Article

How Do Green Finance and Green Technology Innovation Impact the Yangtze River Economic Belt’s Industrial Structure Upgrading in China? A Moderated Mediation Effect Model Based on Provincial Panel Data

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Abstract: Industrial structure upgrading is a huge driving force for China’s green economic development. The Yangtze River Economic Belt (YREB), a crucial component of China’s spatial economic pattern, is facing the dual pressure of economic development and environmental protection. Therefore, it needs to have its industrial structure upgraded immediately. This article measures the development levels of green finance using the entropy method and bases its analysis on the panel data of 11 provinces (municipalities) in the YREB from 2005 to 2019. A moderated mediating effect model is then built to thoroughly examine the influence paths of green finance and green technology innovation on industrial structure upgrading. According to the empirical findings, green finance and green technology innovation have a significant direct role in promoting the upgrading of industrial structures. They reflect significant regional disparities across the East, Midland, and West. Second, green technology innovation has an effective transmission mechanism in green finance, boosting industrial structure upgrading. Third, environmental regulations positively regulate green finance’s direct and indirect routes to support industrial structure upgrading. This study is the first to combine green finance, green technology innovation, environmental regulation, and industrial structure upgrading under one research framework, broadening the research scope of industrial transformation. These research findings provide theoretical and practical guidance for upgrading China’s Yangtze River Economic Belt’s industrial structure.

Keywords: green finance; green technology innovation; industrial structure upgrading; environmental regulation; the Yangtze River Economic Belt (YREB)

1. Introduction

The Yangtze River Economic Belt (YREB) in China comprises eleven provinces (municipalities) spanning the East, the Midland, and the West, with a full range of industries and abundant resources (as shown in Figure 1). A total of 2,502,300 square kilometers, or 521.4% of China’s total land, make up the YREB. There were 606 million people in the YREB as of the end of 2020, or 42.9% of China’s total population. 36% of China’s total water resources, 20% of its rivers, lakes, reservoirs, and wetlands, 39.7% of its uncommon and endangered plant species, and 33% of its freshwater fish are found in the Yangtze River. In China, the YREB is a region with a brisk economy and economic development potential. In 2020, the regional GDP of the eleven YREB provinces (municipalities) reached 47.2 trillion yuan,
representing 46.4% of the national GDP, while the output value of the secondary industry represented 47.6% of the national GDP. The YREB is a crucial strategic hub for China’s economic development and plays a model and pivotal role in China’s economic development [1]. The YREB’s economic boom, however, has severely compromised the ecology and undermined the ecosystem’s health by depleting a number of natural resources [2,3]. Industry serves as the basis for economic development. Optimizing the industrial structure and promoting industrial upgrading is an internal requirement of economic development and an important part of green development. In order to achieve the YREB’s green development, the industrial structure should be transformed and upgraded to guide the green upgrade of traditional industries and cultivate a new green and eco-friendly production industries. Industrial structure upgrading is a complex process influenced by a variety of variables, including financial development, technological advancement, and regulatory changes. Among these, green finance is the link between finance and green emerging industries [4] and has been regarded as a powerful instrument for structural transformation [5]. Green technology innovation is a newly created technical innovation that combines economic growth with environmental conservation.

![Figure 1. The Yangtze River Economic Belt in China. (Source: National Bureau of Statistics of China).](image)

The industrial structure of the YREB has currently been further optimized, as seen in Figures 2 and 3. Overall, while the output value of the tertiary industry has increased quickly, the output value of the primary and secondary industries has steadily declined. Primary, secondary, and tertiary industries’ respective output values have changed from 11.48%, 47.52%, and 41.0% in 2005 to 7.25%, 38.57%, and 54.18% in 2020. According to the three areas, the YREB’s economic aggregate is higher in the East and lower in the West, and the industrial structure varies by region. The East extensively developed the tertiary industry in 2012 as a basis of the “three, two, and one” industrial structure's change. In Shanghai, Jiangsu, and Zhejiang in 2020, the tertiary industry’s proportion was 73.4%, 52.2%, and 55.9%, respectively, while the primary industry’s proportion was just 2.76%, 4.41%, and 3.35%. In contrast, the West has the biggest proportion of primary industry. Sichuan, Guizhou, and Yunnan were respectively responsible for 11.5%, 14.2%,
and 14.7% of the primary industry in 2020. The secondary industry is extremely important to Midland. In Jiangxi, the secondary industry accounted for 43.1% of the economy in 2020. The “three, two, and one” industrial structure was transformed by the Midland and West in 2016 and 2013, respectively, through ongoing industrial structure optimization. However, industry still has significant structural issues. Numerous heavy and chemical industries, such as those producing sulfuric acid, soda ash, ethylene, cement, flat glass, crude steel, and other industries, are located in the YREB. In 2020, the output of sulfuric acid, soda ash, ethylene, cement, flat glass, and crude steel in the YREB accounted for 62.4%, 39.3%, 32.5%, 49.7%, 38.3%, and 32.0% of the country, respectively. In addition, there are numerous traditional industries, including those that produce machinery, automobiles, and clothing. For their modernization and transformation, these old industries require a lot of funding and technology. The “heavy” industrial structure scenario has not changed significantly. The energy structure of “heavy coal” and the industrial structure of the “heavy chemical industry” have both increased resource consumption while also making pollutant prevention and control more challenging. An amount of 1.02 billion tons of general industrial solid waste was generated in the YREB in 2020, an increase of 10.6% over 2015, while the comprehensive utilization rate fell by 2.9%. The task of structural optimization is challenging, and coordination between ecological, environmental protection, and economic development is heavy. To maintain the ecological environment of the Yangtze River Economic Belt as a top priority, how can green finance and green technology innovation be leveraged to boost the Yangtze River Economic Belt’s industrial structure upgrading in order to accomplish green development? The investigation is warranted because this is a practical problem.

Figure 2. Output value of the three industries (CNY billion) and proportion in the YREB (Source: National Bureau of Statistics of China).
Finance development is high, renewable energy technology plays a significant function in industrial transformation. Ge et al. [17] discovered that when the degree of green financial lending is high, the tertiary industries are the ones most affected by green finance. They believe that green finance directs financial resources to the green environmental protection industry and limits the "two high, one surplus" industry of capital."}

2. Literature Review

The YREB has recently emerged as a research hotspot for scholars as a crucial area for green development in China. Due to the brief research period, there are no distinct phase features. However, based on the existing research results, the main focus is on studying the impact of different influencing factors on industrial structures.

2.1. Green Finance and Industrial Structure Upgrading

The first relationship researchers looked at while studying the connection between green finance and modernizing industrial structures was financial development and industrial structure. Financial development and industrial structural adjustment mutually influence and promote relationships [6]. Implementing financial regulations can facilitate the free movement of social capital among industries and provide a guarantee of funds for industrial development [7]. As green finance has continued to grow, scholars have focused on the development between green finance and industrial structures. Compared to traditional finance, green finance is a bridge between the financial industry and environmental protection [4,8], and the objective of developing green finance is to execute the concept of environmental protection comprehensively to achieve high-quality economic development [9]. The connection between green finance and industrial transformation is dynamic and coordinated, a crucial method for promoting the sustainable growth of the regional economy and environment. Its influence is mostly in the areas of financial assistance and informational guidance [10,11], supporting the allocation of funds to green industries, directing public resources to engage in green financial production, preventing the advancement of high-pollution and high-emission projects, and successfully encouraging industrial structure upgrading [12]. Furthermore, some scholars have discussed the effects of green finance development on agriculture [13], the environmental protection industry [14], and the high energy consumption industry [15] based on studies on various industries. They believe that green finance directs financial resources to the green environmental protection industry and limits the “two high, one surplus” industry of capital lending. Additionally, Wang and Wang [16] found that the tertiary industries are the ones most affected by green finance. Ge et al. [17] discovered that when the degree of green finance development is high, renewable energy technology plays a significant function.
in supporting the restructuring of industrial structure. Meanwhile, several scholars presented opposing arguments. According to Zhang and Qian [18], the bias of environmental technology progress will limit the impact of green finance on the cleaning of industrial structures. When the bias of environmental technology progress is below a particular critical value, the development of green finance is not favorable to the clean transformation of the environmental protection industry.

