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Does Environmental, Social, and Governance (ESG) Performance Improve Financial Institutions' Efficiency? Evidence from China

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Abstract: Nowadays, the call for sustainable development is becoming stronger in all countries of the world, and environmental, social, and governance (ESG) performance, as a vivid practice of this concept, has gradually received extensive attention from enterprises and investors. Financial institutions have an important position in the national economy as an important tool for the state to regulate the macroeconomy. Whether ESG performance can improve financial institutions' efficiency is of key significance for boosting sustainable development. Based on data from China's listed financial institutions from 2015 to 2021, this study aims to investigate the impact of ESG performance on financial institutions. The robust nonparametric boundary model and fixed-effects model are employed for analysis. The empirical results demonstrate that ESG performance and its sub-indicators of environmental performance and social responsibility performance can significantly enhance financial institutions' efficiency. In particular, this effect is more pronounced in the securities industry and diversified financial industry, as well as in non-state and small-scale financial institutions. The results remain unchanged after a series of robustness tests. Furthermore, the mechanism tests indicate that ESG performance can enhance financial institutions' efficiency by reducing downside risk and agency costs.

Keywords: environmental, social, and governance (ESG) performance; financial institutions' efficiency; downside risk; agency costs

MSC: 91B38

Citation: Wu, Z.; Chen, S. Does Environmental, Social, and Governance (ESG) Performance Improve Financial Institutions' Efficiency? Evidence from China. *Mathematics* **2024**, *12*, 1369. https://doi.org/10.3390/math12091369

Academic Editors: Antonella Basso and Palle E.T. Jorgensen

Received: 8 April 2024
Revised: 26 April 2024
Accepted: 29 April 2024
Published: 30 April 2024

1. Introduction

Nowadays, the social gap between the rich and the poor, the continuous warming of the climate, and the imbalance in regional development have become important issues that need to be solved by all countries in the world. In 2015, the United Nations Summit on Sustainable Development adopted the "*Transforming our World: The 2030 Agenda for Sustainable Development*", which called for a thorough solution to the development problems in the three aspects of society, economy, and environment, and the shift to the road of sustainable development between 2015 and 2030. As a concrete practice of sustainable development, environmental, social, and governance (ESG) performance has gradually attracted extensive attention from countries around the world. ESG performance covers the performance of a company's environmental, social, and governance synthesis, and comprehensively measures a company's sustainable development capacity from three dimensions. The practice of ESG activities by enterprises is in line with historical trends and the need to meet the sustainable development goals. As the hub of social resource allocation, financial institutions play an important role in promoting the development of the national economy. The ability of ESG performance to improve financial institutions' efficiency is important for promoting sustainable economic development. Therefore, financial institutions should take the lead in practicing ESG concepts, which can form a positive demonstration effect and drive the ESG practice of the whole market to promote global sustainable development.

In 2004, the United Nations Environment Program (UNEP) first proposed the concept of ESG activities. In 2006, the United Nations established the Principles for Responsible Investment (PRI), which formally incorporated the field of ESG-responsible investment into the basic code of conduct. Investment institutions were encouraged to incorporate ESG indicators into their decision-making. As of September 2023, 5138 organizations have become PRI signatories, and the PRI cover more than 70 countries and regions. ESG practices are not only actively practiced in developed countries but are also widely promoted worldwide. In 2020, the 75th United Nations General Assembly proposed that "China's carbon dioxide emissions should peak by 2030, and strive to achieve carbon neutrality by 2060" ("Dual Carbon Goal") in order to promote sustainable development globally. development. Since then, the "Dual Carbon Goal" has become the leader in ESG system construction work. Flush data show that, as of June 2023, 1755 A-share listed companies disclosed ESG-related reports for 2022, accounting for 34.32% of all A-share companies. Currently, 455 ESG fund products are available on the market, with a total net value of RMB 573.644 billion.

There is a large body of literature on how ESG practices react to firm efficiency. However, the impact of ESG performance on firm efficiency is currently controversial in academia. Friede et al. [1] found that approximately 90% of the literature suggests that there is a non-negative impact of ESG performance on firm efficiency, by analyzing data from about 2000 empirical studies. Some scholars believe that ESG performance will have an impact on reducing the cost of capital of firms, thus increasing firm efficiency [2]. In addition, Duque-Grisales [3] found that ESG performance reduced firm efficiency, by analyzing data from listed firms in Latin America, and Narula et al. [4] used Indian firms as a sample for their study and found that ESG performance had little effect on firm efficiency. However, most of the evidence from China suggests that ESG performance can be effective in improving firm efficiency [5–7]. However, most of these studies focus on the effect of ESG performance on overall industry efficiency, while there are few relevant studies in the financial sector. Traditional financial institutions, including banks, securities, insurance, trusts, and futures, hold the core lifeblood of the national economy, and their business practices are very different from those of other firms. In addition, the composition of China's financial institutions is quite different from that of Western countries. China's financial sector is predominantly state-owned, and shareholding-based financial institutions are dominated by state-owned property rights. China's financial sector has meager profit margins because of its strong policy regulations. Therefore, what is the impact of ESG performance on financial institutions' efficiency in China? Whether ESG performance can improve financial institutions' efficiency is of great significance for promoting sustainable economic development. Considering China as the scope of our study, we provide new evidence that ESG performance can improve financial institutions' efficiency.

In terms of corporate efficiency measures, some scholars use Return on Total Assets Ratio (ROA), Return on Equity (ROE), and Tobin's Q to measure corporate efficiency [7–9]. Such methods mainly measure enterprise efficiency from a financial perspective, which often does not accurately reflect the efficiency situation and does not consider the asset operation level, production capacity, and other enterprise efficiency characteristics. Simultaneously, with the continuous maturity of data envelopment analysis (DEA), many scholars have begun to use the DEA method to measure enterprise efficiency [9–12]. Daraio et al. [13,14] proposed a nonparametric boundary model, based on a probabilistic approach, to measure efficiency, which was improved by Bădin et al. [15]. This approach uses inputs, outputs, and environmental variables to measure firm efficiency, by selectively substituting environmental variables as externalities into the model and calculating conditional and unconditional efficiencies separately. The nonparametric approach is effective for avoiding many complexities. Its main advantage is that it overcomes the problems associated with endogenous control variables and omitted variables [16,17]. While nonparametric models only compare observations with similar values of the control variables, parametric regression combines all observations in a unified regression framework. Thus, only the

direct effect of ESG performance on financial institutions' efficiency needs to be focused on without considering the effects of other variables. Hence, the nonparametric boundary model is used to measure financial institutions' efficiency and to further examine the effect of ESG performance on financial institutions' efficiency.

The stakeholder theory points out that enterprises need to comprehensively balance the interest requirements of various stakeholders in production and operation, and the practice of ESG activities reflects comprehensive attention to these stakeholders. Companies with higher ESG performances consider the expectations of all stakeholders, thus improving corporate efficiency by increasing investment efficiency and reducing the cost of capital [18,19]. However, shareholder primacy theory emphasizes that shareholders should maximize their interests as a company's goal. Practicing ESG concepts may instead increase unnecessary costs for a company, thereby reducing corporate efficiency. In addition, existing research suggests that ESG performance is beneficial for the efficiency and stability of financial institutions [20,21]. ESG performance improves financial institutions' efficiency through two channels. In the external channel, ESG performance improves corporate image and earns reputation by sending positive signals to society [22]. This builds trust with stakeholders and reduces financing costs and downside risks, which in turn improves financial institution efficiency. In the internal channel, ESG performance can improve the governance structure of a firm, which requires financial institutions to improve corporate governance in terms of board diversity, compensation management, and equity structure. In addition, relevant studies have found that good corporate governance can help mitigate agency problems [23]. Therefore, ESG performance can help improve financial institutions' efficiency.

