ESG Performance, Product Market Competition, and High-Quality Corporate Development

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Abstract. This paper uses cross-industry enterprise-level panel data from 2012-2022 to explore the impact of corporate Environmental, Social, and Governance (ESG) performance on high-quality corporate development under different product market competition. The study uses a fixed-effects model to analyze the direct impact of ESG performance on high-quality corporate development, and introduces product market competition as a moderating variable to assess its impact on the relationship between ESG and Total Factor Productivity (TFP). The study found that good ESG performance significantly improves the high-quality development of the company, and this effect shows significant heterogeneity in different market competition. Specifically, in markets with weak product competition, that is, monopoly or oligopolistic market structures, the positive impact of ESG on TFP is more significant. This study reveals the complex relationship between ESG, product market competition, and high-quality corporate development, providing policy implications and practical guidance for corporations on how to enhance their strength in different market environments by improving ESG performance.

Keywords: ESG Performance, Total Factor Productivity, Market Competition, Product Market Competition, Market Structure.

1 INTRODUCTION

In the business environment of the 21st century, corporate social responsibility and sustainable development are increasingly valued. As the global focus on sustainable development deepens, ESG (Environmental, Social, and Governance) performance has become an important indicator for evaluating a company's future growth potential and risk management[1]. ESG performance refers to a company's performance in environmental protection, social contribution, and efficient governance. ESG standards originated in the investment industry, aiming to measure a company's performance in environmental, social, and governance aspects. The environment (E) refers to the impact of a company's production and operation on the environment, including resource utilization, waste discharge, and environmental protection. Society (S) focuses on a company's performance in social responsibility, employee benefits, consumer rights and in-

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terests, and community contributions. Governance (G) emphasizes issues such as corporate governance structure, independence, transparency, and ethical norms. With the development of the ESG concept, more and more companies are incorporating ESG standards into their business strategies and risk management frameworks[2]. In 2018, the China Securities Regulatory Commission added sections on social responsibility, environmental protection, and stakeholders to the "Corporate Governance Guidelines for Listed Companies", encouraging listed companies to disclose information related to corporate environmental protection, social responsibility, and corporate governance. Driven by the government and the market, companies have started to practice the ESG concept, value ESG information disclosure, and hope to achieve certain economic benefits while realizing social value. In this context, studying the relationship between ESG and high-quality corporate development is particularly important. In today's globalized economy, companies need to enhance their competitiveness while valuing their social responsibility. Total factor productivity(TFP) is a key indicator for measuring corporate production efficiency and technological progress, and it is a key factor in measuring high-quality corporate development[3]. It reflects the growth in productivity that companies achieve by organizing production processes more effectively, adopting new technologies, or innovating management methods after considering traditional production factors such as labor and capital[4]. Improving total factor productivity means that the company has achieved more output with fewer resources, which is a sign of increased efficiency and competitiveness[5]. However, by combing through the existing literature, it can be found that the relationship between ESG and total factor productivity is not directly obvious. Some studies have shown that good ESG performance can improve production efficiency by increasing employee job satisfaction, attracting better talent, or using resources more efficiently[6]. However, other studies believe that ESG activities may divert the company's attention and resources, thereby negatively affecting production efficiency[7]. The possible reason for the different research conclusions lies in the differences in the measurement methods of corporate ESG performance and total factor productivity by different scholars, and the ESG performance and total factor productivity may also be affected by other factors of the company (such as different industries, different ownership properties, etc.)[8]. From this point of view, the relationship between ESG performance and total factor productivity needs further study. Product market competition is an indicator used to measure the share of dominant companies in an industry or market, usually used to evaluate the degree of competition in that market. High product market competition means that a few large companies control most of the market share, which may affect pricing power, innovation incentives, market efficiency, and corporate competitiveness[9]. Modern companies place more and more importance on corporate social responsibility behavior, and product market competition may have a significant impact on corporate social responsibility behavior and total factor productivity[10]. In markets with high concentration, companies may face less external pressure to improve their social responsibility performance, thereby further improving their ESG performance[11]; on the other hand, markets with a higher degree of concentration may reduce competition between companies, thereby affecting the drive for companies to innovate technology and improve production efficiency, fur-

ther affecting corporate total factor productivity, promoting high-quality corporate development[12]. The existing literature rarely considers the relationship between ESG and total factor productivity in the context of product market competition in our country. Therefore, this article uses the sample of Chinese A-share listed companies from 2012 to 2022 to study the relationship between corporate ESG performance and total factor productivity, and whether corporate product market competition plays a moderating role in the relationship between ESG performance and total factor productivity. It further explores the impact of different ownership properties and different industry characteristics on the research results.

2 THEORETICAL ANALYSIS AND RESEARCH HYPOTHESIS

2.1 Corporate ESG Performance and High Quality Corporate Development

The relationship between ESG standards and high-quality corporate development has received broad attention in modern corporate management. ESG standards, as an important manifestation of corporate social responsibility, have increasingly been valued, and TFP, as a key indicator measuring corporate comprehensive efficiency and innovative capabilities, has a profound impact on the long-term development of the enterprise[13]. According to the Resource-based View(RBV), the key to a company sustaining competitive advantages lies in its internal resources and capabilities, especially those resources and capabilities that are scarce, valuable, difficult to imitate, and substitute[14]. Within this theoretical framework, ESG practices can be viewed as a distinctive resource of a corporation, embodying sound environmental management, social relationships, and corporate governance structures. These factors can enhance a company's brand image, strengthen stakeholder trust, boost employee morale, and ultimately improve the overall operational efficiency and production efficiency of the corporation[15]. From an environmental perspective, corporate environmental protection measures can reduce resource waste, improve energy utilization efficiency, and thus lower production costs. The undertaking of social responsibility can help corporations build stable supply chain relationships and customer loyalty, and by engaging in positive interactions between the corporation and society, enhance the corporation's social capital, which also has a positive impact on improving the high-quality development of the corporation[16]. Optimization in corporate governance, such as enhanced transparency and strengthened internal control, can reduce friction and risks within the corporation, and improve decision-making efficiency, all of which are potential driving factors for improving high-quality corporate development[17]. In addition, the diffusion of innovation theory indicates that the spread of new technologies, products, or processes has a significant impact on the production and operational methods of a corporation. Applying this theory to the relationship between ESG and high-quality corporate development shows that ESG practices often accompany innovations in corporate man-