2.2. Green Technology Innovation and Industrial Structure Upgrading

Research in the area of green technology innovation and industrial structure upgrading at the enterprise level has provided the basis for much scholarly research. Zhang and Ma [19] found that green innovation strategies help firms offer differentiated products and indirectly improve firm performance by improving their environmental reputation. Wang et al. [20] discovered that green innovation strategies could increase a company’s resources, and Zhang et al. [21] further found that implementing green innovation strategies increased a company’s resource usage rate, facilitated a shift to an intensive, knowledge-based development model, and promoted sustainable enterprise development. According to Xie and Teo [22], the introduction of green technologies is an effective driver of clean upgrading, except for the low value-added and clean industrial sectors. Whereas Boakye et al. [23] argued that green innovation harmed firm performance as it increased the environmental cost and affected the firm’s investment in production activities. In addition, some scholars took a macro perspective. Ngai and Pissarides [24] argued that the advancement of technology is necessary for the modernization of industry, and the innovation of new technologies was both the engine that drives industrial upgrading and the path that led there [25]. According to empirical evidence gathered by Liu and Wang [26], green technology innovation has a significant short-term impact on industrial upgrading in China. Wu and Liu [27] used the Durbin spatial model to find that areas with high levels of technological innovation development benefit from modernizing industrial structures but may negatively impact out-of-region effects. Using a spatial Durbin model, Zhai and An [28] also discovered that the effectiveness of the green transformation is significantly influenced by both technological R&D and technological commercialization. Hu et al. [29] split green technology innovation further into process innovation and product innovation, showing the regulatory function of environmental regulation on green technology innovation, and providing a new theoretical basis for advancing China’s green and low-carbon transformation.

The research above sheds light on specific trends in the effects of green technology innovation and green finance on upgrading industrial structures. It does not place all three into the same theoretical framework for research. Furthermore, the politics, business, and social culture are all permeated with the notion of green ecology and environmental conservation [30,31], so the interactions among the three inextricably link the influence of environmental regulation [11,32–34]. Environmental regulation imposes a mandatory constraint on an enterprises’ production and emission behavior to protect the environment. At the micro level, it can support an enterprises’ pollution control and green innovation. At the macro level, it can guide the transformation of pollution-intensive enterprises into clean enterprises, achieving a significant transition from the secondary to the tertiary industry. In order to study the mechanism of green finance and green technology innovation on industrial structure upgrading, we built models utilizing panel data for 11 provinces (municipalities) in China’s YREB from 2005 to 2019. Then, we further integrated environmental regulation into the research framework to expand the border path of industrial structure upgrading.

2.3. Innovation of This Study

Two parts of the study’s contributions are evident. First, it expands the area of research on industrial transformation. This study first integrates green finance, green technology innovation, environmental regulation, and industrial structure upgrading into a single research framework. It then focuses on the direct and indirect effects of green finance and
green technology innovation on the upgrading of regional industrial structures, as well as
the interaction of various influencing elements, to uncover the rules, which is not only the
study’s innovative point but also its singular worth. Second, it offers practical advice for
the practice of regional industrial transformation. The direct effects of green finance and
technological innovation on the modernization of the industrial structure are found in this
article to vary between regions. Both the direct and intermediary effects of green technology
innovation on industrial structure upgrading cannot be separated from the regulation of
environmental regulation. Green technology innovation is a significant intermediary
avenue for green finance to boost industrial structure upgrading. These research findings
offer theoretical and practical advice for changing and improving industrial structures.

3. Theoretical Analysis and Hypotheses

3.1. The Direct Impact of Green Finance

Firstly, green finance refers to a kind of financial service that backs initiatives to im-
prove the environment via the use of financial instruments. This guides the flow of financial
market capital to green industries with less input, lower pollution, higher output, and
reduced investment in highly polluting industries to improve capital allocation efficiency
(Liu et al., 2017) [35], thus guiding the transformation and optimization of industrial struc-
ture [36–38]. Secondly, green finance is also an essential financing allocation policy that
encourages green investment in green sectors and the growth of green emerging industries
by lowering lending rates and increasing loan limits [39,40]. Finally, financial institu-
tions can promote energy conservation and emission reductions to mitigate environmental
hazards and contribute to a shift in industrial development direction [41,42]. Therefore,
Hypothesis 1 is proposed.

Hypothesis 1. Green finance significantly promotes the YREB’s industrial structure upgrading.

3.2. The Direct Impact of Green Technology Innovation

Green technology innovation is applied to all production aspects to bring innovation
and environmental spillover effects [43,44]. There are three paths. First, green technol-
yogy innovation optimizes resource allocation [45]. Green innovation resources converge
and integrate with high-productivity industries, accelerating the development process of
industrial structures toward high-quality knowledge intensification. Second, green tech-
nology innovation has balanced the supply and demand structure [46]. The new products
and processes generated by green technology innovation stimulate consumer demand for
green consumption and direct the flow of capital, adjusting the investment structure. In
addition, the new industries created by green technology innovation attract innovative
talents and surplus labor to transfer to the tertiary industry, significantly improving the
labor force’s employment and quality structure and further optimizing the industrial struc-
ture [47]. Third, green technology innovation improves the industrial chain system [48].
Breakthroughs in green technology innovation can give rise to new processes and products,
such as clean production technology. Additionally, it can open new industries, such as the
environmental protection industry, and drive the leapfrog development of the industrial
structure. More importantly, new products or industries will also inevitably put forward
new requirements for the related industries, enhancing the inter-industry linkage and driv-
ing the green upgrading development of the industrial system. Accordingly, we present
Hypothesis 2.

Hypothesis 2. Green technology innovation significantly promotes the YREB’s industrial struc-
ture upgrading.
3.3. The Mediating Effect of Green Technology Innovation between Green Finance and Industrial Structure Upgrading

As a policy-backed financial service for environmental protection projects, green finance effectively disperses the risk of green technological innovation for environmental protection enterprises while increasing their excitement for technological innovation [49]. In comparison, the resource-siphoning effect of green finance development will restrict the financing space of high-polluting enterprises, compelling them to invest in green technology innovation. When combined with Hypothesis 2 above, we can determine the mechanism of action between the three: green finance will encourage the flow and inclination of resources for green innovation, improve the effectiveness of technological innovation, direct the concentration of production factors toward green industries, optimize resource allocation, balance the supply and demand structure, enhance the industrial chain system, strengthen industrial links, and encourage industrial transformation. The above analysis has led to the formulation of Hypothesis 3.

**Hypothesis 3.** Green technology innovation plays a significant intermediary role between green finance and industrial structure upgrading in YREB.