Based on data from listed financial institutions in China between 2015 and 2021, this paper aims to investigate the impact of ESG performance on financial institutions' efficiency and the mechanism of impact. The empirical results demonstrate that ESG performance, and its sub-indicators of environmental performance and social responsibility performance, contribute to financial institutions' efficiency. Particularly, this effect is more pronounced in the securities industry and diversified financial industry, as well as in non-state and small-scale financial institutions. Furthermore, the mechanism test indicates that ESG performance can improve efficiency by reducing downside risk and agency costs.

The potential contributions of this study are as follows: First, this study enriches the literature on ESG performance and financial institutions' efficiency. Most established studies focus on the impact of ESG performance on overall industry efficiency [7–9]. In addition, Cao et al. [20] analyzed the impact of ESG performance on bank efficiency, and Chiaramonte et al. [21] analyzed the impact of ESG performance on the stability of insurance institutions. However, the above literature focuses either on the overall industry or on a single research object, such as banks and insurance. Therefore, this study enriches the literature on the link between ESG performance and financial institutions' efficiency. Second, this study improves the methodology for measuring financial institutions' efficiency. Most established studies use financial indicators, such as ROA and ROE, to measure corporate efficiency [7,24]. However, this method has some shortcomings. This study measures financial institutions' efficiency using a nonparametric boundary model based on probabilistic approach. The advantage of this method is that it overcomes the problems associated with endogenous control variables [16,17]. Therefore, this method can effectively measure the impact of ESG performance on financial institutions' efficiency. Third, this study elucidates the internal logic of the impact of ESG performance on financial institutions' efficiency through two channels: downside risk and agency costs.

2. Literature Review and Hypotheses

Currently, most studies on ESG performance and corporate efficiency focus on the overall industry, and there is less relevant literature on ESG performance in the financial industry. Some scholars have found a significant positive link between ESG performance and banking industry efficiency [2]. Some scholars also believe that there is a nonlinear

relationship between ESG performance and banking industry efficiency [25]. In addition, ESG performance can affect the performance of the insurance industry in the capital market; that is, an upward revision of ESG ratings causes stock prices to rise and vice versa [26]. Stock prices tend to have a strong relationship with firm efficiency. First, ESG performance has a reputational spillover effect [20]. By disclosing relevant information externally, ESG performance can build trust with stakeholders and create an external environment that attracts external investment. Second, ESG investment concepts are increasingly favored by investors, and good ESG performance can help to reduce financing costs [19]. Third, ESG performance helps companies identify issues that need to be addressed [27]. This helps financial institutions improve corporate governance in terms of board diversity, compensation management, and shareholding structure, which in turn improves their efficiency of financial institutions. Fourth, ESG performance requires financial institution employees to have strong business skills. Financial institutions can effectively enhance the professionalism of their employees by introducing composite senior management talent and strengthening internal employee skill training, thereby improving efficiency.

Based on the above analysis, this study proposes the following hypothesis:

H1. *ESG performance can improve financial institutions' efficiency.*

ESG performance is also an important factor that affects firm risk. Banks with higher ESG performance can take greater risks [28]. Relevant studies have found that ESG performance can significantly reduce a firm's downside risk [24]. First, ESG performance can effectively alleviate the information asymmetry problem between companies and stakeholders [29]. ESG performance reduces the downside risk of financial institutions by disclosing relevant value information to stakeholders in a timely manner, which in turn gives investors the ability to make timely and correct investment decisions and reduces the information asymmetry problem. Second, financial institutions with better ESG performance usually have sound corporate governance mechanisms that can effectively monitor management and reduce the possibility of withholding bad news and self-interested behaviors, thus reducing downside risks and ensuring the sustainable development of the company [30]. Third, an increasing number of investors incorporate ESG performance into their investment decisions, favoring firms with superior ESG performance. Such firms are more likely to be backed by long-term capital because long-term investors believe that these firms are more resilient to future uncertainty, thereby reducing downside risk. In addition, when companies face higher downside risks, they may be forced to shift more resources (e.g., capital and labor) from day-to-day operations to risk management, which in turn reduces financial institutions' efficiency. Therefore, reducing downside risk is conducive to improving financial institutions' efficiency.

Based on the above analysis, this study proposes the following hypothesis:

H2. *ESG performance improves financial institutions' efficiency by reducing downside risk.*

The costs incurred due to measures taken in response to management's behavior, which may be self-interested and harmful to shareholders' interests, in the context of information asymmetry between shareholders and management, are referred to as agency costs. Good ESG performance can improve financial institutions' efficiency by reducing agency costs. When firms have sufficient free cash flow, management has an incentive to invest the free cash flow within the firm in projects with negative net present value for private gain, which in turn reduces financial institutions' efficiency [31]. The costs paid by firms in terms of ESG performance are conducive to reducing the level of free cash flow of firms, which in turn reduces the agency costs of firms and improves financial institutions' efficiency [32]. In addition, financial institutions with good ESG performance also typically have well-developed corporate governance mechanisms that can effectively discipline managers and reduce agency costs. Positive ESG information can reduce the negative impact of media reports, buffer external pressure, and lower agency costs [18]. By publicly dis-

closing information about a firm's ESG-related valuable information, corporate managers demonstrate a positive attitude toward investors and stakeholders and communicate their ethical concerns, thereby improving stakeholders' perceptions of the firm's credibility and reputation and mitigating agency conflicts between managers and investors [33]. At the same time, in the presence of agency problems, resources within the firm are not effectively utilized. Management may prioritize the allocation of resources to areas that are in their favor rather than the firm's most valuable projects for personal or departmental interests, which can reduce the overall operational efficiency of the firm. Therefore, mitigating agency costs is conducive to improving financial institutions' efficiency.

Based on the above analysis, this study proposes the following hypothesis:

H3. *ESG performance improves financial institutions' efficiency by reducing agency costs.*

3. Research Design

3.1. Model

3.1.1. Efficiency Measurement Model

In this study, a nonparametric boundary model based on a probabilistic approach is selected to measure financial institutions' efficiency. It was proposed by Daraio [13,14] and improved by Bădin et al. [15]. Subsequently, a financial institution's production process can be characterized by a set of inputs, $x \in R_+^p$, which produce a set of outputs, $y \in R_+^q$. This can be described as follows:

$$\Psi = \left\{(x, y) \in R_+^{p+q} \mid x \; can produce \; y\right\} \tag{1}$$

The Farrell measure of input-oriented efficiency score can be defined as follows:

$$\theta(x, y) = \inf\{\theta \mid (\theta x, y) \in \Psi\} \tag{2}$$

Next, the production process can be described by the joint probability measure of (X, Y) on $R_+^p \times R_+^q$. Then, the probability function $H_{XY}(.,.)$ can be defined as follows:

$$H_{XY}(x, y) = \text{Prob}(X \leqslant x, Y \geqslant y) \tag{3}$$

For the input-oriented case the efficiency scores $\theta(x, y)$ for $(x, y) \in \Psi$ are defined as follows:

$$\theta(x, y) = \inf\left\{\theta \mid F_{X|Y}(\theta x \mid y) > 0\right\} = \inf\left\{\theta \mid H_{X|Y}(\theta x, y) > 0\right\} \tag{4}$$