agement and technology. For instance, the adoption of environmental protection technology can improve resource utilization efficiency, social responsibility activities can promote organizational learning and knowledge sharing, and good corporate governance can support corporations in long-term investment and R&D activities. All these innovative activities have a direct or indirect positive impact on enhancing high-quality corporate development[18]. Further, according to institutional theory, a corporation's ESG behavior is also significantly influenced by external institutional pressures. These pressures may come from legislative requirements, market and consumer expectations, advocacy from societal organizations, etc. In the face of these pressures, corporations typically take corresponding measures to improve their performance in ESG aspects. Compliance with environmental regulations requires corporations to reduce pollution emissions, social expectations drive corporations to take on more social responsibilities, and investor attention to corporate governance forces corporations to improve their transparency and responsibility. Through these efforts, corporations can not only avoid potential legal and reputational risks but also enhance their high-quality corporate development by improving operational efficiency and market positioning[19]. Therefore, this paper proposes the following hypothesis:

H1: Corporate ESG performance is positively correlated with high-quality corporate development, that is, good corporate ESG performance will promote the improvement of high-quality corporate development.

2.2 Product Market Competition and High-Quality Corporate Development

Product market competition refers to the degree of control over sales or output by a few companies in a specific market. High product market competition usually indicates that fewer companies hold a larger market share[20]. Product market competition is one of the key indicators measuring the degree of market competition. It can significantly impact corporate behavior and the overall performance of the market in various ways, especially total factor productivity (TFP), the level of corporate output after considering the input of production factors such as labor, capital, and intermediary inputs[21]. Research on the relationship between product market competition and TFP provides a robust analysis framework from industrial organization theory, especially its central structure-conduct-performance(SCP) paradigm[22]. The SCP paradigm proposes that market structure (such as product market competition) affects firm behavior (like pricing, investment, and output decisions), which in turn impacts market performance (such as productivity and profitability).In an environment where product industry concentration is high, i.e., market competition is weak, dominant companies might reap cost benefits due to the advantage of scale. These companies can spread their fixed costs through economies of scale, thereby reducing average costs when producing more goods[23]. For example, R&D investments often involve a large amount of fixed costs, including laboratory equipment, researcher salaries, and other infrastructure. These costs can be spread over more products or services in larger scale companies, thereby reducing the cost of an individual product and improving production efficiency. In addition to the effects of economies of scale, a higher industry concentration might also increase the

incentive for dominant companies to carry out R&D and innovation. Since these companies control the lion's share of the market, they can expect a larger return, hence willing to make substantial investments in research and development[24]. Technological innovation and the development of new products are often important ways to improve total factor productivity. The R&D activities of dominant companies can not only improve their efficiency but also have spillover effects on the technological level of the entire industry, thereby enhancing the total factor productivity of the entire economy[25]. Moreover, companies in a highly concentrated market might use their market position and higher profit rates to accumulate capital. These funds can be invested in productivity-enhancing activities, such as purchasing more advanced machinery and equipment, providing employee training, and improving supply chain management, etc. These investments further improve the company's production efficiency, having a positive impact on overall total factor productivity[26]. Therefore, this paper proposes the following hypothesis:

H2: Product market competition and total factor productivity are negatively correlated. That is, the higher the industry concentration of a company, the weaker the degree of product market competition, the higher the total factor productivity of the company, thereby promoting high-quality corporate development.

2.3 Analysis of the Moderating Role of Product Market Competition

Product market competition is usually measured by calculating the total market shares of the largest companies in a specific market. Weaker product market competition implies that the dominant companies in the market have a greater degree of market control. Product market competition may significantly affect the relationship between ESG performance and total factor productivity (TFP). Firstly, the resource dependency theory suggests that a company's reliance on the resources it needs can impact its strategic decisions and behavior patterns[27]. In an environment where product market competition is weak, dominant companies may, in order to maintain their market competitiveness, pursue higher standards of ESG performance by controlling key resources, such as raw materials, capital, and technology[28]. This control of resources might make these companies more inclined to focus on long-term sustainable growth, thereby enhancing high-quality corporate development. Secondly, agency theory proposes that there may be inconsistencies between the objectives of corporate management and shareholders[29]. When product market competition is weak, managers may face fewer external constraints, which may lead them to seek personal benefits more readily rather than maximizing corporate benefits or shareholder value. In this situation, excellent ESG performance can play a crucial role. In a market environment where competition is not intense, companies may not need to innovate or improve efficiency to maintain their market position, which might lead to managerial slack. However, good ESG performance requires companies to pay attention to a broader group of stakeholders, including environmental protection, social responsibility, and high standards of corporate governance, all of which can help companies achieve high-quality development from a long-term and comprehensive perspective. Finally, the innovation incentive theory em-