3.4. The Regulatory Effect of Environmental Regulation

3.4.1. The Moderating Effect of Environmental Regulation on the Direct Path of Green Finance to Industrial Structure Upgrading

Environmental regulation affects the relationship between green finance and industrial restructuring directly or indirectly. Environmental regulation restricts financial aid to specific industries by applying specific credit regulation standards and including financial institutions’ green credit performance in the macroprudential risk assessment framework, increasing entry barriers for polluting businesses and enhancing the comparative advantages of green industries. Indirectly, the government implements environmental disclosure regulations to offer financial institutions complete environmental information on loaned company projects to improve the efficiency of green financial services, thereby boosting the improvement of regional green levels. Nevertheless, the “pollution refuge hypothesis” indicates that highly polluting enterprises will take advantage of disparities in regulation intensity between countries or regions to relocate and invest. At the current stage of China’s development, areas with stringent environmental regulations would entice polluting enterprises to relocate to areas with lax environmental regulations, impeding the improvement of the ecological environment and industrial structure upgrading [50]. In summary, Hypothesis 4 is proposed.

**Hypothesis 4a.** Environmental regulation positively regulates the direct effect of green finance on industrial structure upgrading.

**Hypothesis 4b.** Environmental regulation negatively regulates the direct effect of green finance on industrial structure upgrading.

3.4.2. The Moderating Role of Environmental Regulation on the Intermediary Path of Green Finance to Industrial Structure Upgrading

The financial support, project guidance, and risk diversification provided by green finance are essential to the innovation of green technology [51]. Each of these systems is susceptible to environmental regulations. In terms of financial backing, environmental regulations clarify the future development direction and guide financial institutions to offer financial support for green technology innovation; with project guidance, under solid environmental regulations, many high-energy-consuming and high-polluting enterprises need to introduce new green technologies to improve their existing production processes to meet national environmental protection standards, which strengthens the guidance effect of green finance. Environmental regulation encourages governments, businesses, universities,
and others to collaborate on developing new energy-saving and environmentally friendly green technologies, therefore dispersing innovation risk. Hypothesis 5 is presented.

**Hypothesis 5a.** Environmental regulation positively regulates green technology innovation’s intermediary impact on industrial structure upgrading.

**Hypothesis 5b.** Environmental regulation negatively regulates green technology innovation’s intermediary impact on industrial structure upgrading.

3.4.3. The Moderating Effect of Environmental Regulation on the Direct Path of Green Technology Innovation to Industrial Structure Upgrading

According to Porter, environmental regulation can provide economic and environmental benefits by driving technological innovation [52] via the “innovation compensation effect” [53–55]. According to the “innovation compensation effect,” although environmental regulations will raise the price of pollution control in the short term, the government will finance green enterprise innovation through green subsidy policies, which can ultimately slow down or offset the increased environmental costs by environmental regulations. It can also drive enterprises to continuously improve their innovation capacity, improving the efficiency of technological innovation, and guiding enterprises to develop in a green direction. The “cost-following effect”, on the other hand, postulates that the increase in pollution control costs brought on by environmental regulations will have a crowding-out effect on businesses’ R&D expenditures. This will lead to a decrease in the finances available to businesses for green innovation technology, which is detrimental to encouraging business innovation in green technology, modernizing the industrial structure, and enhancing the effectiveness of green innovation. The intensity of the “innovation compensation effect” and “cost-following effect” is argued to vary depending on the effect of environmental regulation [56,57], making the effect of environmental regulation on green technology innovation unpredictable. Finally, we present Hypothesis 6.

**Hypothesis 6a.** Environmental regulation positively regulates the direct impact of green technology innovation on industrial structure upgrading.

**Hypothesis 6b.** Environmental regulation negatively regulates the direct impact of green technology innovation on industrial structure upgrading.

Based on the above research Hypotheses (1–6), a theoretical hypothesis framework is constructed below (Figure 4).

![Theoretical Hypothesis Framework](image-url)

**Figure 4.** Theoretical Hypothesis Framework.
4. Measurement of Green Finance (GF)

4.1. Measurement Method

This paper uses the entropy method to evaluate green finance in the Yangtze River Economic Belt. The entropy method measures the weight of each indicator layer in a composite system [58]. Compared with methods such as hierarchical analysis and principal component analysis, the weights of the entropy method are determined based on the actual situation of each indicator data, and the inherent differences between data are reflected objectively by the weights. The higher the degree of dispersion of an indicator, the more valid the information it contains. The entropy method is calculated as follows:

First, we construct a comprehensive indicator system. If there are \( r \) years, \( n \) provinces (cities), and \( m \) indicators, \( X_{\theta ij} \) is the value of the \( j \)-th indicator of the \( i \)-th province in the \( \theta \)-th year (\( i = 1, 2, 3... n; j = 1, 2, 3... m, \) and \( \theta = 1, 2, 3... r \)).

Second, standardization of the \( j \)-th indicator \( Y_{\theta ij} \). Standardization is needed as different indicators have different scales and units.

If the indicator is positive,

\[
Y_{\theta ij} = \frac{(X_{\theta ij} - \text{min}(X_{\theta ij}))}{(\text{max}(X_{\theta ij}) - \text{min}(X_{\theta ij}))}
\]

If the indicator is negative

\[
Y_{\theta ij} = \frac{(\text{max}(X_{\theta ij}) - X_{\theta ij})}{(\text{max}(X_{\theta ij}) - \text{min}(X_{\theta ij}))}
\]

where \( \text{min} \) represents the minimum value and \( \text{max} \) represents the maximum value.

Third, after standardization of the statistical values, the characteristic proportion or contribution of the \( j \)-th indicator \( Z_{\theta ij} \) must be calculated.

\[
Z_{\theta ij} = \frac{Y_{\theta ij}}{\sum_{i=1}^{n} \sum_{\theta=1}^{r} Y_{\theta ij}}, i = 1, 2, 3... n, \theta = 1, 2, 3... r
\]

Then, the entropy value of \( j \)-th indicator \( E_j \) must be calculated.

\[
E_j = K \sum_{i=1}^{n} \sum_{\theta=1}^{r} Z_{\theta ij} \ln(Z_{\theta ij}), K = -\frac{1}{\ln(nm)}, 0 \leq E_j \leq 1
\]

Fifth, the information utility value of the \( j \)-th indicator \( G_j \) must be calculated.

\[
G_j = 1 - E_j
\]

Finally, after obtaining the information utility value, the weight of \( j \)-th indicator \( (W_j) \) in the indicator system can be calculated.

\[
W_j = \frac{G_j}{\sum_{j=1}^{m} G_j}, j = 1, 2, 3... m
\]

4.2. Construction of a Comprehensive Indicator System of Green Finance

Given the availability and usefulness of data, this study developed the YREB green finance comprehensive indicator system, which includes green credit, green securities, green investment, and green insurance [59] (Table 1).

As green credit data are bank-based and provincial data is lacking, and the interest rate gap of China’s industry loans is relatively small, the change of industry interest expense is mainly related to the scale of loans, and the change of interest expense ratio indirectly reflects the change of loan scale ratio. As the six high-energy-consuming industries are generally characterized by overcapacity, high consumption, and high pollution, they are the key areas of national development restrictions in recent years. For this reason, this research chose the ratio of interest expenditure of the six high-energy-consuming industries to the total interest expenditure of industrial industries to measure green credit [60]. It serves
as an inverse indicator of commercial banks’ efforts to curb resource and environmental deterioration. Green securities are also chosen based on the ratio of the total market value of the six high-energy-consuming industries to the total market value of A-shares in each province, and it reflects the level of financing in the capital market through the issuance of shares by the six high-energy-consuming industries. Green investment was selected as the proportion of public budget expenditure on energy efficiency and environmental protection by provincial governments to show the degree of funding for green enterprises via alternative financing channels as opposed to bank loans. The major product in China’s green insurance system is environmental pollution liability insurance. However, because it only recently began, systematic statistics on pertinent data are lacking. We chose regional agriculture insurance as green insurance because it can reflect the development of green insurance due to its public traits and content elements.