For an input direction, a boundary of *order-m* can be introduced as follows. For a given fixed integer $m > 1$ and a given level of output y, we obtain the random production set of the order-m units producing more than y as follows:

$$\Psi_m(y) = \left\{(x, y') \in R_+^{p+q} \mid x \geqslant X_i \; y' \geqslant y, \; i = 1, \ldots, m\right\} \tag{5}$$

In addition, for any x, we can define the following:

$$\widetilde{\theta}_m(x, y) = \inf\{\theta \mid (\theta x, y) \in \Psi_m(y)\} \tag{6}$$

The order-m efficiency score of a financial institution can be defined as follows:

$$\hat{\theta}_{m,n}(x, y) = \hat{E}\left(\widetilde{\theta}_m(x, y) \mid Y \geqslant y\right) \tag{7}$$

The order-m efficiency score is the expected value of the input-oriented efficiency score of a financial institution (x, y) when it produces more outputs than y, compared with m randomly selected financial institutions. The efficiency score calculated using the order-m formula can take a value greater than 1. An estimated value greater than 1 indicates that

financial institutions operating at the (x, y) level are more efficient than their m peers on average. In the input-oriented case, the efficiency score for a financial institution is 0.7, which implies that the financial institution uses 30% more inputs than would be expected from the lowest input level of m other financial institutions drawn from the group of financial institutions at the output level $\geq y$. Finally, when $m \to \infty$ is $\theta_{m,n}(x, y) \to \theta_{\mathrm{FDH}}(x, y)$.

According to Daraio and Simar [13], it is assumed that different variables (exogenous to the production process), $Z \in R$, can be used to explain changes in the efficiency of the production process. In contrast to the traditional two-stage approach, the probabilistic approach does not impose the assumption of separability between the Z-value and the input–output space [34]. ESG scores are used as exogenous variables, and the production process of the financial institution with ESG performance as a constraint $Z = z$ and the joint distribution (x, y) conditional on $Z = z$ defines the production process of $Z = z$ as follows:

$$H_{XY|Z}(x, y \mid z) = \mathrm{Prob}(X \leqslant x, Y \geqslant y \mid Z = z) \tag{8}$$

The input-oriented technical efficiency scores of financial institutions under the effect of external factors can be expressed as follows:

$$\theta(x, y \mid z) = \inf\left\{\theta \mid F_{X|Y,Z}(\theta x \mid y, z) > 0\right\} \tag{9}$$

The conditional order-m nonparametric estimated coefficients can be obtained as follows:

$$\hat{\theta}_m(x, y \mid z) = \hat{E}_{X|Y,Z}\left(\hat{\theta}_m^z(x, y) \mid y, z\right) \tag{10}$$

Finally, we compute the q, which equals to the ratio of conditional order-m efficiency (Equation (10)) to unconditional order-m efficiency (Equation (7)). Subsequently, the scatterplot of Z (ESG performance) against q is inscribed along with its smoothed nonparametric regression plot to observe the overall effect of Z on financial institutions' efficiency. The effect of Z on financial institutions' efficiency can be observed using nonparametric regression plots [14]. If the smoothed nonparametric regression line increases, then it indicates that Z is unfavorable to financial institutions' efficiency. An increase in the smoothed nonparametric regression line suggests that Z is detrimental to financial institutions' efficiency; conversely, it is favorable.

3.1.2. Fixed-Effect Model

In order to test hypothesis H1, the fixed-effect model is employed to examine the impact of *ESG* performance of financial institutions on their efficiency. Furthermore, the impact of the three sub-dimensions of *ESG* performance, *Environment*, *Social*, and *Governance* on financial institutions' efficiency is also explored. The specific regression model is set up as follows:

$$Eff_{it} = Intercept + \alpha_1 ESG_{it} + \alpha_2 Control_{it} + Individual + Year + \varepsilon_{it} \tag{11}$$

where subscripts i and t denote sample individuals and years, *Eff* denotes the explained variable, *ESG* denotes the core explanatory variables, *Controls* denotes a set of firm-level control variables, *Individual* represents firm-level individual fixed effects, *Year* represents time fixed effects, *Intercept* represents the intercept term, α_1 represents the estimated coefficients on the explanatory variables, and α_2 represents the estimated coefficients on the control variables.

3.1.3. Mediating Effect Model

In order to explore the mechanism of ESG performance on financial institutions' efficiency, the mediation effect model is used to test hypotheses H2 and H3. The specific model is as follows:

$$M_{it} = Intercept + \beta_1 ESG_{it} + \beta_2 Controls_{it} + Individual + Year + \varepsilon_{it} \tag{12}$$

where M denotes the mediating variables, including agency costs (AC) and downside risk ($Risk$). β_1 represents the coefficient of ESG performance on the mediating variable.

3.2. Variable

3.2.1. Explained Variable

The explained variable in this paper is unconditional efficiency, which is measured by the nonparametric boundary model. According to the characteristics of the industry operation of various types of financial institutions, this study uses different input and output indicators to construct the efficiency measurement index system of financial institutions.

For banks, referring to Degl' Innocenti [35], this study chooses employee compensation, net fixed assets, and total deposits as input indicators. Total loans and the sum of derivative financial assets and trading financial assets are used as output indicators. For insurance organizations, following Guan et al. [36], this study selects employee compensation, the sum of paid-in capital and capital surplus, and the sum of business taxes and other operating costs as input indicators. Premium and net investment income are used as output indicators. For securities organizations, following Qin and Liu [12], this study chooses employee compensation, the sum of paid-in capital and capital surplus, net fixed assets, and the sum of other operating costs and administrative expenses as input indicators. The commission income and net investment income are used as output indicators. Currently, few studies examine the efficiency of diversified financial institutions. This study combines the main activities and characteristics of diverse financial companies, according to the principle of consistency and authenticity of the calibration of the indicators, calculability, and other concepts. We select employee compensation, the sum of paid-in capital and capital surplus, net fixed assets, and the sum of administrative expenses and other operating costs as input indicators. Total operating income and net investment income are used as output indicators, and ESG performance is used as an exogenous variable for all industries. Then, unconditional and conditional efficiency are measured using a nonparametric boundary model. All variables are defined in Table 1.

Table 1. Evaluation system of financial institutions' efficiency.

Industry	Inputs	Outputs	External Variable
Bank	Employee compensation	Total loans	ESG
	Net fixed assets	The sum of derivative financial assets and trading financial assets	
	Total deposits		
Insurance	Employee compensation	Premium	ESG
	The sum of paid-in capital and capital surplus	Net investment income	
	The sum of business taxes and other operating costs		
Securities	Employee compensation	Commission income	ESG
	The sum of paid-in capital and capital surplus	Net investment income	
	Net fixed assets		
	The sum of other operating costs and administrative expenses		
Diversified financial	Employee compensation	Total operating income	ESG
	The sum of paid-in capital and capital surplus	Net investment income	
	Net fixed assets		
	The sum of other operating costs and administrative expenses		

Finally, we select unconditional efficiency as an explained variable. The reasons for the selection are as follows: First, the results of the permutation test in Table 2 show that the probability distributions of conditional and unconditional efficiency are significantly different, and that the regression results of the two efficiencies as explained variables are

bound to be different. Second, conditional efficiency is measured under constraints, and does not reflect the true level of efficiency of financial institutions. Therefore, we choose unconditional efficiency as an explained variable.

3.2.2. Core Explanatory Variable

With the promotion of socially responsible investment, many ESG rating systems have emerged at home and abroad. China's Huazheng ESG rating system references the framework of mainstream ESG rating systems and comprehensively covers a company's publicly disclosed data, social responsibility report, and sustainability report, which is more in line with China's political and economic environment [37]. Currently, this index is widely recognized and applied by the industry and academia [37–39]. Therefore, we use the Huazheng ESG score and its sub-indicators as the core explanatory variable.