phasizes the key role of market competition in driving corporate innovation. In situations where competition is weak, companies face less external pressure, which might reduce the direct economic incentive for aggressive innovation. However, this type of competitive environment also provides companies with a relatively relaxed space to explore and implement long-term strategies, such as improving their ESG performance. Excellent ESG performance can be seen as an innovation incentive, as it requires companies to make continuous innovations in products, processes, management, etc., to meet the requirements of environmental protection, social responsibility, and high-standard governance. In the long run, good ESG performance can help companies establish more robust public trust and consumer confidence, which is vital for the sustainable development of companies. Especially in environments where market competition is weak, companies that excel in ESG innovation can attract more investment, top-quality talents, and loyal customers, all of which are key factors in promoting high-quality corporate development. Furthermore, innovation in ESG can also help companies foresee and reduce potential operational risks in the future, such as changes in environmental regulations and social responsibility risks, providing a competitive edge in surviving and growing under cutthroat competition. Therefore, this paper proposes the following hypothesis:

H3: The higher the industry concentration, the weaker the degree of product market competition. For companies that occupy a lot of market shares, good ESG performance can better enhance the company's total factor productivity, thereby promoting high-quality corporate development.

3 RESEARCH DESIGN

3.1 Sample Selection and Data Source

This study's sample consists of all listed companies on the Shanghai and Shenzhen A-share markets from 2012 to 2022. The data underwent the following treatments: (1) Exclusion of financial sector companies; (2) Exclusion of companies labeled as ST and *ST during the sample period; (3) Exclusion of companies missing critical data such as ESG ratings and total factor productivity; (4) Winsorization of all continuous variables, targeting the top and bottom 1% of observations. After these treatments, a total of 6555 observations were obtained. ESG rating data was sourced from Shanghai Wind Information Co., Ltd., while data on market competition, total factor productivity, and other control variables were sourced from the CSMAR database. The data processing software used in this study was Stata 15.0.

3.2 Variable Definitions

Dependent Variable. Total Factor Productivity (TFP). Total Factor Productivity reflects the additional output efficiency a firm achieves given a certain level of input of various production factors. It is often considered a comprehensive indicator of high-

quality corporate development. Before measuring Total Factor Productivity, the structure of the Cobb-Douglas function is first used to define the form of the production function, which is expressed as follows:

$$Y_{it} = A_{it} L_{it}^{\alpha} K_{it}^{\alpha} \tag{1}$$

Taking the logarithm of both sides of Equation (1) yields the form of Equation (2):

$$\ln Y_{it} = \alpha \ln L_{it} + \beta \ln K_{it} + \mu_{it} \tag{2}$$

In this context, Y_{it}, L_{it}, K_{it}, respectively represent output, labor, and capital, while μ_{it} is the firm's total factor productivity (TFP). Currently, the academic community's main methods for measuring micro-enterprise TFP include traditional Ordinary Least Squares (OLS) and semiparametric methods (OP method, LP method, and ACF method). However, in practical applications, due to the unavoidable simultaneity bias and sample selection bias problems inherent in OLS, as well as its inability to address the endogeneity among variables, which leads to an overestimation of firm TFP, scholars in China usually opt for nonparametric methods to measure the TFP of micro-enterprises. The OP method uses investment as a proxy variable, which, although it avoids simultaneity bias and sample selection bias to some extent and addresses the endogeneity problem among variables, cannot estimate the TFP for companies with no investment data or those with negative actual investment values, ultimately leading to excessive sample loss. The ACF method considers the time-variation of parameters and the elasticity of factors, making the calculation results more precise. However, this method relaxes the original assumptions of the equation, and is thus less used in practice. Therefore, this paper uses the TFP measured by the ACF method as an alternative dependent variable for robustness checks. The LP method is a refined version of the OP method, using intermediate products as proxy variables, not only solving the problems of simultaneity bias and sample selection bias but also avoiding sample loss due to missing investment data. Hence, this paper chooses the LP method to measure the TFP of enterprises and constructs the following model to estimate the TFP of enterprises:

$$\ln Y_{it} = \alpha_0 + \alpha_1 \ln L_{it} + \alpha_2 \ln K_{it} + \alpha_3 \ln M_{it} + \omega_{it} + \mu_{it} \tag{3}$$

In Equation (3), i represents the individual firm, and t represents the year; Y_{it}, L_{it}, K_{it}, and M_{it} respectively denote total output, labor, capital, and intermediate inputs. Yit is represented by the main business revenue, L_{it} by the number of employees at the end of the year, K_{it} by the net value of fixed assets, and M_{it} by the cash paid for purchasing goods and receiving labor services; ω_{it} represents the total factor productivity of the firm; μ_{it} represents the residual term.

Independent Variable. Corporate ESG (ESG). This paper selects the Huazheng ESG rating as the measurement indicator of corporate ESG performance, which has been recognized and widely used in both the industry and academic circles. The Huazheng ESG rating is divided into nine levels, from low to high: C, CC, CCC, B, BB, BBB, A, AA, AAA. Referencing existing literature, this paper assigns a value of 1 to 9 to these

nine ratings in ascending order, with higher scores indicating better corporate ESG performance.

