement in the case of unexpected output [3]. Cui and Lin (2019) used the Malmquist Luenberger productivity index method and directional distance function (DDF) to comprehensively model and measure the green total factor productivity of enterprises [4].

#### 2.1.2. The Impact of the Establishment of Environmental Courts on the Corporate Level

Hancevic (2016) believed that under strict environmental regulation, enterprises tend to use more funds for non-productive activities, such as the purchase of environmental protection equipment. The additional loss and the decrease in the matching degree between the means of production and the original production equipment will eventually lead to a loss of productivity [5]. Huang et al. (2018) believed that due to the lag of policies, outdated environmental policies will induce enterprises to accelerate the increase of polluting economic output in order to compensate for the cost of pollution reduction and reduce green total factor productivity [6]. Li and Chen (2019) used the Luenberger productivity index method based on the relaxed directional distance function to measure the green total factor productivity of industrial pollution sources in the national "environmental statistical reporting system," and examined the dynamic impact mechanism of environmental regulation on the green total factor productivity of enterprises. The results show that environmental regulation will reduce the green total factor productivity of enterprises in the short term, and will promote the green total factor productivity of enterprises in the long term [7]. Cheng and Chen (2019) considered that appropriate environmental regulation can stimulate enterprises' green technology innovation activities by quantitatively and qualitatively testing the impact of environmental regulation, technological progress, and sustainable development. Cui and Lin (2019) used the propensity score matching method (PSM) and difference-in-differences method (DID) to test the net effect of FDI on the green total factor productivity of enterprises. There is a 'U'-shaped relationship between Lu (2020) environmental regulation and green total factor productivity of China's thermal power listed companies, and the environmental regulation intensity faced by most of China's thermal power listed companies is located on the left side of the 'U'-shaped critical point [9]. Based on the data of manufacturing listed companies from 2007 to 2018, Li and Xu

(2021) used the super-efficiency SBM model and GML index method to measure and decompose the green total factor productivity of enterprises and used the triple difference and threshold model to empirically test the impact of manufacturing servitization on GTFP of enterprises under the background of replacing business tax with VAT[10].

## 2.2. Hypothesis Development

This paper holds that the impact of the establishment of environmental courts on the green total factor productivity of enterprises is mainly reflected in the following three aspects: the establishment of environmental courts as appropriate environmental regulation can stimulate the innovative development ability of regulated enterprises, produce innovative compensation effect that exceeds the cost of environmental regulation, and further increase output. The new environmental regulation can not only improve the quality of the environment but also improve the profits of enterprises, which mainly come from the exploration of market potential[11]. The specialization of environmental justice through the establishment of environmental courts can improve the environmental pollution situation in the region and enhance the green total factor productivity of enterprises in the region.

Based on the above analysis, we propose our main assumptions as follows:

**H1:** Establishing environmental courts will improve the green total factor productivity of enterprises.

## 3. Research Design

### 3.1. Sample and Data

This paper selects all A-share listed companies from 2007 to 2021 as the research object, and conducts the following screening in the screening process : (1) Excluding listed companies in the financial industry ; (2) Excluding listed companies with ST, ST \*, and STPT from 2007 to 2021 ; (3) Eliminate samples with all missing data or serious missing data ; (4) Tailing the continuous variables at 1 % and 99 % quantiles. Finally, 30625 samples were obtained.

We manually collected the data of the establishment time of environmental protection courts in prefecture-level cities from the official home page of the provincial (state) intermediate people's courts, the website of the provincial and state people's governments, or the news reports published by local media.

On the construction of the dependent variable enterprise green total factor productivity ( GTFP ) index: This paper uses the SBM-GML model to measure the enterprise green total factor productivity. The main indicators of GTFP measurement include two aspects: input and output : Input: divided into capital investment, labor input, and energy input. (1) Capital investment: The perpetual inventory method is used to estimate the capital investment of each enterprise. That is  $K_t = K_{t-1}(1 - \delta_t) + I_t/P_t$ . Among them,  $K_t$  is the capital stock in period  $t$ ,  $\delta_t$  is the depreciation rate of 5 %,  $I_t$  is the net fixed assets of enterprises in period  $t$ , and  $P_t$  is the investment price index of the province where the enterprise is located in period  $t$ . (2) Labor input: represented by the number of employees in the enterprise. (3) Energy input: The electricity consumption of industrial enterprises in the city where the listed company is located is used as a proxy indicator.