3.2.3. Mediating Variables

The mediating variables selected in this study included agency costs (*AC*) and downside risk (*Risk*). Drawing on existing studies [24,40], we select total asset turnover (*AC*) and downside risk (*Risk*) as proxies to measure the agency costs and downside risk of financial institutions, respectively.

Risk is defined as follows: when a stock's monthly return is lower than the average of the stock's monthly returns for the year, a standard deviation is calculated using the daily returns for that month, and then an average is calculated using the standard deviations for those months as the company's downside risk for the year [24]. The specific calculation is as follows:

$$Risk = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(r_i - \overline{r})^2} \tag{13}$$

where r_i is the return when a stock's monthly return is below the one-year average, $\overline{r}$ is the average of a stock's monthly returns over a one-year period, N is the total number of stocks whose monthly returns are below the average over a one-year period, and the monthly return is the monthly return on an individual stock that does not take into account reinvestment of cash dividends.

3.2.4. Control Variables

Drawing on Wen et al. [24] and Yang et al. [41], this paper examines both firm and macro-level factors in the selection of control variables. For the enterprise level, it is generally believed that enterprise size and leverage will have some impact on enterprise efficiency, and enterprise size (*Size*) and leverage (*Leverage*) are selected as control variables here. In addition, the number of employees and the concentration of equity will also have a certain impact on the efficiency of the enterprise. Therefore, we choose the number of employees (*staff*) and equity concentration (*Top10*) as firm-level control variables. The macro level controls the regional economic growth rate (*GDPGrowth*). Also, the annual turnover rate of the number of outstanding shares (*Freefloat*) and the systematic risk of the company (*Beta*) are included in the model as important control variables affecting the financial industry's efficiency. The calculation of *Beta* is referred to in Equation (14).

Beta represents the systematic risk of a firm and is derived from the capital asset pricing theory, where $\mathrm{Cov}(r_i, r_m)$ denotes the covariance of the daily individual stock return and the daily composite market return of a stock for each year, and σ_m^2 is the variance of the daily composite market return for each year. Then, the ratio of the $\mathrm{Cov}(r_i, r_m)$ to σ_m^2 are used to calculate the annual systematic risk of the firm. The specific calculation is as follows:

$$Beta_{it} = \frac{\mathrm{Cov}(r_i, r_m)}{\sigma_m^2} \tag{14}$$

3.3. Data

The purpose of this study is to investigate the impact of ESG performance on financial institutions' efficiency, and the R language (Version number 4.2.3) is used as the statistical software for this analysis. Based on data availability, we select 73 listed financial institutions in China from 2015 to 2021 as our research sample, including 16 banks, 28 securities firms, 25 multi-finance companies, and 4 insurance companies. In total, we obtain 511 samples. For some missing values in finance, linear interpolation is applied. Financial data are obtained from the China Stock Market & Accounting Research and Wind databases, and ESG rating data are obtained from the China Huazheng ESG Rating Corporation. Appendix A presents descriptive statistics for the main variables.

4. Empirical Results and Analysis

4.1. Current Status of the Impact of Environmental, Social, and Governance (ESG) Performance on the Efficiency

Figure 1 shows the annual trend in the yearly averages of the ESG performances, unconditional efficiency, and conditional efficiency of financial institutions for each year. It can be seen that the yearly averages of ESG score, unconditional efficiency, and conditional efficiency generally show an upward trend. Moreover, the unconditional and conditional efficiency move in approximately the same direction, and the conditional efficiency is generally lower than the unconditional efficiency in each year. Unconditional and conditional efficiency continued to increase between 2015 and 2017. Unconditional efficiency increased from 1.1314 in 2015 to 1.2343 in 2018, and conditional efficiency decreased from 1.0052 in 2017 to 1.0917 in 2018. During this period, the unconditional and conditional efficiency showed an increasing trend in all years except for 2017 to 2018, when the unconditional efficiency and conditional efficiency decreased. Unconditional efficiency increased from 1.1308 in 2018 to 1.3048 in 2021, and conditional efficiency decreased from 1.0461 in 2018 to 1.0486 in 2021. There was a slight decrease in the mean ESG score of financial institutions between 2016 and 2019, with their ESG scores decreasing from 75.6393 in 2016 to 74.1229. However, there is high growth from 2019 to 2021, and it increases from 74.1229 in 2019 to 77.6792 in 2021. This indicates that financial institutions have substantially improved in terms of ESG performance.

Non-parametric tests were used to determine whether there was a significant difference between the two sets of variables. Drawing on Degl'Innocenti [35], the conditional and unconditional efficiency for each year are used as two sets of variables, and this study employ the permutation test in the non-parametric test to examine whether ESG have a different impacts on two sets of efficiency. Table 2 presents the results. It can be observed from the table that 2021 has the smallest p-value with a p-value and test statistic of 0.0020 and −3.5692, respectively. The largest p-value was for 2015, with p-values and test statistics of 0.0639 and −1.8888, respectively. Based on the results, there is a significant difference in the efficiency scores between the two groups. Therefore, it is reasonable to state that ESG performance leads to a significant difference between the efficiency scores of the two groups.

Table 2. Permutation test.

	2015 vs. 2015c	**2016 vs. 2016c**	**2017 vs. 2017c**	**2018 vs. 2018c**	**2019 vs. 2019c**	**2020 vs. 2020c**	**2021 vs. 2021c**
t-value	−1.8888	−2.1483	−2.2478	−2.3339	−2.5485	−2.3094	−3.5692
p-value	0.0639	0.0400	0.0320	0.0300	0.0160	0.0100	0.0020