Moderating Variable: Industry Concentration (HHI). The Herfindahl-Hirschman. Index (HHI) measures a company's size relative to its business sector or the entire market. Empirical studies widely use the HHI as an indicator to measure the concentration of different economic sectors. The HHI, represented by the Herfindahl index, is calculated by summing the squares of the ratios of each firm's main business revenue to the total main business revenue in the industry. The Herfindahl index can measure industry concentration, reflecting the competitive situation of the industry and indicating the dispersion of firm sizes within the industry. The advantages of this index calculation include: first, it covers the number of companies in the industry from an absolute concentration perspective, considering all companies in the industry, and also takes into account the size of each company in the industry from a relative concentration perspective, reflecting the total scale of enterprises in the market and the market structure condition, comprehensively, systematically, and accurately reflecting the degree of market competition. Second, it genuinely reflects the scale differences among enterprises, with larger-scale enterprises being more sensitive to this index. Most scholars currently use the Herfindahl index when studying the degree of industry concentration. This index is calculated by the sum of the squares of the market shares of firms within the industry; the higher the value, the higher the concentration. The specific formula is as follows:

$$HHI = \sum_{i=1}^{n} (X_i/X)^2 \tag{4}$$

In Formula (4), Xi represents the main business revenue of an individual company, and X represents the total main business revenue of the industry to which the company belongs. Xi/X represents the company's market share in the industry.

Control variables. The performance of a company's ESG is influenced by various factors. To reduce empirical biases, this study selects company size (Size), age (Age), share concentration (Share), growth capability (Growth), cash flow (Flow), return on assets (ROA), and leverage (LEV) as control variables. The size of the company is measured by the natural logarithm of the company's total operating revenue. The age of the company is determined by subtracting the year the company was listed from the current year, adding one to the result, and then taking the natural logarithm. Share concentration is defined by summing the shareholding proportions of the top five shareholders. Growth capability is measured by the growth rate of net profit. Cash flow is represented by the ratio of the net cash flow generated from operating activities to total assets. The return on assets condition uses the ratio of net profit to total assets to measure the profitability level of the company. The leverage condition is reflected by the ratio of total liabilities to total assets to reflect the company's financial leverage situation. The definitions of each variable are as shown in Table 1.

Table 1. Variable Definitions

Variable Type	Variable Name	Symbol	Measurement
Dependent Variable	Total Factor Productivity	TFP	See Model (3) for details
Independent Variable	Corporate ESG Performance	ESG	Scored from high to low based on the Huazheng ESG evaluation system, with scores ranging from "9" to "1"
Moderating Variable	Industry Concentration	HHI	See Model (4) for details
Control Variables	Company Size	Size	Natural logarithm of the company's total operating revenue
	Company Age	Age	Natural logarithm of the current year minus the company's listing year plus one
	Share Concentration	Share	Sum of the shareholding percentages of the top five shareholders of the listed company
	Growth Capability	Growth	Growth rate of net profit
	Cash Flow	Flow	Ratio of net cash flow generated from operating activities to total assets
	Return on Total Assets	ROA	Ratio of net profit to total assets
	Asset Liability	LEV	Ratio of total liabilities to total assets

3.3 Model Specification

To test Hypothesis H1, which posits that a firm's good ESG performance contributes to the enhancement of high-quality development, this paper treats corporate ESG performance (ESG) as the explanatory variable and Total Factor Productivity (TFP) as the dependent variable, while controlling for other variables. The model is constructed as follows:

$$\mathrm{TFP}_{\mathrm{itjk}} = \beta_0 + \beta_1 \mathrm{ESG}_{\mathrm{it}} + \beta_j \sum \mathrm{Controls}_{\mathrm{it}} + \sum \mathrm{Year} + \sum \mathrm{Industry} + \varepsilon_{\mathrm{it}} \quad (4)$$

TFPijtk represents the Total Factor Productivity of high-pollution company i in industry j located in province k in year t; represents a constant term; Year and Industry represent time and industry dummy variables, respectively, with Controls being a set of control variables, and represents a random error term.

To test Hypothesis H2, that is, whether lower product market competition can promote high-quality development of firms, this paper treats product market competition (HHI) as the explanatory variable and Total Factor Productivity (TFP) as the dependent variable, while controlling for other variables to construct the following model:

$$\mathrm{TFP}_{\mathrm{itjk}} = \beta_0 + \beta_1 \mathrm{HHI}_{\mathrm{it}} + \beta_j \sum \mathrm{Controls}_{\mathrm{it}} + \sum \mathrm{Year} + \sum \mathrm{Industry} + \varepsilon_{\mathrm{it}} \quad (5)$$

To test Hypothesis H3, which examines whether product market competition can moderate the relationship between corporate ESG performance and Total Factor Productivity, the model introduces an interaction term between corporate ESG performance and product market competition (ESG×HHI). This study treats corporate ESG performance (ESG) as the independent variable and Total Factor Productivity (TFP) as the dependent variable, while controlling for other variables to construct the following model:

$$TFP_{itjk} = \beta_0 + \beta_1 ESG_{it} + \beta_2 HHI_{it} + \beta_3 ESG \times HHI_{it} + \beta_j \sum Controls_{it} + \sum Year + \sum Industry + \varepsilon_{it} \quad (7)$$

Here, ESG×HHI represents the interaction term between ESG rating and product market competition, with other variable definitions consistent with the foregoing text.

4 Empirical Analysis

4.1 Descriptive Statistics

Table 2 presents the descriptive statistics for all variables. The statistical results show that the maximum and minimum values of the dependent variable Total Factor Productivity (TFP) are 13.144 and 4.780, respectively, with a standard deviation of 1.071, indicating significant differences in Total Factor Productivity among the sample companies. The minimum and maximum values for Corporate ESG (ESG) are 1 and 8, respectively, with a standard deviation of 1.059, which indicates that there are also significant differences in ESG performance among the sample companies. The Herfindahl-Hirschman Index (HHI) has minimum and maximum values of 0 and 1, respectively, with a standard deviation of 0.139, indicating that there are differences in product market competition among industries.

