WEP Warwick Evans Publishing

International Journal of Global Economics and Management

ISSN: 3005-9690 (Print), ISSN: 3005-8090 (Online) | Volume 8, Number 1, Year 2025
DOI: https://doi.org/10.62051/ijgem.v8n1.16
Journal homepage: https://ijgem.org

A Study on the Impact of the Synergistic Effects of Green Finance and Environmental Regulation on China's High-Quality Economic Development: An Empirical Analysis from a Heterogeneous Regional Perspective

Zewei Zhang

School of Economics, Xiamen University, Xiamen 361005, China

ABSTRACT

Based on panel data from 30 provinces in China from 2010 to 2022, this study constructs a green finance development index, an environmental regulation intensity index, and their interaction term to empirically examine the regional heterogeneity of their synergistic effects on high-quality economic development. Using a comprehensive evaluation system encompassing innovation, coordination, green development, openness, and sharing, combined with a two-way fixed-effects model, the results show that: The synergistic effects vary across regions: The interactive effect between green finance and environmental regulation significantly promotes high-quality development nationwide and in the eastern and central regions; however, in western China, this effect is statistically insignificant and exhibits a weak inhibitory trend. The core mechanism is clear: the high-end transformation of industrial structure and green technology innovation constitute a dual path for synergistically enhancing total factor productivity and driving high-quality development. Analysis of the Roots of Regional Disparities: The eastern region achieves deep synergy through its industrial foundation, mature financial markets, and efficient policy implementation; the central region experiences effective synergy during its transition period, but its intensity is limited; the western region, constrained by resource-based path dependence, a lack of green finance, ineffective regulation, and weak enterprise transformation capabilities, faces the challenge of balancing short-term compliance costs with long-term development momentum. Research Value and Policy Implications: The study confirms the significant spatial dependence of synergy effects, providing empirical support for differentiated regional governance. Future policies require precise positioning: the eastern region should strengthen institutional innovation leadership, the central region should focus on supporting transformation, the western region needs to prioritize strengthening green financial infrastructure and building a progressive environmental regulatory framework to promote high-quality and coordinated development across the region.

KEYWORDS

Green finance; Environmental regulation; Synergy; High-quality development; Regional heterogeneity; China

1. INTRODUCTION

China's economy has entered a stage of high-quality development, the core of which lies in building a new development pattern that is innovation-driven, coordinated and balanced, and green and low-carbon. This transformation requires breaking away from traditional path-dependence and achieving synergy between growth and the environment. Against this backdrop, the synergy between green finance and environmental regulation—two key policy tools driving this green transition—has become a key focus. The former guides capital allocation toward environmentally friendly sectors

through market-based mechanisms, while the latter leverages government regulation to curb polluting behavior and internalize environmental costs.

The two complement each other: the effective operation of green finance relies on clear and enforceable environmental standards as a basis for identification; and strict environmental regulation, to truly promote industrial upgrading rather than merely increase burdens, requires the financing support and risk-sharing provided by green finance. Together, these two constitute a key engine driving this green, low-carbon transformation. However, China exhibits significant regional disparities, with systematic differences in development stage, industrial structure, resource endowment, environmental carrying capacity, and policy implementation. This heterogeneity can lead to significant spatial variations in the strength and even direction of synergistic effects. Ignoring regional differences and adopting a one-size-fits-all policy approach will not only fail to unleash synergistic potential, but may also weaken overall effectiveness and even exacerbate regional development imbalances.

Existing research often focuses on the effects of single policies or national-level synergistic effects. In-depth systematic research examining their specific manifestations, strength, and underlying causes across different regions is lacking. This results in a lack of theoretical understanding of differentiated synergistic mechanisms and a lack of empirical support for targeted policy implementation.