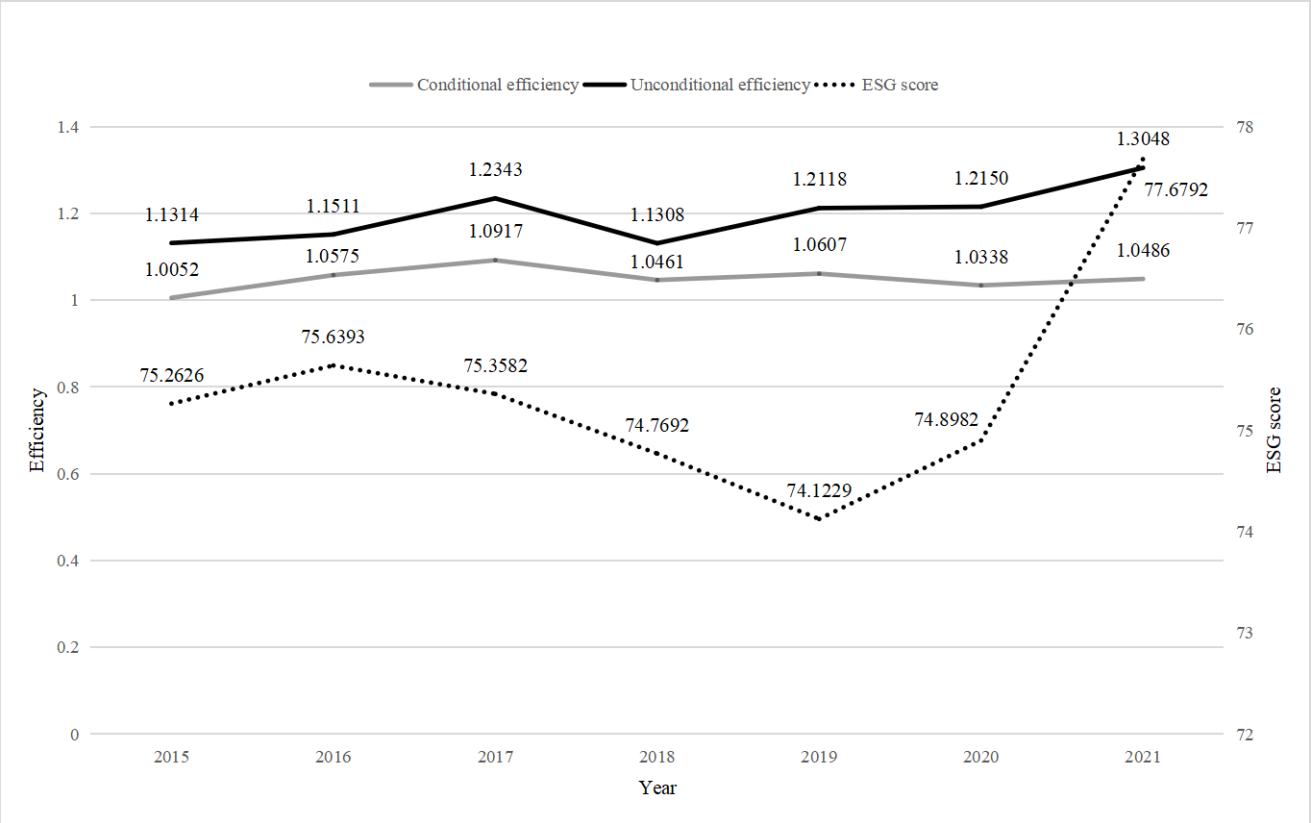
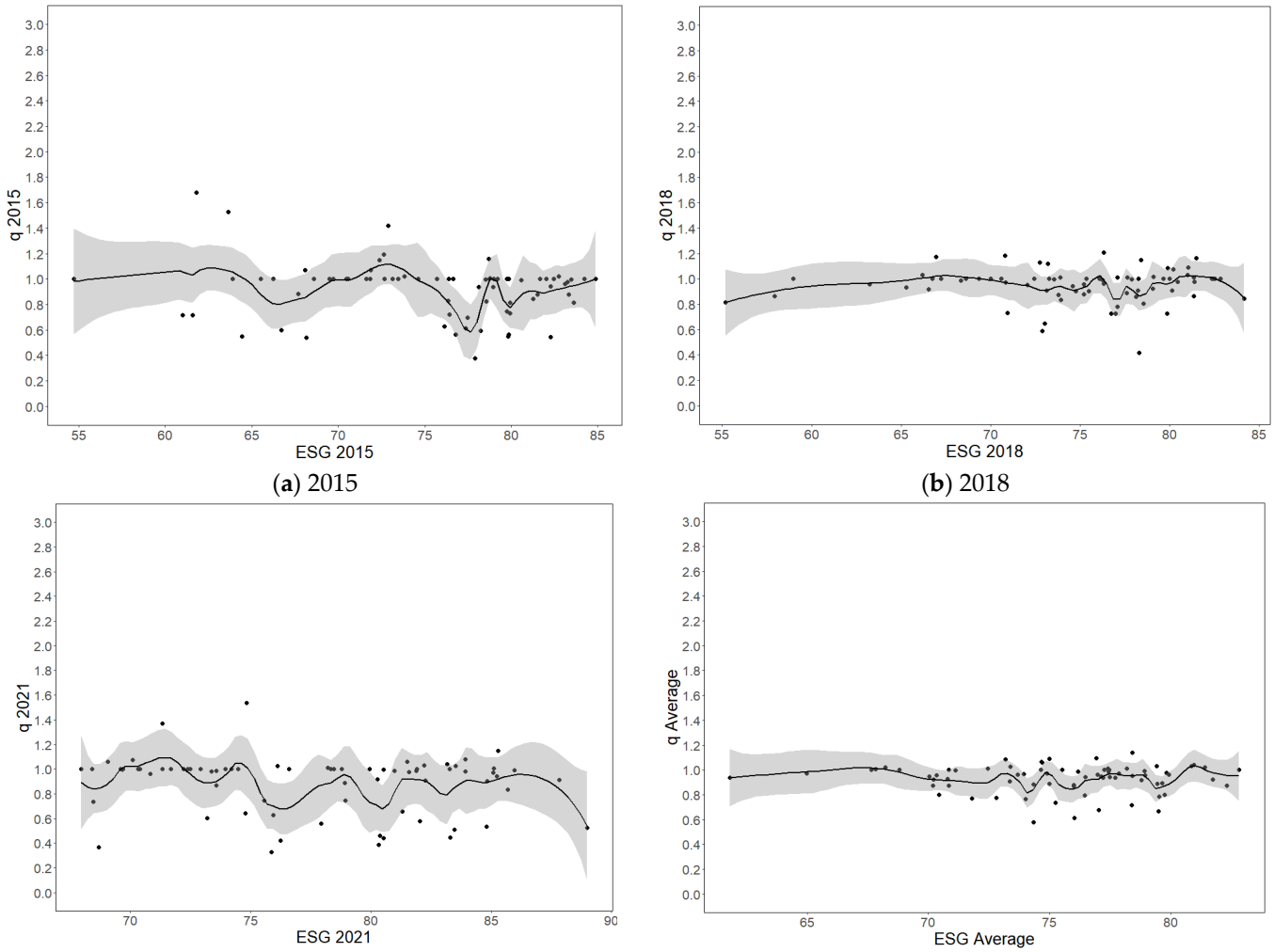


Figure 1. Time trends in ESG performance, unconditional efficiency, and conditional efficiency.

Referring to established studies [13–15], this study describes the nonparametric regression curves of ESG performance against q using ESG performance as the horizontal axis and the ratio of the conditional efficiency score to the unconditional efficiency score, q, as the vertical axis (see Figure 2). Figure 2a–d show the nonparametric regression curves of ESG performance against q for 2015, 2018, 2021, and the average sample period, respectively. The black dots and curves denote the scatter distribution and nonparametric curve of the ESG on q, respectively, and the shaded areas represent confidence intervals. If the curves are rising, ESG performance acts as an additional "bad output", which is detrimental to the production process of financial institutions. Conversely, it indicates that ESG performance has the opportunity to "save" inputs in the production process of the financial institution, thus acting as a "substitute". It implies that ESG performance has a "positive" impact on the production process.

In 2015, the nonparametric regression curve shows an upward trend, suggesting that ESG performance may reduce financial institutions' efficiency. In the early years, ESG practices required significant capital investments. In addition, returns on ESG investments may lag. Therefore, in the short term, an increase in costs may be observed, which reduces efficiency. Except for 2015, all nonparametric regression curves show a slow downward trend, and the change appears to be less pronounced. However, the downward bending of the curves gradually increases with time. This implies that, over the course of time, investments in ESG are transformed into long-lasting, sustainable returns. Therefore, in the long run, ESG performance contributes to financial institutions' efficiency. In the next section, this study further argues this point using a fixed effects model.



(**a**) 2015 (**b**) 2018

(**c**) 2021 (**d**) Average

Figure 2. The impact of ESG performance on efficiency.

4.2. Baseline Results and Analysis

In this section, this study uses a fixed effects model to examine the effect of ESG performance on financial institutions' efficiency. In addition, we explore the effect of the ESG performance sub-indicators. The results are presented in Table 3.