Table 2. Descriptive Statistics

Variable	obs	Mean	Std . Dev	Min	Max
TFP	6555	8.601	1.077	4.780	13.144
ESG	6555	4.242	1.059	1	8
HHI	6555	0.134	0.139	0	1
Size	6555	22.290	1.278	19.970	26.250
Age	6555	2.410	0.582	1.386	3.367
Share	6555	0.506	0.192	0.214	0.951
Growth	6555	0.380	0.980	-0.679	6.893
Flow	6555	0.153	0.118	0	1
Roa	6555	0.038	0.073	-1.648	0.786
Lev	6555	0.426	0.198	0.008	1.141

4.2 Correlation Analysis

On the basis of descriptive statistical analysis, this section conducts a Pearson correlation analysis of the research variables, with the results detailed in Table 3. According to the correlation test results, the correlation coefficient between corporate ESG performance and TFP is 0.251, which is significant at the 1% level, preliminarily indicating that corporate ESG performance has a positive impact on total factor productivity; the correlation coefficient between HHI and TFP is 0.014, but it is not significant, hence the relationship between the two needs further demonstration. Most control variables are significantly correlated with the dependent variable, proving that the model is well-controlled for other factors affecting corporate total factor productivity. In addition, the absolute values of the correlation coefficients between variables are all less than 0.85, indicating that there is no serious multicollinearity among the variables.

Table 3. Correlation Coefficients of Variables

	TFP	ESG	HHI	Size	Age	Share	Growth	Flow	ROA	LEV
TFP	1.000									
ESG	0.251***	1.000								
HHI	0.014	0.041***	1.000							
Size	0.272***	0.117***	0.139***	1.000						
Age	0.348***	-0.002	0.038***	0.107***	1.000					
Share	0.124***	0.131***	0.041***	0.148***	-0.174***	1.000				
Growth	0.044***	0.022*	-0.016	0.008	-0.014	0.042***	1.000			
Flow	-0.120***	0.095***	-0.010	-0.055***	-0.123***	0.111***	0.007	1.000		
ROA	0.105***	0.159***	-0-044***	0.010	-0 094***	0.154***	0.284***	0.198***	1.000	
LEV	0.490***	-0.015	0.034***	0.105***	0.347***	-0.055***	-0.045***	-0.376***	-0.276***	1.000

4.3 Regression Results and Analysis

Analysis of the Impact of Corporate ESG Performance on Total Factor Productivity. The regression results for Model (1) are reported in Column 1 of Table 4. In

Column (1), the coefficient of the explanatory variable, corporate ESG performance (ESG), on the dependent variable, total factor productivity (TFP), is 0.187, which is significantly positive at the 1% level. This indicates that good corporate ESG performance can enhance a company's own total factor productivity, thereby promoting high-quality development of the company. Hypothesis 1 is validated.

Analysis of the Impact of Product Market Competition on Total Factor Productivity. The regression results for Model (2) are reported in Column (2) of Table 4. In Column (2), the coefficient of the explanatory variable, product market competition (HHI), on total factor productivity (TFP) is 0.386, which is significantly positive at the 5% level. This suggests that the weaker the product market competition, that is, the larger the market share a company holds, the higher its total factor productivity, which can further promote the high-quality development of the company. Hypothesis 2 is validated.

Analysis of the Moderating Effect of Product Market Competition. The regression results for Model (3) are reported in Column (3) of Table 4. In Column (3), the coefficient of the interaction term ESG×HHI on total factor productivity is 0.342, which is significantly positive at the 1% level. This indicates that for companies occupying a large market share, good ESG performance can further enhance their total factor productivity, thereby more effectively promoting high-quality development of the company. Hypothesis 3 is validated.

Table 4. Baseline Regression Results

	TFP （1）	TFP （2）	TFP （3）
ESG	0.187***		0.229***
	(17.24)		(15.14)
HHI		0.386**	1.106***
		(2.09)	(2.98)
ESG×HHI			0.342***
			(4.11)
Size	0.005***	0.001***	0.003***
	(5.76)	(6.17)	(6.09)
Age	0.020***	0.018***	0.020***
	(11.72)	(10.43)	(11.58)
Share	0.008***	0.009***	0.007***
	(10.41)	(11.25)	(10.27)
Growth	-0.001	-0.004	-0.001

	(-0.03)	(-0.38)	(-0.04)
Flow	0.204**	0.284***	0.197**
	(2.09)	(2.78)	(2.03)
ROA	2.885***	3.293***	2.898***
	(6.92)	(7.33)	(7.01)
LEV	2.526***	2.557***	2.524***
	(34.86)	(33.37)	(34.93)
Time-Fixed	Y	Y	Y
Industry-Fixed	Y	Y	Y
_Cons	5.895***	6.665***	5.771***
	(85.48)	(100.84)	(67.94)
N	6555	6555	6555
R-sq	0.537	0.509	0.539
Adj . R-sq	0.530	0.502	0.532

4.4 Robustness Tests

Replacing Independent Variables. In the main regression analysis, the data assignment standard is as follows: C, 2C, 3C, B, 2B, 3B, A, 2A, 3A, with 3A being the highest grade and assigned in an ascending order from 1 to 9. In the robustness tests, the method for assigning ESG ratings is changed. The categories C, 2C, 3C are grouped into one major category and designated as grade C, assigned 1 point; B, 2B, 3B are grouped into another major category and designated as grade B, assigned 2 points; A, 2A, 3A are grouped into yet another major category and designated as grade A, assigned 3 points. After reclassification and reassignment, the ESG rating is named ESG2. Repeating the empirical process described earlier, the results are shown in Table 5. The coefficient of the explanatory variable corporate ESG2 performance on the dependent variable, total factor productivity (TFP), is 0.024, significantly positive at the 1% level, indicating that good corporate ESG2 performance enhances total factor productivity, consistent with the main test results. Industry concentration is positively related to total factor productivity, indicating that companies in more concentrated industries are more likely to improve their own total factor productivity; the coefficient of the interaction term ESG2×HHI is 0.13, significant at the 10% level, indicating that industry concentration has a positive moderating effect, enhancing the impact of corporate ESG performance on total factor productivity. The empirical results with this reassignment are consistent with the previous findings, demonstrating the robustness of the empirical results of this study.