Therefore, this study focuses on regional differences, aiming to systematically analyze the paths, effects, and spatial heterogeneity of the synergistic impact of green finance and environmental regulation on China's high-quality economic development, and explore its root causes. This theoretical approach will help expand the framework for environmental-economic collaborative governance; in practice, it will provide key insights for the central government to formulate differentiated regional coordination policies and for local governments to optimize policy mixes tailored to local conditions, thus having significant value in promoting high-quality development across the region.

2. THEORETICAL FOUNDATION, SYNERGISTIC MECHANISM, AND RESEARCH HYPOTHESIS

The core logic of green finance and environmental regulation working together to drive high-quality development stems from the complementary functions and consistent goals of the two. Environmental regulation, through tools like emission standards, environmental taxes and fees, and emission rights trading, internalizes negative environmental externalities faced by businesses, raising the cost of pollution and thereby forcing them to eliminate outdated production capacity or undertake green transformation. Green finance, through channels like green credit and green bonds, provides financing support for businesses' environmental transformation, clean technology research and development, and green projects, mitigating the financial constraints and risks of these transformations. The "push" created by environmental regulation combined with the "pull" provided by green finance creates significant synergy.

This synergistic effect primarily drives high-quality development through two core pathways:

Industrial Structure Optimization and Upgrading: The combination of improved environmental standards and green capital injections has significantly increased the operating and financing costs of high-pollution, high-energy-consuming industries, forcing them to exit or transform. At the same time, the synergistic effect has created positive market expectations and financing environment for green industries such as energy conservation, environmental protection, and clean energy. This guides the shift of production factors from traditional to green sectors, promotes the evolution of the industrial structure toward high value-added, low-environmental impact, and enhances total factor productivity [1].

Incentivizing Green Technology Innovation: The combined pressure of environmental compliance and the low-cost R&D support and risk-sharing mechanisms provided by green finance strengthen the internal motivation and external conditions for enterprises to innovate in green technologies. Such innovation not only directly reduces pollution and improves resource efficiency, but also creates new market growth points, becoming a core driver of high-quality development.

Given the significant regional imbalances in China's development, synergy effects are expected to exhibit spatial heterogeneity. The eastern region, with its developed economy, strong industrial foundation, mature financial market, and strong environmental enforcement, is well-positioned to foster a virtuous cycle of "effective regulatory constraints - targeted financial support - rapid industrial response - and continuous technological innovation," and is expected to experience the most significant synergy effects. Central China is in the mid-to-late stage of industrialization, with both traditional industry upgrades and emerging industry development. If synergistic policies can effectively guide resource flows, they could be a significant boost to its green leapfrogging development. Western regions, on the other hand, face multiple constraints: a relatively underdeveloped economy with a high reliance on resource-based industries; an underdeveloped green finance market with weak service capabilities; potentially limited environmental regulatory infrastructure and enforcement; and generally insufficient capacity and willingness among enterprises to transition to green development. In the short term, strict environmental protection requirements, without sufficient green finance support, could significantly increase corporate costs, inhibit traditional growth drivers, and temporarily dampen high-quality development, making synergistic efficiency gains difficult. This leads to a core hypothesis: Green finance and environmental regulation can synergize to promote high-quality development, the effect shows regional gradient differentiation: it is strongest in the east, followed by the central region, and is not significant or slightly negative in the west.

3. RESEARCH DESIGN, VARIABLE MEASUREMENT AND DATA BASIS

Based on panel data from 30 provinces in China from 2010 to 2022, this study empirically examines the impact of the synergy between green finance and environmental regulation on high-quality economic development and its regional disparities.

Explained Variable: A comprehensive indicator system covering five dimensions, namely innovation, coordination, green development, openness, and sharing, is constructed, and a composite index is synthesized using the entropy-weighted TOPSIS method to measure this.

Core Explanatory Variable:

Green Finance Development: A comprehensive index is constructed using the entropy-weighted method, integrating indicators of scale, structure, and efficiency.

Environmental Regulation Intensity: A comprehensive index is constructed using the entropy-weighted method, integrating indicators of command-and-control, market incentives, and public participation.