Output: divided into expected output and undesired output. (1) Expected output: The main business income of the enterprise is used as the proxy index of the expected output. (2) Undesirable output: Undesirable output variables are expressed by the amount of three wastes produced by industrial enterprises, including industrial SO<sub>2</sub> emissions, industrial wastewater emissions, and industrial soot emissions. Undesirable output data come from the ' China City Statistical Yearbook '.

Since the direct result measured by the SBM-GML model is the green total factor growth rate, this paper uses the multiplicative method to calculate the green total factor productivity of each year.

Accumulative multiplication: Set 2010 as the base period, and the green total factor productivity is 1. Other years ' green total factor productivity is the product of the GML index of the year and the green total factor productivity of the previous year, as follows: where i is the province,  $i = 1, 2, \dots, 30$ ,  $t = 2010, \dots, 2021$ .

$$\text{Green}_{2010} = 1 \tag{1}$$

$$\text{Green}_{it} = 1 \times \prod_{t=2006}^T \text{GML}_{it} \tag{2}$$

### 3.2. Regression Model

In order to test the impact of the construction of ecological rule of law on the green total factor productivity of enterprises, we use the establishment of environmental courts and the differences in the establishment time between cities to construct the following difference-in-differences model:

$$\text{GTFP}_{it} = \beta_0 + \beta_1 \text{Court}_{it} + \beta_2 X_{it} + \gamma_t + \mu_{city} + \varepsilon_{it} \tag{3}$$

In the model,  $\text{GTFP}_{it}$ , the explained variable represents the green total factor productivity of enterprise i in year t.  $\text{Court}_{it}$  is a dummy variable. If the environmental court has been set up in the city t where enterprise i is located, the value is 1, otherwise the value is 0 ;  $X_{it}$  represents control variables. The model controls the city fixed effect  $\mu_{city}$  and the year fixed effect  $\gamma_t$ ,  $\varepsilon_{it}$  which is a random error term. In addition, all continuous variables are entailed at the 1% and 99% levels to mitigate the impact of outliers. The details of variable definitions are in Table 1.

**Table 1.** Variable definitions

Variable	Variable-definition
Dependent variable	
<i>GTFP</i>	Enterprise green total factor productivity, measured by SBM-GML model.
Independent variable	
Court	If the city i where the company is registered has established the environmental court at year t, the court value is 1. Otherwise, it is 0.
Control variables	
Size	Company size is the natural logarithm of the annual total assets.
Lev	Asset-liability ratio: Total liabilities at year-end / total year-end assets.
ROA	Total assets net profit margin: net profit / total assets average balance.
Fixed	The proportion of fixed assets is the ratio of net fixed assets to total assets.
BM	Book market value ratio: book value / total market value.
Indep	Proportion of independent directors.
Dual	Proportion of persons holding two posts in one.
PB	Price-to-Book Ratio.
Employee	Natural logarithm of the number of employees.

## 4. Empirical Results

### 4.1. Baseline Regression

Table 2 reports the regression results of the impact of the establishment of environmental courts on the green total factor productivity of enterprises in China. In Column (1), only the enterprise individual fixed effect is added; in Column (2), only year fixed effect and enterprise individual fixed effect are added. In Column (3), only control variables are added without fixed effects; in Column (4), control variables and two fixed effects of year and individual are added at the same time. The results show that the regression coefficient of the establishment of environmental courts is significantly positive, indicating that the establishment of environmental courts in China has significantly improved the green total factor productivity of enterprises to a certain extent.

**Table 2.** Environmental court establishment and corporate GTFP

Variables	(1)	(2)	(3)	(4)
	GTFP	GTFP	GTFP	GTFP
Court	0.0039***	0.0045***	0.0060***	0.0052***
	(6.97)	(6.26)	(13.40)	(7.16)
Constant	1.0024***	1.0071***	1.0309***	0.9818***
	(3816.52)	(965.09)	(210.63)	(81.07)
Observations	30625	30625	28708	28708
Control variable	no	no	yes	yes
Year fixed effect	no	yes	no	yes
Firm fixed effect	yes	yes	no	yes
R – square	0.0018	0.0184	0.0094	0.0237

Notes: This table documents the results of the baseline model. Figures in parentheses are t-statistics based on standard errors adjusted for city clustering. Levels of significance are denoted by \*(10%), \*\*(5%), and \*\*\*(1%).