Table 5. Regression Results with Replaced Explanatory Variables

	TFP (1)	TFP (2)	TFP (3)
ESG2	0.024***		0.041***
	(2.52)		(3.17)
HHI		0.423**	0.975***
		(2.04)	(2.85)
ESG2×HHI			0.130*
			(1.91)
Size	0.029***	0.027***	0.026***
	(5.40)	(5.36)	(5.33)
Age	0.019***	0.410***	0.019***
	(10.48)	(10.41)	(10.69)
Share	0.009***	0.034***	0.009***
	(11.41)	(11.31)	(11.50)
Growth	0.001	-0.004	-0.001
	(0.09)	(0.08)	(-0.08)
Flow	0.301**	0.284***	0.297**
	(2.84)	(2.85)	(2.079)
ROA	3.056***	3.049***	3.068***
	(6.77)	(6.80)	(6.82)
LEV	2.585***	2.582***	2.580***
	(32.37)	(32.34)	(32.22)
Time Fixed	Y	Y	Y
Industry Fixed	Y	Y	Y
_Cons	5.895***	6.636***	6.787***
	(85.48)	(93.83)	(81.75)
N	6555	6555	6555
R-sq	0.510	0.509	0.510
Adj . R-sq	0.502	0.502	0.503

Replacing the Dependent Variable. The total factor productivity (TFP) is recalculated using the OP method, which assumes that firms make investment decisions based on their current productivity levels. Thus, a firm's current investment is used

as a proxy for unobservable productivity shocks, addressing the issue of simultaneity bias. The recalculated TFP is named TFP_2, and the results are shown in Table 6. The coefficient of the explanatory variable, corporate ESG performance, on the dependent variable TFP_2 is 0.011, significantly positive at the 1% level. This indicates that good corporate ESG performance enhances total factor productivity, consistent with the main test results. Industry concentration is positively related to TFP_2, suggesting that firms in more concentrated industries are more likely to improve their own total factor productivity. The coefficient of the interaction term ESG × HHI is 0.065, significant at the 5% level, indicating that industry concentration has a positive moderating effect, facilitating the improvement of total factor productivity through better corporate ESG performance. The empirical results with this reassignment are consistent with previous findings, demonstrating the robustness of the study's empirical results.

Table 6. Regression Results with Replaced Dependent Variable

	TFP_2 （1）	TFP_2 （2）	TFP_2 （3）
ESG	0.011***		0.019***
	(0.89)		(1.11)
HHI		0.052**	0.226**
		(0.24)	(0.51)
ESG×HHI			0.065**
			(0.74)
Size	-0.005***	-0.006***	-0.005***
	(-2.52)	(-2.69)	(-2.64)
Age	0.007***	0.007***	0.007***
	(3.38)	(3.44)	(3.42)
Share	0.006***	0.006***	0.006***
	(6.16)	(6.07)	(6.19)
Growth	0.001*	0.001*	0.001*
	(1.65)	(1.69)	(1.64)
Flow	0.147**	0.143**	0.148**
	(1.17)	(1.15)	(1.18)
ROA	0.231***	0.208***	0.229***
	(1.18)	(1.08)	(1.17)
LEV	0.024	0.023	0.025***
	(0.31)	(0.29)	(0.31)
Time Fixed	Y	Y	Y
Industry Fixed	Y	Y	Y
_Cons	3.196***	3.147***	3.222***
	(37.05)	(41.55)	(31.07)
N	6555	6555	6555
R-sq	0.345	0.344	0.345
Adj . R-sq	0.336	0.334	0.337

4.5 Endogeneity Test

Lagged Independent Variables. Lagged periods of ESG are less likely to be adversely affected by the current total factor productivity, and to mitigate the endogeneity problem of reverse causality, lagged ESG is used as the explanatory variable. To test the endogeneity issues of Hypotheses 2 and 3, the industry concentration (HHI) is lagged by one period. The regression results are shown in Table 7. Column (1) shows that the coefficient of lagged ESG on firm total factor productivity is 0.169, significant at the 1% level, indicating that the performance of ESG in the lagged period can still have a positive impact on firm total factor productivity. It also suggests that the effect of firm ESG on firm total factor productivity can have a lag effect. The significant positive coefficient of lagged ESG performance indicates that good corporate ESG performance can have a sustainable impact on enhancing firm total factor productivity over a certain period. Column (2) shows that the coefficient of lagged HHI on firm total factor productivity is 0.903, significant at the 1% level, indicating that the industry concentration in the lagged period can still have a positive impact on firm total factor productivity. It also suggests that the effect of industry concentration on firm total factor productivity can have a lag effect. The significant positive coefficient of lagged HHI indicates that higher industry concentration can have a sustainable impact on enhancing firm total factor productivity over a certain period. Column (3) shows that the coefficient of the interaction term between lagged ESG performance and lagged HHI is 0.065, significant at the 1% level, indicating that the industry concentration in the lagged period can still positively moderate the relationship between firm ESG performance and firm total factor productivity.