Table 1. The comprehensive indicator system of green finance.

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Computing Method</th>
<th>Attribute</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Credit</td>
<td>1 Six high energy-consuming industries’ interest expense/Industry interest expense (%)</td>
<td>–</td>
<td>0.3401</td>
</tr>
<tr>
<td></td>
<td>Six high energy-consuming industries’ total market capitalization/Total A-share market capitalization (%)</td>
<td>–</td>
<td>0.2458</td>
</tr>
<tr>
<td>Green Securities</td>
<td>Energy conservation and environmental protection expenditure/General public budget expenditure (%)</td>
<td>+</td>
<td>0.1763</td>
</tr>
<tr>
<td></td>
<td>Agricultural insurance expenditure/Agricultural insurance income (%)</td>
<td>+</td>
<td>0.2178</td>
</tr>
</tbody>
</table>

1 China’s National Development and Reform Commission defines the six high-energy-consuming industries, including the six industries of chemical raw materials and chemical products manufacturing, non-metallic mineral products, ferrous metal smelting and rolling processing, non-ferrous metal smelting and rolling processing, petroleum processing and coking and nuclear fuel processing, and production and supply of electricity and heat.

"−" indicates a positive indicator and "+" indicates a negative indicator.

4.3. Data Selection

For our research, we use panel data from 2005 to 2019 from 11 YREB provinces (municipalities) in China. The data sources are the Industrial Statistics Database of the National Research Network, the iFinD database, the Chinese Environmental Statistics Yearbook, the Chinese National Bureau of Statistics, and the local statistical yearbooks of the 11 provinces (cities). Using linear interpolation, a few data gaps that were unavailable were filled.

4.4. Measurement Result

Table 2 shows the measurement results of green finance (GF), and Figure 5 shows the changing trend.
Table 2. GF in the YREB.

<table>
<thead>
<tr>
<th>Year</th>
<th>West</th>
<th>Chongqing</th>
<th>Sichuan</th>
<th>Guizhou</th>
<th>Yunnan</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2005</td>
<td>0.663</td>
<td>0.480</td>
<td>0.353</td>
<td>0.211</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2006</td>
<td>0.655</td>
<td>0.612</td>
<td>0.378</td>
<td>0.223</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2007</td>
<td>0.591</td>
<td>0.417</td>
<td>0.383</td>
<td>0.176</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2008</td>
<td>0.673</td>
<td>0.391</td>
<td>0.549</td>
<td>0.348</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2009</td>
<td>0.661</td>
<td>0.476</td>
<td>0.604</td>
<td>0.303</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2010</td>
<td>0.645</td>
<td>0.485</td>
<td>0.607</td>
<td>0.273</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2011</td>
<td>0.654</td>
<td>0.462</td>
<td>0.432</td>
<td>0.271</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2012</td>
<td>0.640</td>
<td>0.468</td>
<td>0.402</td>
<td>0.262</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2013</td>
<td>0.656</td>
<td>0.464</td>
<td>0.422</td>
<td>0.288</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2014</td>
<td>0.640</td>
<td>0.415</td>
<td>0.408</td>
<td>0.296</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2015</td>
<td>0.666</td>
<td>0.457</td>
<td>0.422</td>
<td>0.290</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2016</td>
<td>0.682</td>
<td>0.450</td>
<td>0.470</td>
<td>0.319</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2017</td>
<td>0.692</td>
<td>0.477</td>
<td>0.456</td>
<td>0.274</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2018</td>
<td>0.699</td>
<td>0.494</td>
<td>0.465</td>
<td>0.332</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2019</td>
<td>0.747</td>
<td>0.589</td>
<td>0.500</td>
<td>0.321</td>
</tr>
<tr>
<td>mean</td>
<td></td>
<td>0.664</td>
<td>0.476</td>
<td>0.457</td>
<td>0.279</td>
<td>0.469</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Midland</th>
<th>Anhui</th>
<th>0.397</th>
<th>0.325</th>
<th>0.375</th>
<th>0.429</th>
<th>0.382</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2006</td>
<td>0.390</td>
<td>0.287</td>
<td>0.313</td>
<td>0.479</td>
<td>0.367</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2007</td>
<td>0.380</td>
<td>0.181</td>
<td>0.316</td>
<td>0.417</td>
<td>0.324</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2008</td>
<td>0.423</td>
<td>0.377</td>
<td>0.350</td>
<td>0.417</td>
<td>0.392</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2009</td>
<td>0.448</td>
<td>0.355</td>
<td>0.446</td>
<td>0.488</td>
<td>0.434</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2010</td>
<td>0.509</td>
<td>0.316</td>
<td>0.484</td>
<td>0.555</td>
<td>0.466</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2011</td>
<td>0.507</td>
<td>0.289</td>
<td>0.433</td>
<td>0.505</td>
<td>0.433</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2012</td>
<td>0.517</td>
<td>0.293</td>
<td>0.440</td>
<td>0.557</td>
<td>0.452</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2013</td>
<td>0.565</td>
<td>0.376</td>
<td>0.521</td>
<td>0.577</td>
<td>0.510</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2014</td>
<td>0.552</td>
<td>0.365</td>
<td>0.500</td>
<td>0.589</td>
<td>0.501</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2015</td>
<td>0.608</td>
<td>0.439</td>
<td>0.517</td>
<td>0.583</td>
<td>0.537</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2016</td>
<td>0.707</td>
<td>0.483</td>
<td>0.591</td>
<td>0.591</td>
<td>0.593</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2017</td>
<td>0.649</td>
<td>0.419</td>
<td>0.542</td>
<td>0.609</td>
<td>0.555</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2018</td>
<td>0.639</td>
<td>0.422</td>
<td>0.627</td>
<td>0.620</td>
<td>0.577</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2019</td>
<td>0.634</td>
<td>0.491</td>
<td>0.639</td>
<td>0.646</td>
<td>0.603</td>
</tr>
<tr>
<td>mean</td>
<td></td>
<td>0.528</td>
<td>0.361</td>
<td>0.473</td>
<td>0.538</td>
<td>0.475</td>
<td></td>
</tr>
</tbody>
</table>