### 4.2. Cross-sectional Heterogeneity

**Table 3.** Cross-sectional heterogeneity

Variables	Area		Enterprise Nature	
	(1)	(2)	(3)	(4)
	Western Region	Central and Eastern regions	State Enterprise	Non-State Enterprises
	GTFP	GTFP	GTFP	GTFP
Court	-0.0024	0.0071***	0.0072***	0.0031***
	(-1.45)	(8.92)	(6.25)	(3.23)
Observations	4972	23328	12264	15459
Controls	yes	yes	yes	yes
Firm fixed effect	yes	yes	yes	yes
Year fixed effect	yes	yes	yes	yes
Adjusted R-square	0.3185	0.1454	0.1892	0.1453

Figures in parentheses are t-statistics based on standard errors adjusted for firm clustering. Levels of significance are denoted by \*(10%), \*\*(5%), and \*\*\*(1%).

The above empirical results confirm the prediction of the tested hypothesis H1, and the establishment of China's environmental protection court has significantly improved the green total factor productivity of enterprises to a certain extent. Further, we explore the impact of the establishment of environmental courts on the green total factor productivity of enterprises under different environmental conditions from the dimensions of enterprise characteristics and regional characteristics. The results are shown in Table 3.

The results of the regional heterogeneity test show that the establishment of environmental courts has not had a significant positive impact on the green total factor productivity of enterprises in the western region of China, but has a significant positive impact on enterprises in the eastern and central regions. The policy effect of state-owned enterprises and non-state-owned enterprises is not much different, which shows that the policy of establishing environmental courts can improve the green total factor productivity of enterprises of different natures.

## 5. Conclusion

The establishment of environmental courts is a major innovation in China's ecological rule of law practice and an important focus of China's green development strategy. This paper takes the establishment of environmental courts as a quasi-natural experiment. The regression results of the difference-in-differences model show that the establishment of environmental courts has significantly improved the green total factor productivity of enterprises, especially for enterprises in the eastern region with a high degree of marketization and good development. The policy effect is more obvious. This fills the theoretical gap between the establishment of environmental courts and the green total factor productivity at the enterprise level.

## Acknowledgments

College Students' Innovation and Entrepreneurship Training Plan Program (S202310445206, S202310445219).

## References

- [1] W. Liu , W.Y.Fan : Does public interest litigation improve the performance of urban environmental governance ? - An empirical study based on micro data of 287 prefecture-level cities [ J ]. Journal of Shanghai University of Finance and Economics, 2021, 23 ( 04 ) : 48-62.(In Chinese).
- [2] Y. H. Chung, FÅre R, Grosskopf S. :Productivity and Undesirable Outputs: A Directional Distance Function Approach [J]. Journal of Environmental Management, 1997, 51(3): 229-240.
- [3] K. A. Tone : slacks-based measure of efficiency in data envelopment analysis [J]. European Journal of Operational Research, 2001, 130(3): 498-509.
- [4] X. H. Cui , N. Y. Lin :How does FDI affect the green total factor productivity of enterprises ? Empirical analysis based on Malmquist-Luenberger index and PSM-DID [J].Economic management, 2019,41 ( 03 ) : 38-55.(In Chinese).
- [5] P.I. Hancevic: Environmental regulation and productivity: The case of electricity generation under the CAAA-1990[J]. Energy economics,2016,60(Nov.):131-143.
- [6] Q. H. Huang , J. F. Hu , X. D. Chen : Environmental regulation and green total factor productivity : Dilemma or win-win ? [J].China Population, Resources and Environment, 2018,28 ( 11 ) : 140-149.(In Chinese).
- [7] P. S. Li , Y. Y. Chen : Environmental regulation, corporate bargaining power and green total factor productivity [J]. Finance and Trade Economy, 2019,40 ( 11 ) : 144-160.(In Chinese).
- [8] G. B. Cheng , X. Chen : New Path of Sustainable Development : Environmental Regulation and Technological Progress - Empirical Test Based on Threshold Effect [J].Journal of Anhui Normal

University ( Humanities and Social Sciences Edition ), 2019,47 ( 03 ) : 69-77.Xinyi H ,Fei T ,Yu X , et al. Bankruptcy courts and the marketization of bond issuance[J].China Accounting and Finance Review,2022,24(3):359-390.(In Chinese).

- [9] C. Y. Lu : The impact of environmental regulation on the green total factor productivity of thermal power enterprises [ D ]. Master, China, 2020.(In Chinese).
- [10]Y. Li, Y. M. Xu : The impact of manufacturing servitization on corporate green total factor productivity under the background of replacing business tax with VAT [ J ].Soft Science, 2021,35 ( 9 ) : 117-123.(In Chinese).
- [11]D. Simpson, R. Bradford : Taxing Variable Cost: Environmental RegulationsIndustrial Policy [j], Journal of Environmental Economics and Management,1996(30):282-300.