The result in column (1) shows that the estimated coefficient of *ESG* on *Eff* is significantly positive at the 1% confidence level, with a value of 0.009, which suggests that ESG performance is effective in improving financial institutions' efficiency. The economic benefits of increased investment in ESG by financial institutions are much greater than the costs they incur, thus increasing financial institutions' efficiency. Hypothesis H1 is confirmed. In addition, the estimated coefficients of *Environment* and *Social* on *Eff* are significantly positive at the 1% and 10% confidence levels, respectively, which indicates that the better the environmental and social responsibility performance, the more efficient the financial institutions. However, the estimated coefficient of *Governance* on *Eff* is positive but insignificant. The possible reason for this is due to the fact that ESG performance conveys a positive reputation to the society, mainly through environmental performance and social responsibility performance, which attracts investment and reduces the associated costs, thus increasing financial institutions' efficiency. In contrast, the internal governance of the firm does not have a significant effect on efficiency. Among the control variables, all the results show that the estimated coefficients of Size are significantly positive at the 1% confidence level. As for-profit firms, financial institutions earn profits mainly by lending

capital. Therefore, by expanding asset size, financial institutions can increase their operating income, thus improving their efficiency of financial institutions. In addition, all results show that the estimated coefficients of beta are significantly negative, which indicates that risk reduces financial institutions' efficiency.

Table 3. Baseline regression results.

	Eff			
	(1)	**(2)**	**(3)**	**(4)**
ESG	0.009 ***			
	(2.681)			
Environment		0.010 ***		
		(2.712)		
Social			0.005 *	
			(1.822)	
Governance				0.003
				(1.367)
Size	0.347 ***	0.359 ***	0.348 ***	0.352 ***
	(8.443)	(8.744)	(8.419)	(8.515)
Leverage	−0.0005	−0.001	−0.001	−0.001
	(−0.354)	(−0.491)	(−0.460)	(−0.391)
Beta	−0.139 *	−0.133 *	−0.124 *	−0.130 *
	(−1.945)	(−1.868)	(−1.729)	(−1.808)
Freefloat	0.00003	0.00003	0.00002	0.00004
	(0.380)	(0.448)	(0.318)	(0.555)
Staff	−0.197 ***	−0.180 ***	−0.202 ***	−0.184 ***
	(−3.366)	(−3.098)	(−3.383)	(−3.138)
Top10	−0.004	−0.003	−0.004	−0.004
	(−1.252)	(−1.041)	(−1.192)	(−1.164)
GDPGrowth	−3.480 *	−3.592 *	−3.500 *	−3.274
	(−1.755)	(−1.810)	(−1.754)	(−1.643)
Individual	YES	YES	YES	YES
Year	YES	YES	YES	YES
N	511	511	511	511
R-squared	0.187	0.187	0.179	0.177

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; t statistics in parentheses.

4.3. Robustness Tests

In order to ensure the reliability of the regression results, the following robustness tests are performed:

(i) Placebo test. Referring to Ferrara et al. [42] and Liu and Lu [43], this study uses a placebo test to ensure that our conclusions are not due to chance. Specifically, ESG performance in the sample is randomly assigned to construct the pseudo-variable False-ESG. Then, the constructed pseudo-variable is used to replace the true ESG performance and re-estimate model (11). This process is repeated 500 times. We record the estimation result of the pseudo-variable in each regression and use the result to plot the density curve (see Figure 3). In addition, the dashed line denote the true coefficient of *ESG* on *Eff*. The figure shows that the estimated coefficients from the 500 regressions are roughly normally distributed, centered at 0, and that most of the estimated coefficients are distant from the true estimated coefficients (dashed line). This suggests that unobservables do not affect our findings. (ii) Adjusting standard errors with individuals as clustering levels. In order to mitigate the endogeneity problem of the model as much as possible, we adjust the standard errors by using individuals as the clustering hierarchy when estimating model (11). The results are shown in column (1) of Table 4. (iii) Replacement of explanatory variables. This study re-measures the unconditional efficiency by adding one to the m-value of each of the four industries. Then, this study replaces the explanatory variables with total return on assets (ROA) and new unconditional efficiency and regresses them separately; the results

are shown in column (2) and (3) in Table 4. The above test proves that the conclusions of this study are reliable.

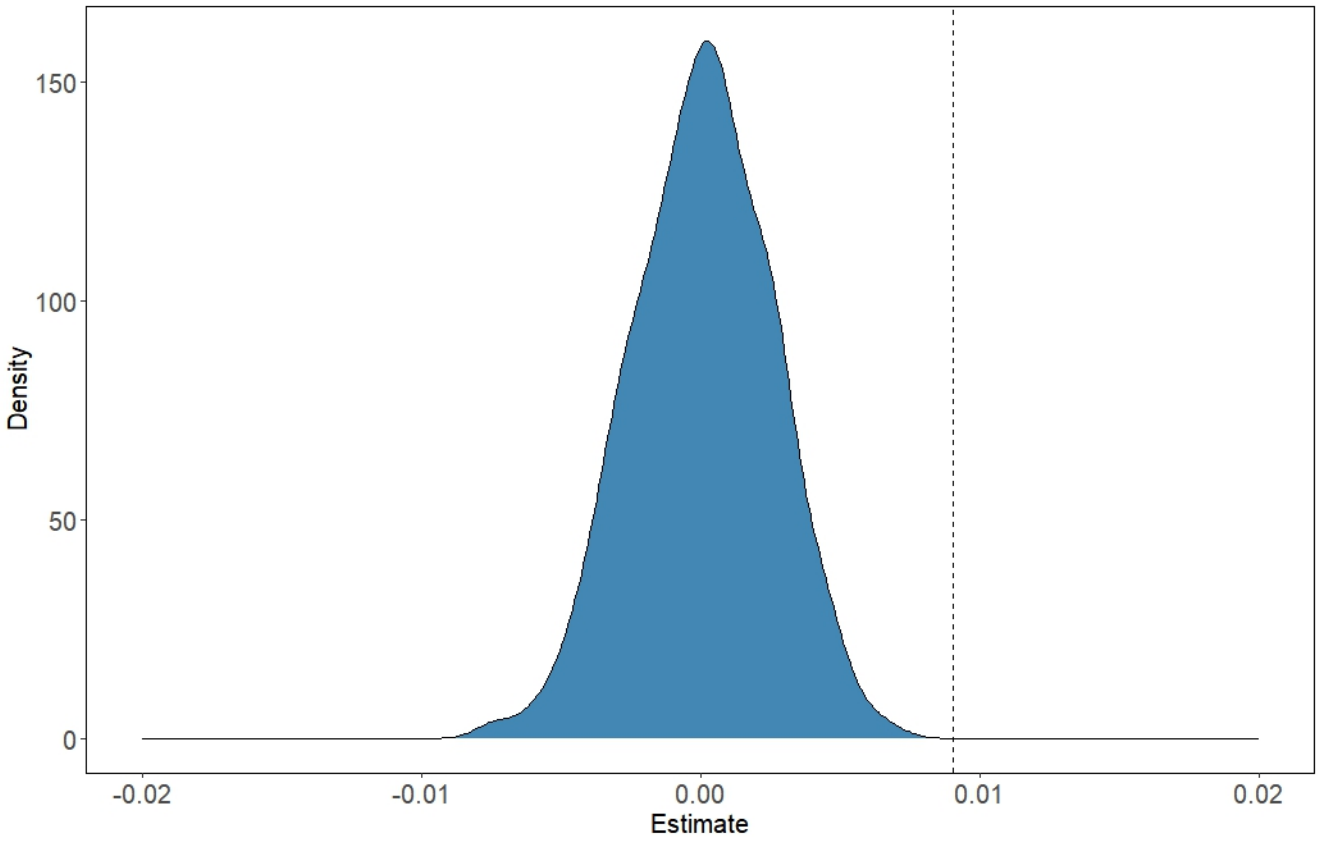


Figure 3. Placebo test.