| Year | East | Shanghai | 0.508   | 0.612   | 0.632  | 0.584 |
|------|------|----------|---------|---------|--------|------|------|
|      |      | 2006    | 0.467   | 0.483   | 0.692  | 0.547 |
|      |      | 2007    | 0.528   | 0.541   | 0.658  | 0.576 |
|      |      | 2008    | 0.476   | 0.576   | 0.667  | 0.573 |
|      |      | 2009    | 0.505   | 0.633   | 0.700  | 0.613 |
|      |      | 2010    | 0.499   | 0.616   | 0.709  | 0.608 |
|      |      | 2011    | 0.568   | 0.603   | 0.663  | 0.612 |
|      |      | 2012    | 0.651   | 0.616   | 0.649  | 0.639 |
|      |      | 2013    | 0.619   | 0.623   | 0.662  | 0.635 |
|      |      | 2014    | 0.668   | 0.643   | 0.649  | 0.653 |
|      |      | 2015    | 0.653   | 0.672   | 0.673  | 0.666 |
|      |      | 2016    | 0.639   | 0.676   | 0.687  | 0.667 |
|      |      | 2017    | 0.671   | 0.659   | 0.691  | 0.673 |
|      |      | 2018    | 0.679   | 0.694   | 0.685  | 0.686 |
|      |      | 2019    | 0.701   | 0.686   | 0.725  | 0.704 |
| mean |      | 0.589   | 0.622   | 0.676   | 0.629 |
As shown in Table 2 and Figure 5 above, green finance (GF) in the YREB increased from a low point in 2005 to a high point in 2019, demonstrating the optimization of green finance development. Throughout the YREB, there are obvious differences among the three regions. The GF ranges from 0.547 to 0.740 in the East (Shanghai, Jiangsu, and Zhejiang), with the highest level mainly owing to the East’s significant concentration of advanced factors of production, high resource utilization, return on capital, and the high level of the financial scale. Midland, which encompasses Anhui, Jiangxi, Hubei, and Hunan, has an average GF score from 0.324 to 0.603, making it the region with the second-highest degree of green financial development. The Western region, which comprises Chongqing, Sichuan, Guizhou, and Yunnan, has the lowest average GF score, ranging from 0.392 to 0.539. Chongqing, located in the upper reaches of the Yangtze River, comes in fourth place among them in terms of the development of green finance. Moreover, pertaining to the development trend, the gap in green finance among the regions is narrowing. When China’s economy multiplied, the capital was more concentrated in the East and Midland. As China’s economy shifts to high-quality development, economic growth has slowed, the social environment and economic development model have changed significantly, the rough investment is insufficient to sustainably support economic growth, and traditional industries have witnessed a crucial move towards green transformation. Financial institutions, social enterprises, and the general public are more supportive of investing in green industries and the goods and services they provide. Simultaneously, the Western Development strategy has accelerated, and regional economic imbalances have been improved, thus accelerating the pace of green financial development and reducing regional differences.

5. Models Construction and Variable Measurement

5.1. Construction of the Model

Based on the above theoretical hypothesis framework (as shown in Figure 4), we construct a moderated mediating effect model to explore the direct and mediating effects of green finance and green technology innovation on the upgrading of industrial structure, as well as the moderated direct and mediating effects.

5.1.1. Direct Effect Model

First, the following model is constructed to verify the direct effect of green finance and green technology innovation on industrial structure upgrading.

\[
\text{USI}_{i,t} = \alpha_0 + \alpha_1 \text{GF}_{i,t} + \alpha_3 \text{FAI}_{i,t} + \alpha_4 \text{UR}_{i,t} + \alpha_5 \text{EI}_{i,t} + \alpha_6 \text{FDI}_{i,t} + \mu_i + \epsilon_{i,t} \tag{7}
\]

\[
\text{USI}_{i,t} = \alpha_0 + \alpha_1 \text{GTI}_{i,t} + \alpha_3 \text{FAI}_{i,t} + \alpha_4 \text{UR}_{i,t} + \alpha_5 \text{EI}_{i,t} + \alpha_6 \text{FDI}_{i,t} + \mu_i + \epsilon_{i,t} \tag{8}
\]
In the equations above, \( i \) stands for the province or municipality that makes up the YREB, and \( t \) represents \( t \)-th period; \( a_0 \) is the intercept term, \( \mu_i \) represents individual differences, and \( \epsilon_{it} \) stands for the random disturbance term.

5.1.2. Mediating Effect Model

Then, based on the above direct effects, we further test the mediating effect of green technology innovation between green finance and industrial structure upgrading.

\[
USI_{i,t} = \alpha_0 + cGF_{i,t} + \alpha_2CONTROL_{i,t} + \mu_i + \epsilon_{it} \tag{9}
\]

\[
GTI_{i,t} = \beta_0 + aGF_{i,t} + \alpha_2CONTROL_{i,t} + \mu_i + \epsilon_{it} \tag{10}
\]

\[
USI_{i,t} = \gamma_0 + c\gamma GTI_{i,t} + bGTI_{i,t} + \alpha_3CONTROL_{i,t} + \mu_i + \epsilon_{it} \tag{11}
\]

Among them, \( GTI_{it} \) is the intermediary variable, a series of control variables, including FAI, UR, EI, FDI, and \( c \) is green finance’s total effect on industrial structural upgrading. The variable \( c' \) represents the effect of green finance on industrial structural upgrading after the addition of green technology innovation. Additionally, \( a, b, \) and \( c \) all represent the effect that green finance has on green technology innovation and \( b \) represents the effect that green technology innovation has on industrial structure upgrading. If \( a, b, \) and \( c \) are all significant and \( c' \) is not, then green technology innovation is a complete mediator; If \( a, b, \) and \( c \) are all significant and \( c' < c \), green technology innovation is a partial mediator.

5.1.3. Regulatory Effect Model

Finally, based on the above direct and mediating effects, we use environmental regulation as the moderating variable to investigate the regulatory effect on the direct and intermediary path of green finance to industrial structure upgrading.

\[
USI_{i,t} = c_0 + \alpha_1GF_{i,t} + \alpha_2ER_{i,t} + \alpha_3CONTROL_{i,t} + \mu_i + \epsilon_{it} \tag{12}
\]

\[
USI_{i,t} = c_0 + \alpha_1GF_{i,t} + \alpha_2ER_{i,t} + \alpha_3CONTROL_{i,t} + \mu_i + \epsilon_{it} \tag{13}
\]

\[
GTI_{i,t} = c_0 + \alpha_1GF_{i,t} + \alpha_2ER_{i,t} + \alpha_3CONTROL_{i,t} + \mu_i + \epsilon_{it} \tag{14}
\]

\[
GTI_{i,t} = c_0 + \alpha_1GF_{i,t} + \alpha_2ER_{i,t} + \alpha_3CONTROL_{i,t} + \mu_i + \epsilon_{it} \tag{15}
\]

\[
USI_{i,t} = c_0 + \alpha_1GTI_{i,t} + \alpha_2ER_{i,t} + \alpha_3CONTROL_{i,t} + \mu_i + \epsilon_{it} \tag{16}
\]

\[
USI_{i,t} = c_0 + \alpha_1GTI_{i,t} + \alpha_2ER_{i,t} + \alpha_3CONTROL_{i,t} + \mu_i + \epsilon_{it} \tag{17}
\]

The regulatory effect is broken down into three stages: first, the coefficients of the explanatory variable are significant in the direct effects test; then, the coefficients of the explanatory and regulatory variables are significant once the regulatory variable is included. Finally, the explanatory and regulatory variables, as well as their interaction term, are incorporated into the model, and the significant coefficient of the interaction term proves the existence of the regulatory effect.

5.2. Variable Selection and Measurement

5.2.1. Explained Variable: Industrial Structure Upgrading (ISU)

Industrial structure upgrading is widely measured in present research through industrial structure rationalization and advanced industrial structure. This study employs the approach proposed by Wang et al. [61] to estimate the upgrading of industrial structures, including primary, secondary, and tertiary industries.

\[
ISU = \sum_{i=1}^{3} Y_i \times i (1 \leq \text{indications} \leq 3) \tag{18}
\]
\( Y_i \) represents the proportion of the regional GDP that was contributed by the i-th industry’s value-added output, and the indicator reflects the ability of the industry to increase quality and efficiency.