Table 7. Regression Results of Lagged Explanatory Variables

	TFP （1）	TFP （2）	TFP （3）
L.ESG	0.169***		0.019***
	(13.21)		(1.11)
L.HHI		0.903**	0.226**
		(3.01)	(0.51)
L.ESG×L.HHI			0.065**
			(0.74)
Size	0.005***	0.006***	0.005***
	(3.58)	(3.73)	(2.64)
Age	0.016***	0.015***	0.007***
	(7.15)	(6.30)	(3.42)
Share	0.007***	0.008***	0.006***
	(7.70)	(8.10)	(6.19)

Growth	0.003	0.003	0.001*
	(0.13)	(0.13)	(1.64)
Flow	0.314**	0.369***	0.148**
	(2.55)	(2.88)	(1.18)
ROA	2.521***	2.793***	0.229***
	(4.61)	(5.03)	(1.17)
LEV	2.688***	2.726***	0.025***
	(28.28)	(27.29)	(0.31)
Time Fixed	Y	Y	Y
Industry Fixed	Y	Y	Y
_Cons	6.049***	6.843***	3.222***
	(64.97)	(69.97)	(31.07)
N	4308	4308	4308
R-sq	0.552	0.531	0.345
Adj . R-sq	0.543	0.521	0.337

Instrumental Variable Method. The average ESG score of other companies in the same city and year (ESG_IV) is chosen as the instrumental variable for each company. The ESG performance of a company is influenced by the ESG performance of other companies within the same province, while the ESG performance of these other companies is not directly related to the company's total factor productivity. This paper employs a two-stage least squares (2SLS) method for the instrumental variable regression. Column (1) of Table 8 reports the results of the first stage regression, showing that the industry average of ESG is significantly correlated with ESG. Column (2) reports the results of the second stage regression. In the second stage, the coefficient of ESG is significantly positive at the 5% level, indicating that the conclusion that ESG can promote the improvement of total factor productivity is robust.

Table 8. Instrumental Variable Method

	ESG （1）	TFP （2）
	First stage	Second stage
ESG		0.635**
		(2.24)
ESG_IV	0.102***	

	(3.19)	
Size	0.023***	0.017***
	(7.23)	(4.04)
Age	-0.001	0.032***
	(-0.74)	(17.89)
Share	0.006***	0.005**
	(6.35)	(2.41)
Growth	-0.002	0.001
	(-1.61)	(1.08)
Flow	0.520***	-0.020
	(4.17)	(-0.11)
ROA	2.043***	1.902***
	(10.21)	(3.12)
LEV	0.208***	2.447***
	(2.63)	(25.92)
Time Fixed	Y	Y
Industry Fixed	Y	Y
_Cons	3.293***	3.222***
	(22.94)	(31.07)
N	6555	6555
R-sq	0.049	0.252
Adj . R-sq	0.048	0.251

5 HETEROGENEITY ANALYSIS

5.1 Property Right Heterogeneity Analysis

When exploring the relationship between ESG performance, product market competition, and high-quality corporate development, property rights heterogeneity, as an important dimension, reveals the differences between state-owned enterprises and non-state-owned enterprises in the path of high-quality development under the interaction of these factors. Specifically, state-owned enterprises, due to their unique policy background, sense of social responsibility, and long-term development goals, may exhibit

different characteristics in ESG performance compared to non-state-owned enterprises. At the same time, the strategic choices, resource allocation capabilities, and flexibility of state-owned and non-state-owned enterprises when facing market competition may significantly differ, which further impact their ability to achieve high-quality development. This study attempts to reveal the differences in the impact of the relationship between ESG performance, market competition, and high-quality corporate development under different property rights. The research results are shown in Columns (1) and (2) of Table 9. In both sets of data, the coefficients of ESG performance on total factor productivity are significantly positive at the 1% level. Moreover, compared to state-owned enterprises, the improvement of total factor productivity in non-state-owned enterprises due to ESG performance is more pronounced, the possible reasons are as follows: Firstly, the flexibility of non-state-owned enterprises in operation, management, or innovation enables them to adapt and integrate ESG-related improvement measures more quickly. They are more sensitive to improvements in ESG performance and more effective in converting ESG performance into productivity improvements. Secondly, this difference reflects different incentive and constraint mechanisms. State-owned enterprises may face more external constraints, while non-state-owned enterprises are more motivated by market incentives when pursuing ESG improvement. Furthermore, non-state-owned enterprises may be more efficient in resource allocation and utilization, especially in implementing ESG measures. Market and external pressures may also drive non-state-owned enterprises to pay more attention to ESG performance as a means to enhance competitiveness and attract investment. Lastly, non-state-owned enterprises may be more proactive in risk-taking and innovation, which can help them gain an advantage in improving productivity. The coefficient of industry concentration on the total factor productivity of non-state-owned enterprises is significantly positive at the 10% level, while the coefficient for state-owned enterprises is not significant. This difference may be due to state-owned enterprises facing different business objectives and external constraints, such as focusing more on long-term goals and social responsibilities, rather than merely pursuing efficiency maximization. Additionally, the effects of different policy and regulatory environments may also contribute to this result, where state-owned enterprises might face more regulatory constraints, limiting their ability or motivation to improve productivity in highly concentrated industry environments.

