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Editorial

Environmental Protection and Economic Development: Research Progress of Eco-Efficiency

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1. Introduction

This Special Issue (Environmental Protection and Economic Development: Research Progress of Eco-Efficiency) explores environmental conservation and the ongoing progress in economic research, particularly productive efficiency, commonly referred to as eco-efficiency or environmental efficiency. The concept of eco-efficiency was first introduced in 1992 by the Business Council for Sustainable Development. It revolves around the idea of achieving greater desired outcomes while consuming fewer resources and minimizing the generation of undesirable byproducts. While numerous authors have made valuable contributions to the eco-efficiency literature [1–3], conducting empirical analyses of eco-efficiency remains challenging, primarily due to the complexities involved in modeling undesirable outputs. In recent years, eco-efficiency has been explored through the lens of production theory, but there is still a lack of widely accepted methodologies and analytical frameworks for measurement.

Recognizing these challenges, we believe eco-efficiency provides a promising avenue for harmonizing environmental protection and economic development across various decision-making levels and stages. Environmental protection entails the proactive preservation and conservation of the environment, aiming to maintain its safety and overall health. Its primary objective is to reduce the generation of unintended outputs and mitigate factors contributing to environmental degradation [4,5].

Economic development refers to the ongoing process aimed at improving the quality of life and economic well-being of individuals within a specific region, country, or on a global scale. This progress is guided by specific goals and well-defined objectives. Governments typically pursue economic development with a focus on achieving sustainable industrialization and economic growth [6,7].

An effective approach to designing sustainable development, one that considers environmental impacts alongside economic and non-economic factors, involves the use of eco-efficiency analysis in conjunction with Data Envelopment Analysis (DEA). Eco-efficiency DEA models rely on mathematical optimization techniques and incorporate unintended outputs within the framework of production economics [8–10]. However, there remains ongoing debate and a lack of consensus among researchers regarding handling unintended outputs within the DEA methodology. The most recent development in terms of incorporating undesirable outputs in the production process was proposed by Fukuyama and Tan [11], in which the costly disposability property was interpreted through a strategic disposability interpretation in a network DEA framework.

We have accepted five papers, four directly dealing with eco-efficiency and one considering Sewage Charges Standard Reform in China.

2. Accepted Papers

The first paper, "Exploring the Influence of Environmental Investment on Multinational Enterprises' Performance from the Sustainability and Marketability Efficiency

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Perspectives" (Hsiao-Yen Mao, Wen-Min Lu, and Hsin-Yen Shieh), investigates the impact of environmental investment on the firm performance of multinational enterprises. The analysis is carried out from the sustainability and marketability efficiency perspectives based on network DEA and second-phase truncated regression analysis. The main findings include: (1) innovation (based on the environmental innovation score (EIS)) and resource use (calculated using the resource use score (RUS)) have a significant negative impact on firm performance in the short term; (2) while EIS and RUS do not have significant effects on the sustainability and marketing efficiencies, the emission score is positively associated with these two efficiencies.

The second paper, "Eco-Efficiency and Its Evolutionary Change under Regulatory Constraints: A Case Study of Chinese Transportation Industry" (Zhiqiang Zhu, Xuechi Zhang, Mengqing Xue, and Yaoyao Song), studies the eco-efficiency analysis of the transportation industry in China. This study estimates the eco-efficiency DEA model and the corresponding global Malmquist–Luenberger productivity index. The empirical analysis shows that (1) the Middle Yangtze River area was the best efficiency performer among the eight regions, and the Southwest area was placed last, (2) according to the global Malmquist–Luenberger productivity index, an earlier increase and later decrease trend was exhibited.

The third paper, "Exact Eco-Efficiency Measurement in the Yellow River Basin: A New Non-Parametric Approach" (Chuanxin Xia, Yu Zhao, Qingxia Zhao, Shuo Wang, and Ning Zhang), proposes an eco-efficiency indicator, which is defined by the ratio of gross domestic production to environmental impact. The authors use a biennial meta-frontier non-radial model to address potential threats of technology heterogeneity and linear programming infeasibility. This indicator is used to evaluate the city-level eco-efficiency in the Yellow River Basin from 2008 to 2017. The empirical evidence indicates (1) a harmonious relationship between ecological protection and economic development and (2) the technology leadership effect being the main contributor.

The fourth paper, "Carbon Emissions from Manufacturing Sector in Jiangsu Province: Regional Differences and Decomposition of Driving Factors" (Ping Zhou and Hailing Li), discusses how the carbon emissions and economic growth can be separated and applied to the manufacturing sector in southern Jiangsu, northern Jiangsu, and middle Jiangsu during the 13th Five-Year Plan period. These provinces were analyzed by region and industry from 2016 to 2020 based on the decomposition model of carbon emissions.

The last paper, "Does Stronger Environmental Regulation Promote Firms' Export Sophistication? A Quasi-natural Experiment Based on Sewage Charges Standard Reform in China." (Weihao Zhang, Helian Xu, and Yuanyuan Xu), provides an empirical analysis of the impact of environmental regulation on firms' export sophistication. They utilized data from the Chinese annual survey of industrial firms and the Chinese customs trade database from 2004 to 2013. The focus was on the quasi-natural experiment involving sewage charges standard reform, and a staggered difference-in-difference model was employed. The results show that the sewage charge standard reform notably boosts firms' export sophistication, with varying effects across different types of firms. The reform's impact is most pronounced in firms engaged in both import and export activities, large-sized firms, and local firms. This influence on export sophistication primarily occurs through innovation compensation, product switching, and other mechanisms.

List of Contributions

1. Zhang, W., Hu, H., Xu, Y. Does Stronger Environmental Regulation Promote Firms' Export Sophistication? A Quasi-Natural Experiment Based on Sewage Charges Standard Reform in China.
2. Mao, H-Y., Lu, W-M., Shieh, H-Y. Exploring the Influence of Environmental Investment on Multinational Enterprises' Performance from the Sustainability and Marketability Efficiency Perspectives.

3. Zhu, Z., Zhang, X., Xue, M., Song, Y. Eco-Efficiency and Its Evolutionary Change under Regulatory Constraints: A Case Study of Chinese Transportation Industry.
4. Xia, C., Zhao, Y., Zhao, Q., Wang, S., Zhang, N. Exact Eco-Efficiency Measurement in the Yellow River Basin: A New Non-Parametric Approach.
5. Zhou, P., Li, H. Carbon Emissions from Manufacturing Sector in Jiangsu Province: Regional Differences and Decomposition of Driving Factors.

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

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11. Fukuyama, H.; Tan, Y. Implementing strategic disposability for performance evaluation: Innovation, stability, profitability and corporate social responsibility in Chinese banking. *Eur. J. Oper. Res.* **2022**, *296*, 652–668. [CrossRef]