5.2.2. Explanatory Variable: Green Finance (GF)

The study calculates the GF of each province (municipality), and the results are presented in Table 2.

5.2.3. Explanatory Variable and Mediating Variable: Green Technology Innovation (GTI)

In this study, green technology innovation was represented by the total number of inventions and practical patents \[62\] processed by logarithm. The bigger the value of this index, the greater the regional capacity for innovation in green technology.

5.2.4. Regulatory Variables: Environmental Regulation (ER)

Based on the concept proposed by Yuan Yijun \[30,63\], this study selects the comprehensive utilization rate of industrial solid waste, the ratio of the treatment facilities’ operation cost of industrial waste gas to industrial waste gas emission, and the ratio of the treatment facilities’ operation cost of industrial wastewater to industrial wastewater emission to calculate ER using the entropy method. The value of the index represents the intensity of environmental regulation.

5.2.5. Control Variables

With the aid of past research, as shown in Table 3, we select fixed asset investment, urbanization, energy intensity, and foreign direct investment as control variables. This study takes the logarithm of fixed asset investment (FAI), which is the fixed asset investment of the entire society. The degree of urbanization, also known as UR, is the ratio of a region’s urban population to its total resident population at the end of the year. In contrast, the level of energy intensity (EI) is the ratio of a region’s total energy consumption to its year-end resident population. Foreign direct investment level refers to the amount of foreign direct investment utilized (FDI). The value is expressed in RMB using the average annual exchange rate between the RMB and the US dollar, and the paper uses logarithmic processing.

<table>
<thead>
<tr>
<th>Table 3. Description of variables.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Variable type</strong></td>
</tr>
<tr>
<td>Explained variable</td>
</tr>
<tr>
<td>Explanatory variable</td>
</tr>
<tr>
<td>Intermediate variable (Explanatory variable)</td>
</tr>
<tr>
<td>Regulatory variable</td>
</tr>
<tr>
<td>Control variable</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
5.3. Descriptive Statistics

In Table 4, descriptive information for the primary variables is provided. The maximum, minimum, mean, standard deviation, and variance of these variables are presented in the table. These variables include ISU, GF, GTI, ER, FAI, UR, EI, and FDI.

Table 4. Descriptive statistics.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs.</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISU</td>
<td>165</td>
<td>2.360</td>
<td>0.114</td>
<td>2.170</td>
<td>2.726</td>
</tr>
<tr>
<td>GF</td>
<td>165</td>
<td>0.515</td>
<td>0.137</td>
<td>0.176</td>
<td>0.747</td>
</tr>
<tr>
<td>GTI</td>
<td>165</td>
<td>7.275</td>
<td>1.431</td>
<td>3.761</td>
<td>10.35</td>
</tr>
<tr>
<td>ER</td>
<td>165</td>
<td>9.521</td>
<td>3.882</td>
<td>3.353</td>
<td>25.68</td>
</tr>
<tr>
<td>FAI</td>
<td>165</td>
<td>9.691</td>
<td>2.144</td>
<td>6.802</td>
<td>18.62</td>
</tr>
<tr>
<td>UR</td>
<td>165</td>
<td>0.531</td>
<td>0.154</td>
<td>0.269</td>
<td>0.896</td>
</tr>
<tr>
<td>EI</td>
<td>165</td>
<td>2.560</td>
<td>0.896</td>
<td>0.994</td>
<td>4.864</td>
</tr>
<tr>
<td>FDI</td>
<td>165</td>
<td>15.00</td>
<td>1.285</td>
<td>11.42</td>
<td>16.93</td>
</tr>
</tbody>
</table>

6. Empirical Results and Analysis

We use Stata16 statistical software for data processing, and the goodness of fit of each model is high with a view adjusted to $R^2$, indicating that each model can account for the changes.

6.1. Direct Effect Test

Table 5 displays green finance (GF) and (GTI) green technology innovation’s direct effects on industrial structure upgrading (USI). As noted in columns (1) and (5), GF on USI and GTI on USI are both significantly positive at the 1% confidence level, indicating that GF and GTI play a significant direct role in promoting USI across the whole YREB. Therefore, both Hypotheses 1 and 2 are verified.

Table 5. Regression results of the direct effects.

| Variables | (1) All East Midland West (2) All East Midland West (3) All East Midland West (4) All East Midland West (5) All East Midland West (6) All East Midland West (7) All East Midland West (8) All East Midland West |
|-----------|--------------------------------------------------|--------------------------------------------------|--------------------------------------------------|--------------------------------------------------|--------------------------------------------------|--------------------------------------------------|--------------------------------------------------|--------------------------------------------------|
| GF        | 1.805 *** (0.423) 5.228 *** (0.961) 3.742 *** (0.517) -0.925 ** (0.372) | 0.529 *** (0.068) 0.283 *** (0.075) 0.652 *** (0.124) 0.127 (0.082) |
| GTI       | 0.047 *** (0.016) 0.068 * (0.039) 0.073 *** (0.023) 0.007 (0.024) 0.045 *** (0.014) 0.099 ** (0.043) 0.074 *** (0.027) -0.003 (0.028) |
| FAI       | 5.994 *** (0.880) 14.325 *** (2.403) 6.738 *** (1.506) 6.185 *** (0.845) 1.020 (1.047) 17.303 *** (2.645) 2.517 (1.603) 4.843 *** (0.736) |
| UR        | -0.083 (0.136) -1.016 ** (0.419) -0.321 ** (0.134) 0.533 *** (0.143) -0.525 *** (0.134) -1.751 *** (0.454) -0.526 *** (0.188) 0.448 *** (0.159) |
| EI        | 0.057 (0.067) -0.283 (0.197) -0.299 ** (0.138) -0.206 *** (0.043) -0.028 (0.061) -0.498 ** (0.242) -0.517 ** (0.197) ±0.253 *** (0.060) |
| FDI       | 18.802 *** (0.766) 18.905 *** (3.234) 22.505 *** (1.564) 22.564 *** (0.535) 23.464 *** (0.924) 23.562 *** (3.858) 25.467 *** (2.280) 22.806 *** (0.642) |
| _cons     | 165 (115) 60 (60) 60 (60) 165 (115) 45 (45) 60 (60) 60 (60) 60 (60) |
| R²_a      | 0.930 (0.921) 0.844 (0.849) 0.809 (0.945) 0.898 (0.797) 0.797 (0.796) |

Note: Standard errors in parentheses * p < 0.1, ** p < 0.05, *** p < 0.01.

Subregionally, GF on USI and GTI on USI exhibit significant regional features in the East, Midland, and West. In the East, columns (2) and (6) show that the GF on USI and GTI on USI are significantly positive at the 1% confidence level, with regression coefficients of 5.228 and 0.283, respectively. And they have a powerful effect on upgrading the industrial
structure. The East is located in a coastal region with superior topography and a robust economy. It has a high degree of green financial development and strong green technology innovation capabilities, allowing it to play a significant role in accelerating the industrial structure's adaptation to the path of green development through the market mechanism.

In the Midland, the regression coefficient of GF on USI is 3.742, which is slightly lower than in the East (5.228), and GF plays an essential role in promoting industrial structure upgrading. The regression coefficient of GTI on USI is 0.652 and significantly positive, which is higher in the Midland than in the East (0.283). In recent years, the Midland has made full use of its late-development advantage to promote the construction of green finance to provide sufficient funds for industrial development, as well as the introduction of high production factors and advanced technology, thereby promoting the long-term upgrading of industrial structure.