Table 4. Robustness test results.

	Adjust Standard Errors for Cluster	Replacement of Explained Variables	Replacement of Explained Variables
	Eff	*ROA*	*Eff*
	(1)	(2)	(3)
ESG	0.009 **	0.001 **	0.008 *
	(2.467)	(2.275)	(1.700)
Control	YES	YES	YES
Individual	YES	YES	YES
Year	YES	YES	YES
N	511	511	511
R^2	0.187	0.316	0.027

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; t statistics in parentheses.

4.4. Impact Mechanism Results

In this section, in order to test hypothesis 2 and 3, this study uses the mediating effect model to analyze the mechanism of ESG performance on financial institutions' efficiency. The final regression results are presented in Table 5. Columns (1) and (2) show the results of the regressions with downside risk (Risk) and agency cost (AC) as mediating variables, respectively.

Table 5. Mechanism test results.

	Downside Risk Mechanism	Agency Costs Mechanism
	Risk	AC
	(1)	(2)
ESG	−0.0001 *	0.003 ***
	(−1.907)	(3.262)
Control	YES	YES
Individual	YES	YES
Year	YES	YES
N	511	511
R^2	0.313	0.314

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; t statistics in parentheses.

4.4.1. Downside Risk

Columns (1) present the results of the regression with agency costs as the mediating variable. The results in column (1) show that the estimated coefficient of ESG on Risk is significantly negative at the 10% confidence level with a value of −0.0001, indicating that ESG performance is effective in reducing downside risk. Good ESG performance is highly attractive to investors [44]. ESG performance is effective in reducing financial institutions' downside risk by building trust with stakeholders, attracting investment, and strengthening firm confidence. Second, ESG performance can effectively mitigate information asymmetry [29]. Specifically, ESG performance improves corporate transparency by disclosing high-quality information, which helps prevent financial institutions from downside risk. In addition, changes in firm efficiency can be affected by downside risks [45]. The reduction in downside risk helps firms reduce their investment in prevention, which in turn improves financial institutions' efficiency. Therefore, ESG performance can improve financial institutions' efficiency by reducing downside risk.

4.4.2. Agency Cost

Columns (2) show the results of regressions with agency costs as the mediating variable. The results in column (2) show that the estimated coefficient of ESG on AC is significantly negative at the 1% confidence level with a value of 0.003, indicating that ESG performance is effective in mitigating agency costs. First, firms with better ESG performance usually have a well-developed corporate governance structure, which helps avoid management's public–private behavior [18]. Public disclosure of information about a firm's ESG-related values can improve stakeholder perceptions of corporate credibility and reputation, and mitigate agency conflicts between managers and investors [33]. In addition, ESG performance enables the full utilization of internal funds by reducing the company's free cash flow, which in turn increases financial institutions' efficiency [32]. Therefore, ESG performance can improve financial institutions' efficiency by mitigating agency costs.

5. Discussion

5.1. Interpretation of Findings

Under the problems of climate warming, unbalanced economic development, and resource depletion, the living environment of human beings has been severely challenged. The call for sustainable development is becoming stronger and stronger around the world. ESG performance, as a measure of corporate sustainability, has received widespread attention from corporations and investors.

Our study shows that ESG performance significantly improves financial institutions' efficiency. A possible explanation for this phenomenon is the signaling effect of ESG performance. First, ESG performance has a reputational spillover effect [20]. ESG performance improves financial institutions' efficiency by conveying positive signals to stakeholders and obtaining external resources needed for development. Better ESG performance indicates that financial institutions have better corporate governance mechanisms, which can

constrain management behavior and, thus, reduce agency problems [18]. Second, when an enterprise has sufficient free cash flow, management has an incentive to invest in free cash flow in projects to make private profits. The cost paid by an enterprise in ESG is conducive to reducing the level of free cash flow, which in turn reduces the agency cost of the enterprise [31]. In addition, ESG performance, as a type of non-financial disclosure, conveys more information about firm traits to investors and reduces the level of information asymmetry. A lower level of information asymmetry can significantly reduce financial institutions' downside risk. Therefore, ESG performance can improve financial institutions' efficiency by reducing downside risks and agency costs, and, therefore, hypotheses H1, H2, and H3 were confirmed.

Through an empirical analysis, this study confirms that ESG performance can improve financial institutions' efficiency. First, ESG concepts encourage financial institutions to develop green financial products such as green bonds and green funds. By deploying market resources, capital is introduced from high-energy-consuming and high-polluting industries to clean, environmentally friendly, and other green industries, providing financial support for industrial structure optimization and green economic development. Second, ESG performance measures enterprises' sustainable development capability of enterprises [46]. Currently, the world is facing challenges such as global warming, resource depletion, and unbalanced economic development. ESG performance promotes long-term corporate development and adapts to future market uncertainties. Financial institutions should take the lead in practicing ESG concepts to form a positive demonstration and drive market-wide ESG practices. Therefore, this study is significant for promoting sustainable economic development.

5.2. Heterogeneity Analysis

In this section, to deeply analyze the impact of ESG performance on financial institutions' efficiency, this study further explores the heterogeneity of ESG performance on financial institutions' efficiency from the perspective of property right, firm size, and industry attributes. The results are presented in Table 6.

Table 6. Heterogeneity results.

	Property Right		**Firm Size**		**Industry Attributes**			
	State-Owned	**Non-State-Owned**	**Small**	**Large**	**Bank**	**Insurance**	**Securities**	**Diversified Financial**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
ESG	0.008 *	0.013 *	0.015 **	−0.001	−0.008 *	−0.001	0.007 *	0.021 **
	(1.941)	(1.931)	(2.552)	(−0.154)	(−1.757)	(−0.177)	(1.762)	(2.411)
Control	YES	YES	YES	YES	YES	YES	YES	YES
Individual	YES	YES	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES	YES	YES
R^2	0.291	0.120	0.218	0.177	0.108	0.827	0.194	0.239
N	371	140	255	255	112	28	196	175

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; t statistics in parentheses.

5.2.1. Property Right

The effect of ESG performance on financial institutions' efficiency may differ depending on the nature of company ownership. Based on this, we divide the sample into state-owned and non-state-owned financial institutions and perform group regressions. The results are shown in columns (1) and (2).

The results in columns (1) and (2) show that the estimated coefficients of ESG are significantly positive at the 10% confidence level, with values of 0.008 and 0.013, respectively, suggesting that ESG performance improves the efficiency of both state-owned and non-state-owned financial institutions. However, this effect is more pronounced in non-state financial institutions. First, non-state financial institutions have higher ESG scores [47],

indicating that non-state-owned financial institutions have surpassed state-owned financial institutions in terms of ESG practices. Therefore, the effect of ESG performance on non-state-owned financial institutions' efficiency is stronger. In addition, state-owned financial institutions, as tools for the state to regulate the macroeconomy, are characterized by both public and commercial interests. The state's control over them is strong, and there are serious principal–agent problems that lead to their inefficiency. However, non-state-owned financial institutions have more flexible operational means, which, in turn, have a stronger efficiency-enhancing effect.

5.2.2. Firm Size

Firm size is one of the most important factors that affect firm efficiency. Large enterprises tend to be more profitable, and with their good reputation, they can more easily raise equity and debt financing and grow steadily. However, large enterprises also have problems such as redundancy of capital and personnel and cannot realize the effective use of resources. Small enterprises often face financing constraints, resulting in ineffective performance. Based on this consideration, taking the median asset of financial institutions as the threshold, financial institutions larger than the median asset are defined as large-scale financial institutions, and vice versa are defined as small-scale financial institutions, and group regression is performed. Columns (3) and (4) present the results.