Synergy Effect: The product term (GF × ER) of the aforementioned GF index and the ER index is used to quantify this effect.

Control Variables: GDP per capita, urbanization rate, number of students enrolled in higher education, share of foreign direct investment, and share of fiscal expenditure are included. Regional Heterogeneity Analysis: Based on commonly used regional classification criteria, the sample was divided into three major regions: eastern, central, and western. Group regression was performed, focusing on comparing intergroup differences in the Synergy coefficient ($\alpha 3$).

Data Sources and Processing: Basic data were obtained from the China Statistical Yearbook, the China Environmental Statistical Yearbook, the China Finance Yearbook, the China Science and

Technology Statistical Yearbook, provincial statistical yearbooks, and the Wind and CSMAR databases. Missing values were imputed using interpolation or moving averages, and continuous variables were winsorized at the 1% level [2]. Descriptive statistics showed that the variables were reasonably distributed.

4. EMPIRICAL RESULTS AND DISCUSSION

National-level benchmark regression results show that both green finance and environmental regulation can significantly promote high-quality economic development. More importantly, the coefficient of the synergy term is highly significant and positive at the 1% statistical level. This result strongly confirms that policy synergy transcends the independent impact of each policy, supporting the research hypothesis. Specifically, for every 1-unit increase in the synergy index, the comprehensive index of high-quality economic development increases by an average of 0.15 units, fully demonstrating the synergistic effect of policy synergy. Mechanism testing further reveals that this synergy is primarily achieved through two core pathways: promoting the optimization and upgrading of industrial structure and incentivizing green technological innovation.

In-depth regional heterogeneity analysis reveals significant gradient differences:

The eastern region: The synergy effect is most prominent and highly significant. This is due to its strong industrial foundation, highly developed financial markets, and efficient policy implementation system, which have formed a virtuous cycle of "regulatory constraints guiding direction - targeted financial resources supporting - and active response from industry players."

The central region: The synergy effect is also significantly positive, but weaker than that of the eastern region. This reflects the typical characteristics of its transitional period: the parallel upgrading of traditional industries and the cultivation of emerging green industries. The realization of synergy is, to some extent, constrained by insufficient financial deepening and the need to improve policy implementation effectiveness [3].

Western Region: Analysis shows a negative synergy coefficient, but it is not statistically significant. Further investigation reveals that environmental regulation alone has a significant inhibitory effect, while green finance alone has a less pronounced promoting effect. This suggests that at the current stage of development in the western region, the two policies have failed to form an effective synergy. The cost pressures brought about by environmental regulation may materialize quickly, while corresponding green finance support has not kept pace, potentially leading to a slight inhibitory effect in the short term.

Systematic differences between regions in economic development foundations, industrial structure characteristics, and policy implementation capabilities are the main reason for the significant gradient in the synergy effect described above. The mature and well-developed system in the east has amplified the benefits of synergy, while the challenges of transformation in the central region have weakened synergy. However, weak supporting conditions in the west have made it difficult for synergy mechanisms to operate effectively, and may even lead to short-term pain.

5. IN-DEPTH ANALYSIS OF THE CAUSES OF REGIONAL HETEROGENEITY

The synergy effect shows significant differences in the east, central and west regions, and the fundamental reason lies in the systematic differences in development conditions among regions.

Different development stages and industrial foundations: The eastern region is dominated by service and high-tech industries, with low resource and environmental dependence, greater resilience to transition and the ability to absorb environmental costs, and a rich resource base for green projects.

The central region is in a critical period of industrial transformation, with a still-high share of traditional manufacturing, resulting in both potential and resistance to upgrading. The western region is largely in the early to mid-stages of industrialization, with economic growth heavily dependent on energy-intensive heavy industries such as energy and minerals. The cost of environmental regulation has significantly impacted short-term growth, the cultivation of high value-added industries has been delayed, and the challenges of transformation are severe.