In contrast to the East and the Midland, the regression coefficient of GF on USI in the West is $-0.925$ and significantly negative, indicating an inhibitory effect on industrial structure upgrading, whereas the regression coefficient of GTI on USI is positive but not statistically significant. Although the West is rich in ecological resources and has superior national development strategies, its level of green financial development is relatively low and lacks effective and reasonable investment guidance methods and approaches. Therefore, the association between investment direction and industrial structure upgrading is not particularly strong. In addition, the foundation of green technology innovation in the West is rather poor compared to the Midland and the East. Thus, its role in encouraging industrial structure upgrading has not been fully developed.

Among the main control variables, fixed asset investment (FAI) is significantly positively correlated with USI in the East and Midland but not in the West. Urbanization (UR) is significantly positively correlated with USI in general. Energy intensity (EI) is significantly negatively correlated with USI in the East and Midland, while energy intensity (EI) is significantly positively correlated with USI in the West.

6.2. The Mediating Test

In order to establish if green technology innovation (GTI) plays a part in green finance (GF) promoting industrial structure upgrading (USI), Table 6 of this study contains a test of the mediating effect.

Table 6. Regression results of the mediating effect of green technology innovation.

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ISU</td>
<td>GTI</td>
<td>ISU</td>
</tr>
<tr>
<td>GF</td>
<td>1.805***</td>
<td>2.089***</td>
<td>0.812**</td>
</tr>
<tr>
<td></td>
<td>(0.423)</td>
<td>(0.424)</td>
<td>(0.403)</td>
</tr>
<tr>
<td>GTI</td>
<td></td>
<td>0.475***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.072)</td>
<td></td>
</tr>
<tr>
<td>FAI</td>
<td>0.047***</td>
<td>0.014</td>
<td>0.041***</td>
</tr>
<tr>
<td></td>
<td>(0.016)</td>
<td>(0.016)</td>
<td>(0.014)</td>
</tr>
<tr>
<td>UR</td>
<td>5.994***</td>
<td>9.789***</td>
<td>1.343</td>
</tr>
<tr>
<td></td>
<td>(0.880)</td>
<td>(0.882)</td>
<td>(1.049)</td>
</tr>
<tr>
<td>EI</td>
<td>−0.083</td>
<td>0.842***</td>
<td>−0.483***</td>
</tr>
<tr>
<td></td>
<td>(0.136)</td>
<td>(0.136)</td>
<td>(0.134)</td>
</tr>
<tr>
<td>FDI</td>
<td>0.057</td>
<td>0.191***</td>
<td>−0.033</td>
</tr>
<tr>
<td></td>
<td>(0.067)</td>
<td>(0.067)</td>
<td>(0.061)</td>
</tr>
<tr>
<td>Constant</td>
<td>18.802***</td>
<td>−8.973***</td>
<td>23.065***</td>
</tr>
<tr>
<td></td>
<td>(0.766)</td>
<td>(0.768)</td>
<td>(0.936)</td>
</tr>
<tr>
<td>N</td>
<td>165</td>
<td>165</td>
<td>165</td>
</tr>
<tr>
<td>$R^2_a$</td>
<td>0.930</td>
<td>0.955</td>
<td>0.946</td>
</tr>
</tbody>
</table>

Note: Standard errors in parentheses ** $p < 0.05$, *** $p < 0.01$. 
In Table 6, the direct effect of GF on USI evaluated in column (1) is significantly under the 1% confidence level with a regression coefficient of 1.805, and the regression coefficient of GF on GTI tested in column (2) is 2.089, significantly under the 1% confidence level, which is in line with the thoughts of Yu et al. [49] and Zhang et al. [21].

With the addition of the intermediate variable GTI in column (3), GF and ISU are significantly positively correlated at the 5% confidence level with a coefficient of 0.812, which is less than 1.805, and GTI and ISU are significantly positively correlated at the 1% confidence level with a coefficient of 0.475. In addition, the results of the Bootstrap test on the mediating effect indicate that the p-value of the mediating effect of GTI in Table 7 is 0.018 and that the 95% confidence interval does not contain 0, indicating that the mediating effect is statistically significant. In Table 7, the p-value for the direct effect of green finance is 0.030, and the 95% confidence interval does not contain 0, indicating that the direct effect is likewise statistically significant. Therefore, GTI partially mediates the effect of GF on ISU promotion. In addition, among the pathways by which GF promotes ISU, the mediating effect of GTI is 0.992 (2.089 × 0.475), which accounts for 55.2%. Thus, it is evident that GTI is the principal intermediary path of GF promoting ISU in the YREB and that GTI plays a crucial transmission role between GF and USI. The third hypothesis is valid. This is because green finance encourages enterprises to actively engage in green technology innovation through resource allocation and financial policies, promotes the flow and orientation of green innovation resources, and supports the green upgrading of industries.

Table 7. Results of Bootstrap test of the mediating effect.

<table>
<thead>
<tr>
<th>Explained Variable</th>
<th>Explanatory Variable</th>
<th>Intermediate Variable</th>
<th>Effect</th>
<th>Observed Coef.</th>
<th>p-Value</th>
<th>Normal-Based [95%Conf.Interval]</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISU</td>
<td>GF</td>
<td>GTI</td>
<td>indirect</td>
<td>0.298 ** (0.126)</td>
<td>0.018</td>
<td>(0.052 0.544)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>direct</td>
<td>0.638 ** (0.295)</td>
<td>0.030</td>
<td>(0.060 1.216)</td>
</tr>
</tbody>
</table>

Note: Standard errors in parentheses ** p < 0.05.

6.3. The Regulatory Test

The findings of the first phase of the regulatory test are reported in columns (1) and (5) of Table 5 and column (2) of Table 6, and all explanatory variable coefficients are significant in the direct effects test. The final two steps of the regulatory effect are shown in Table 8. Table 8 reveals that green finance (GF) and environmental regulation (ER) in column (1), green finance (GF) and environmental regulation (ER) in column (3), and green technology innovation (GTI) and environmental regulation (ER) in column (5) are all significantly significant. The coefficient of the interaction term between GF and ER (GFER) in column (2), between GF and ER (GFER) in column (4), and between GTI and ER (GTIER) in column (6) are all significantly positive when interaction terms are included. Then, we discover that ER exerts a significant positive regulatory effect during GF induced ISU promotion. The three hypotheses, 4a, 5a, and 6a, are verified. This is because the YREB of China places greater emphasis on the ecological and environmental protection of the Yangtze River basin, increases the input in environmental governance, improves the efficiency of green financial services, strengthens the new guidance of green finance to green technology, and promotes the mutual coordination and promotion of environmental regulation, green finance, and the innovation of green technology. It has offered a solid assurance for promoting industrial upgrading and optimization.
Table 8. Regression results for the regulatory effect of environmental regulation.