Column (3) shows that the estimated coefficient of ESG is significantly positive at the 5% confidence level, with a value of 0.015, which indicates that ESG performance contributes to the efficiency of small-scale financial institutions. However, column (4) shows that the estimated coefficient of ESG performance is negative but insignificant, indicating that ESG performance has no significant effect on the efficiency of large-scale financial institutions. As firm size increases, identifying and managing relevant ESG risks may become more challenging. In particular, large firms are usually more likely to employ bureaucratic control mechanisms, including written regulations, codes of conduct, and cultural norms, when controlling for risks [48]. In addition, smaller firms can generate higher profits owing to extensive stakeholder oversight [49]. Financial institutions know that their behavior is closely monitored, and in turn, they will pay more attention to social responsibility and ethical business practices, which can help improve their corporate image and attract more customers and investors. Therefore, ESG performance has a greater effect on small-scale financial institutions' efficiency.

5.2.3. Industry Attributes

In addition, differences in industry attributes lead to different effects of ESG performance. Based on this, this study utilizes model (11) to regress the four industries of banking, insurance, securities, and diversified finance in groups. The results are shown in columns (5)–(8).

Column (5) shows the coefficient of ESG performance on bank efficiency is significantly negative at the 10% confidence level, indicating that ESG performance reduces bank efficiency. In addition, column (6) shows that the estimated coefficient of ESG performance on the efficiency of insurance organizations is negative but not significant. ESG practices in China began late. In addition, banks and insurance organizations mainly focus on lending and insurance businesses [50,51]. These businesses have longer investment cycles and higher costs, such as upgrading environmental protection facilities, improving governance structures, or implementing social responsibility programs, and the return on these investments may have a lag. In the short term, a rise in costs may be observed, which reduces efficiency. However, in the long run, these investments will gradually be converted into long-term sustainable returns, ultimately improving the efficiency of bank and insurance organizations. Meanwhile, the results in columns (7) and (8) suggest that ESG performance improves the efficiency of securities and diversified financial institutions. This may be due to the fact that securities and diversified financial institutions are dominated by short-term capital market operations, which are characterized by short return cycles on business

investments and business flexibility. These two types of industries can obtain quick returns on their investment. Therefore, ESG performance improves the efficiency of securities and diversified financial institutions.

6. Conclusions

Based on data from listed financial institutions in China between 2015 and 2021, this study examines the impact of ESG performance on financial institutions' efficiency. The robust nonparametric boundary model and fixed-effect model are applied to this analysis. The main findings are as follows: First, ESG performance can effectively improve financial institutions' efficiency. From the perspective of each sub-dimension of ESG performance, each has different effects on financial institutions' efficiency. Environmental and social responsibility performance can significantly improve financial institutions' efficiency, while corporate governance performance has no significant effect on financial institutions' efficiency. In particular, this effect is more pronounced in the securities industry and diversified financial industry, as well as in non-state and small-scale financial institutions. In addition, the mechanism results suggest that ESG performance can improve financial institutions' efficiency by reducing downside risk and mitigating agency costs.

Based on the above conclusions, this study proposes the following suggestions: First, financial institutions should focus on ESG concepts and actively engage in ESG practices. Financial institutions should gradually realize that increasing investment in environmental protection, social responsibility, and improving corporate governance is not an additional cost to the enterprise and abandon negative perceptions, such as the theory that shareholders' interests are paramount. Second, financial institutions should strengthen information disclosure so that stakeholders can grasp the ESG performance of enterprises more accurately and support their development. Stakeholders rely on corporate disclosures to make investments, and ESG performance can help stakeholders ease information friction with financial institutions, thereby improving investment efficiency and promoting corporate development. Third, government and rating agencies should reach a consensus to build a unified ESG performance evaluation system for financial institutions. Currently, China has a wide variety of ESG rating systems, and there are large differences in the ESG ratings of different rating agencies for the same company, which may affect the judgment of stakeholders and, thus, reduce efficiency. Therefore, it is necessary to introduce a unified and authoritative ESG performance rating system to promote healthy development in the ESG field.

Although this study analyzes the impact of ESG performance on financial institutions' efficiency as thoroughly as possible, some shortcomings need to be addressed in the future. First, there is still no consensus among academics on the means of measuring financial institutions' efficiency, which leads to a need to improve the accuracy of measured efficiency. Second, the indicator evaluation system of financial institutions' efficiency is not yet comprehensive. We tried to include input and output indicators of financial institutions as comprehensively as possible in our study. However, owing to the availability of data and differences in the attributes of each industry, it is difficult to accurately measure financial institutions' efficiency. Third, this study provides an in-depth analysis of the impact of ESG performance on financial institutions' efficiency through mechanism tests and heterogeneity. However, other mechanisms and heterogeneity have not been considered. Therefore, in future research, we intend to find more appropriate methods and comprehensive indicator systems to measure efficiency and further analyze the impact of ESG performance on financial institutions' efficiency.

Author Contributions: Validation, Z.W.; formal analysis, Z.W.; data curation and software, Z.W. and S.C.; visualization, Z.W.; writing—original draft, Z.W.; conceptualization, S.C.; methodology, S.C.; funding acquisition, S.C.; resources, S.C.; writing—review and editing, S.C.; supervision, S.C.; project administration, S.C.; funding acquisition, S.C. All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported by MOE (Ministry of Education in China) Project of Humanities and Social Sciences [grant numbers 21XJC790001]; Natural Science Fund of Shaanxi Province General Project [grant numbers 2024JC-YBQN-0746]; National Social Science Foundation of China [grant numbers 22XJL008]; Shaanxi Provincial Department of Education Scientific Research Project [grant numbers 23JK0101]; and Xianyang Soft Science Research Project [grant numbers L2023-RKX-SJ-018].

Data Availability Statement: Data will be made available on request.

Acknowledgments: We acknowledge any support given which is not covered by author contribution or funding sections.

Conflicts of Interest: The authors declare that they have no financial and personal relationships with other people or organizations that could inappropriately influence this work. There is no professional or other personal interest of any nature or kind in any product, service, or company that could be construed as influencing the work presented in this paper.

Appendix A

Table A1. Descriptive statistics of variables.

Variable	Mean	SD	Min	Max	Definition
Eff	1.20	0.46	0.11	3.95	Unconditional efficiency
ESGScore	75.39	6.33	50.37	89.00	Huazheng ESG score
Environment	65.37	7.13	48.24	89.43	Huazheng E score
Social	76.14	8.49	34.54	100.00	Huazheng S score
Governance	79.56	10.89	34.65	95.07	Huazheng G score
DownsideRisk	0.02	0.01	0.00	0.08	The specific calculations are shown in Equation (13)
AC	0.10	0.18	0.00	1.37	Total asset turnover
Size	16.58	2.69	10.04	21.98	Natural logarithm of total company assets
Leverage	5.63	12.93	−6.52	275.34	Equity ratio
Beta	1.09	0.42	−0.03	2.35	The specific calculations are shown in Equation (14)
Freefloat	354.89	362.06	8.36	2582.14	Annual turnover rate of the company's stock
Staff	−0.57	2.08	−6.21	3.92	Natural logarithm of the number of employees
Top10	64.11	17.49	21.88	98.12	Shareholding ratio of top ten shareholders
GDPGrowth	0.06	0.02	−0.05	0.13	Gross regional product index—100/100

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