Differences in Green Finance Development:

Eastern China: The financial market system is mature, with a rich and diverse range of products, including green credit, bonds, funds, insurance, and carbon finance. The service system is well-developed, and the company's project identification and low-cost financing capabilities are outstanding.

Central China: The market continues to grow, but service capabilities for small and medium-sized enterprises need to be strengthened.

Western China: Green finance development lags behind: the institutional structure is low and the number is small; the product range is limited and the scale is limited; professional assessment capabilities are lacking; and corporate financing capabilities are weak. The green financing demand driven by environmental regulations is difficult to effectively meet, with a significant "green financing gap" and a severe lack of financial support for policy coordination.

Diverging Effectiveness of Environmental Regulation Enforcement: Eastern China boasts robust environmental protection institutions, strong monitoring and law enforcement technology, professional personnel, a high level of public oversight, strict and consistent enforcement of regulations, and stable expectations. Overall, enforcement in Central China is acceptable, but some regions face issues of incomplete coverage or inconsistent standards. Western China, constrained by its vast territory, weak regulatory infrastructure, shortage of specialized personnel, local fiscal pressures, and reliance on resource-based economies, faces greater challenges in the intensity, consistency, and sustainability of environmental regulation. "Enforcement flexibility" weakens the regulatory force and reduces green finance's confidence in project environmental impact assessments [4].

Diverging Enterprise Transformation Capabilities and Willingness: Eastern China boasts large scale, advanced technology and management, and a concentration of talent, possessing strong pollution control and innovation capabilities and a positive response to green transformation. While some large enterprises in Central China possess the capacity to transform, many small and medium-sized enterprises face funding, technical, and talent bottlenecks, resulting in insufficient motivation. Western China's enterprises are predominantly small and medium-sized, resource-dependent, and generally lack core technologies, R&D capabilities, and profit margins. They face significant pressure to invest in environmental protection and face significant deficiencies in their understanding and capacity for green transformation. They tend to passively address compliance issues and struggle to proactively seek financial support for deeper transformation.

6. ROBUSTNESS TESTS AND ENDOGENEITY TREATMENT

To ensure the reliability of our conclusions, this study systematically conducted robustness tests and addressed potential endogeneity.

Robustness Tests:

Variable Measurement Replacement: We reconstructed the high-quality development index using principal component analysis; used the proportion of green credit and green bond issuance to measure green finance development; and used market-based indicators such as investment in industrial pollution control per unit of output value to characterize the intensity of environmental regulation.

Key conclusions were robust, with no substantial changes in the direction, significance, or regional heterogeneity of synergistic effects.

Model Specification Adjustment: A province-specific time trend term was incorporated into the baseline two-way fixed-effects model, and feasible generalized least squares was used to address heteroskedasticity and serial correlation. The significance and direction of the core variables were not materially affected.

Analysis of Policy Lag Effects: After the core explanatory variables were lagged for one period, the regression results showed that the synergistic effect in the whole country and the eastern and central regions still significantly promoted high-quality development during the lagged period, but this effect had not yet appeared in the western region.

Special Sample Exclusion: Years in which special environmental protection policies were implemented for major events and provinces with unusual data fluctuations were excluded. After re-regression, the main conclusions remained unchanged.

Endogeneity Treatment:

Endogeneity risk primarily stems from bidirectional causality and omitted variables. The following methods were used to mitigate it:

Instrumental Variable Method:

For green finance, the instrumental variable was the geographical distance of each province from Shanghai or Shenzhen.

For environmental regulation, the instrumental variable was the average intensity of environmental regulations in other provinces in the same region [5].

The Durbin-Wu-Hausman test confirmed the presence of endogeneity, while the weak instrumental variable test indicated that the instrumental variable strength was reasonable. The 2SLS results showed that after controlling for endogeneity, the direction, significance, and regional heterogeneity of the synergy effect coefficient were consistent with the baseline model, and the coefficient value increased, indicating that the baseline results may underestimate the true effect.