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISU ISU</td>
<td>GF 1.195 *** (0.426)</td>
<td>1.478 *** (0.436)</td>
<td>1.510 *** (0.430)</td>
<td>1.730 *** (0.443)</td>
<td>0.442 *** (0.072)</td>
<td>0.436 *** (0.070)</td>
</tr>
<tr>
<td>GTI GTI</td>
<td>0.442 *** (0.070)</td>
<td>0.436 *** (0.072)</td>
<td>0.047 *** (0.009)</td>
<td>0.025 *** (0.008)</td>
<td>0.017 * (0.009)</td>
<td></td>
</tr>
<tr>
<td>ER ER</td>
<td>0.107 * (0.058)</td>
<td>0.137 ** (0.057)</td>
<td>0.026 ** (0.010)</td>
<td>0.025 *** (0.008)</td>
<td>0.017 * (0.009)</td>
<td></td>
</tr>
<tr>
<td>GF × ER</td>
<td>0.011 ** (0.004)</td>
<td>0.137 ** (0.057)</td>
<td>0.025 *** (0.008)</td>
<td>0.017 * (0.009)</td>
<td>0.011 ** (0.004)</td>
<td></td>
</tr>
<tr>
<td>FAI FAI</td>
<td>0.051 *** (0.016)</td>
<td>0.048 *** (0.015)</td>
<td>0.017 (0.016)</td>
<td>0.015 (0.016)</td>
<td>0.014 (0.014)</td>
<td></td>
</tr>
<tr>
<td>UR UR</td>
<td>5.722 *** (0.836)</td>
<td>5.493 *** (0.829)</td>
<td>9.531 *** (0.843)</td>
<td>9.353 *** (0.842)</td>
<td>1.620 (1.038)</td>
<td>1.339 (1.024)</td>
</tr>
<tr>
<td>EI EI</td>
<td>0.224 * (0.133)</td>
<td>−0.140 (0.136)</td>
<td>0.209 *** (0.134)</td>
<td>0.774 *** (0.138)</td>
<td>−0.548 *** (0.131)</td>
<td>0.456 *** (0.133)</td>
</tr>
<tr>
<td>FDI FDI</td>
<td>0.060 (0.063)</td>
<td>0.083 (0.063)</td>
<td>0.193 *** (0.064)</td>
<td>0.211 *** (0.064)</td>
<td>−0.015 (0.060)</td>
<td>0.032 (0.061)</td>
</tr>
<tr>
<td>Constant</td>
<td>19.544 *** (0.747)</td>
<td>18.940 *** (0.778)</td>
<td>−8.270 *** (0.753)</td>
<td>−8.739 *** (0.791)</td>
<td>23.213 *** (0.903)</td>
<td>22.380 *** (0.484)</td>
</tr>
<tr>
<td>N</td>
<td>165</td>
<td>165</td>
<td>165</td>
<td>165</td>
<td>165</td>
<td>165</td>
</tr>
<tr>
<td>R²_a</td>
<td>0.938</td>
<td>0.939</td>
<td>0.959</td>
<td>0.960</td>
<td>0.948</td>
<td>0.959</td>
</tr>
</tbody>
</table>

Note: Standard errors in parentheses * p < 0.1, ** p < 0.05, *** p < 0.01.

7. Conclusions and Suggestions

7.1. Conclusions

First, green finance in the YREB has had a fluctuating and rising trend from 2005 to 2019; there are significant regional disparities, with the East having more green finance than the Midland and West, and the gap between regions is shrinking.

Second, green finance and technology innovation play a significant role in promoting the upgrading of industrial structures. By regional comparison, green finance in the East has a stronger encouraging effect on upgrading the industrial structure than in the Midland. In contrast, green finance in the West has a certain inhibiting effect. The promotion effect of green technology innovation on upgrading industrial structures is stronger in the Midland than in the East, but it is insignificant in the West.

Third, innovation in green technology plays a crucial mediating function in boosting industrial structure upgrading through green finance. The mediating effect of innovation in green technology accounts for 55.2% of the total effect, showing that 55.2% of the impact of green finance on industrial structure upgrading is mediated by innovation in green technology. In other words, green technology innovation is an important intermediary path.

Fourth, environmental regulation not only positively regulates the direct path of green finance and green technology innovation to promote industrial structure upgrading but also positively regulates the intermediary path of green finance to promote industrial structure upgrading.

7.2. Suggestions

7.2.1. Insist on the Combination of Differentiated Development and Regional Synergy

On the one hand, we should give full consideration to regional differences based on each region’s industrial structure and resource endowment. The East and Midland should maximize the economic advantages, increase financial support for green technological innovation, and optimize the science and technology innovation environment for enterprises and research institutions. In the West, we should take advantage of its resourcefulness, improve the investment channels of the green financial system, raise the level of investment,
and try to catch up by learning from the experience of the development of green technology innovation in the East and Midland. On the other hand, it is important to strengthen regional cooperation, focus on the ecological protection and its investment, and financing needs of enterprises, financial institutions, and governments in the Yangtze River Economic Belt. It is also necessary to play the service functions of green financial information exchange, green financial development seminars, green financial personnel training, and matchmaking between supply and demand of investment and financing to enhance the ability of financial institutions to meet the investment and financing needs of enterprises and local governments in ecological protection, green technology innovation, etc.

7.2.2. Promote the Innovation of Green Finance

Under the model of green credit as the primary body and the diversified development of green securities, green insurance, green bonds, and other instruments, the development of green financial instruments plays a crucial role in promoting regional green transformation. Diversified green finance will improve innovation efficiency in green technology [64,65]. Thus, it will promote innovations in green financial products and increase financing for research and development of carbon finance, green bonds, and other financial products. Additionally, it will promote the formation of inter-provincial and regional green funds, and guide social and foreign capital flows to the energy conservation and environmental protection industry. Moreover, through financial investment, it will drive enterprises to continuously produce green technological achievements.

7.2.3. Green Technologies Foster New Driving Forces for Upgrading the Industrial Structure and Green Development

On the one hand, promoting innovation in green technology should be actively utilized. It will establish and enhance the green technology innovation system, and strengthen the primary position of enterprise innovation and green technology innovation in traditional industries such as iron, steel, and chemical industries to improve energy utilization efficiency and decrease pollution emissions. In contrast, industrial innovation in new energy technology and other growing green industries should prioritize the development of green core technologies and enhance firms’ capacity for independent innovation. On the other hand, green finance’s role in fostering innovation in green technology should be fully realized. Increasing green finance support for green technology financing, maximizing green finance’s role in information guidance and risk diversification, and leading the coordinated development of green finance and technology through scientific and technological innovation is important.

7.2.4. Create Good Policy Coordination and Effectively Stimulate Environmental Regulation to Support Industrial Upgrading

The upgrading of industrial structures is the outcome of the cumulative effect of a structure of factors. In light of the regulatory effect of environmental regulation, green finance, environmental regulation, and green technology innovation policies should be analyzed exhaustively and painstakingly to preserve the coordination and cohesion of the policies. Environmental regulation policies should provide signals to the market to guide financial institutions in improving the efficiency of green financial services, enterprises in taking corresponding social responsibility, attach priority to green innovation investment, and focus on improving innovation quality. At the same time, environmental regulation policies should be appropriately oriented to clean and environmental protection industries to stimulate entrepreneurship.

7.3. Research Limitations and Future Directions

This paper examines the relationship between green finance, green technology innovation, and regional industrial upgrading at the provincial level of the YREB. Even though there are advances in theoretical analysis and research views, there are still deficiencies in the following two areas: First, due to the paucity of carbon finance and other green
finance-related data, this paper’s green finance index method cannot thoroughly quantify the green finance state of eleven YREB provinces (cities). Second, provincial panel data cannot yet exhaustively reflect the impact of green finance and green technology innovation on industrial upgrading; local and municipal level or micro-enterprise data might make the study more representative. Therefore, upcoming studies should expand on the two areas above.

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