A dynamic panel model was constructed by introducing lagged terms of the explained variables, using higher-order lagged terms as instrumental variables. Both the Arellano-Bond and Hansen tests met the requirements. The SYS-GMM results further verified that the synergistic effect has a significant promoting effect on the high-quality development of the whole country and the eastern and central regions, and its regional difference characteristics still hold true.

Comprehensive conclusion: Verification by multiple methods shows that green finance and environmental regulation synergistically promote high-quality development, and their promoting effect shows a gradient decreasing characteristic from east to west. This conclusion is robust and reliable.

7. CONCLUSIONS AND POLICY IMPLICATIONS

Based on empirical analysis, this study reveals the impact of the synergy between green finance and environmental regulation on China's high-quality economic development, as well as its significant regional differences. The key findings are as follows:

The synergistic effect exhibits a gradient distribution: The synergy between the two strongly drives high-quality development in eastern China, primarily by promoting industrial upgrading and green technology innovation. It also has a positive impact on central China, but the effect is weaker than in eastern China. In western China, the positive effects are less pronounced and even show a slight

inhibitory effect due to the mismatch between short-term environmental regulation costs and insufficient green finance support.

This heterogeneity stems from regional differences in infrastructure: the eastern region boasts advanced industries, mature finance, and strong regulatory enforcement, making it easier to form a virtuous cycle; the western region, constrained by its heavy reliance on traditional industries, limited green financing channels, weak regulatory capacity, and insufficient enterprise transformation capabilities, makes it difficult for synergy mechanisms to operate effectively.

Targeted Policy Recommendations:

Regional Targeted Measures:

Eastern China: Deepen institutional innovation and lead international standards. Central China: Strengthen support for transformation and improve the precision of environmental supervision.

Western China: Central government fiscal resources will prioritize the development of green finance infrastructure and the implementation of progressive environmental regulations to ease the pain of transition.

Strengthening capacity building in the West: Establish green finance pilot zones in core cities and offer supporting incentives; guide national financial institutions to establish specialized green institutions in the West; promote "financial counterpart support" and technical assistance; develop distinctive green finance products; strengthen environmental supervision capabilities and implement categorized supervision; provide special support for environmental technology upgrades and certification for small and medium-sized enterprises; and establish a green technology transfer platform between the East and the West.

Improve regional coordination mechanisms: Explore cross-regional green finance factor trading markets; improve ecological compensation mechanisms to provide targeted support for green development in the West; coordinate environmental policies to prevent pollution transfer risks.

Respecting regional differences and implementing targeted coordinated policies are key to unleashing synergy and promoting high-quality, balanced development across the region.

REFERENCES

[1] Ding Xin. Research on the impact of environmental regulation and green finance synergy on the high-quality development of manufacturing industry [D]. Nanchang University, 2022. DOI: 10.27232/d.cnki.gnchu.2022.004466.

[2] Xiong Ling, Yan Shuo, Yang Mian. Financial development, environmental regulation and industrial green technology innovation - a study based on the perspective of biased endogenous growth [J]. China Industrial Economy, 2023, (12): 99-116. DOI: 10.19581/j.cnki.ciejournal.2023.12.011.

[3] Zhan Shuke, Wang Renzeng, Liu Yaobin. The impact of financial technology and green finance synergy on industrial structure upgrading - a study based on heterogeneous environmental regulation. [J]. China Population, Resources and Environment, 2023, 33(11): 152-162.

[4] Wang Renzeng, Zhan Shuke. Research on the synergistic impact of digital inclusive finance and green finance on high-quality economic development [J]. Modern Economic Discussion, 2023, (07): 59-70. DOI: 10.13891/j.cnki.mer.2023.07.008.

[5] Zhang Ziyu, Chen Chen, Yi Hong, et al. Research on the impact of green finance development on carbon emissions from the perspective of environmental regulation [J]. Journal of Southwest University (Natural Science Edition), 2023, 45(08): 1-11. DOI: 10.13718/j.cnki.xdzk.2023.08.001.