The regulatory role of market competition for non-state enterprises is significantly positive at the 1% level, while the regulatory role for state-owned enterprises is not significant. The possible reasons are as follows: Firstly, non-state enterprises may have higher strategic flexibility and innovation capability, enabling them to integrate ESG practices more effectively into their business operations to cope with market competition. This flexibility and innovation capability can help non-state enterprises improve productivity while achieving sustainable development goals. On the contrary, state-owned enterprises may face different objectives and external constraints, such as policy direction and social responsibility, which may make their response to market competition not as direct or obvious when pursuing productivity improvement. Secondly, there may be differences between non-state and state enterprises in resource allocation, management capacity, and operational efficiency, which could impact their ability to use

market competition to enhance ESG performance and productivity. Non-state enterprises may rely more on market mechanisms to optimize resource allocation and improve operational efficiency, while state-owned enterprises may have policy support in resource acquisition and allocation, but this support may not directly promote the positive association between ESG performance and productivity. Lastly, the regulatory and policy environments faced by state-owned and non-state-owned enterprises may differ, which could affect their responses to market competition. For example, state-owned enterprises may face more policy guidance and regulatory requirements, which might limit their space or motivation to use market competition to enhance ESG performance and productivity. In conclusion, there is a complex relationship between ESG performance and product market competition in different types of enterprises. Excellent ESG performance can not only shape a good public image in intense market competition and enhance brand value, but also improve total factor productivity directly or indirectly through lowering operational costs, attracting talents, and investments. Moreover, the intensification of product market competition prompts enterprises to seek continuous innovation and efficiency improvement, where enterprises with good ESG performance are often better equipped to adapt to these changes, demonstrating higher adaptability and competitiveness. However, property rights heterogeneity also affects the ESG performance and total factor productivity of enterprises. Enterprises with different property rights characteristics differ in resource acquisition, governance structure, and strategic decision-making, which in turn affect their ESG performance and ability to respond to market competition. Therefore, when formulating and implementing ESG strategies, enterprises need to consider their property rights characteristics to ensure that ESG measures match their long-term development strategies, thus maintaining competitive advantages in product market competition while improving total factor productivity.

5.2 Scale Heterogeneity Analysis

When exploring the relationship between ESG performance, product market competition, and high-quality corporate development, scale heterogeneity serves as another crucial dimension. It reveals the differences in the path towards high-quality development between state-owned enterprises and non-state-owned enterprises under the interaction of these factors. Enterprises of different scales may have different operating practices and strategic selections. Larger enterprises usually have more resources to invest in ESG practices and are likely to withstand more intense market competition. In contrast, smaller enterprises may face resource constraints, but they might be more flexible and possibly react more quickly to market changes. Therefore, scale heterogeneity analysis can help understand the high-quality development paths of different scale enterprises under ESG performance and competitive pressure. This study attempts to reveal the differences under different scalability in ESG performance, market competition, and high-quality corporate development. The research results are shown in columns (3) and (4) of Table 9.In both sets of data, the coefficients of ESG performance on total factor productivity are significantly positive at the 1% level. Furthermore, compared to large-scale enterprises, the contribution of ESG performance to total factor

productivity in small-scale enterprises is more pronounced. The possible reasons are: firstly, small-scale enterprises typically have higher flexibility and adaptability, enabling them to implement ESG-related improvement measures more quickly and effectively, thus directly improving production efficiency. Secondly, for small-scale enterprises, good ESG performance not only enhances their brand value and market competitiveness but also achieves a larger productivity increase based on smaller resource foundations. In contrast, large-scale enterprises, although advantaged in terms of resources and capital, may have a more rigid structure and process, making the transition from ESG input to productivity improvement slower. Moreover, large enterprises may have already optimized production efficiency to some extent, so the room for further productivity improvement through ESG may be relatively limited. The coefficient of industry concentration on total factor productivity of small-scale enterprises is significantly positive at the 1% level, while the coefficient for large-scale enterprises is not significant. This difference might be due to: firstly, for small-scale enterprises, high industry concentration might mean fewer competitors and a larger market share, which could prompt these enterprises to improve their production efficiency to capture a larger market share. Furthermore, in high industry concentration situations, small-scale enterprises might benefit from economies of scale and learning curve effects, thereby improving total factor productivity. In contrast, for large-scale enterprises, industry concentration might have already reached a high level, preventing them from further gaining a larger market share through improved production efficiency. Also, the production process of large-scale enterprises might already be relatively optimized, so the impact of industry concentration on their total factor productivity could be insignificant. The regulatory role of market competition for small-scale enterprises is 0.754 and is significantly positive at the 1% level, while the regulatory role for large-scale enterprises is 0.171 and is significantly positive at the 10% level. The possible reason for this difference might be that, compared to large-scale enterprises, small-scale enterprises can adapt more flexibly to changes in industry concentration. They can enhance competitiveness and efficiency by improving their ESG performance. In highly concentrated industries, small-scale enterprises can improve their brand image and market recognition by enhancing ESG performance. They can also gain advantages in resources allocation, risk management, and innovation capabilities, thus gaining a favorable position in competition. In contrast, although large-scale enterprises also benefit from improving ESG performance, due to their size and the complexity of their operations, the positive impact of improving ESG performance on total factor productivity is relatively small, and therefore, the regulatory role of industry concentration is lower. Furthermore, owing to their existing market position and resource advantages, large enterprises' sensitivity to changes in industry concentration might be lower, thereby affecting the contribution of ESG performance to productivity improvement. In conclusion, there is clear scale heterogeneity between ESG performance, industry concentration, and total factor productivity. In highly concentrated industries, by improving their ESG performance, small-scale enterprises can more effectively enhance their total factor productivity. This illustrates the flexibility and adaptability of small enterprises in the industry. In a highly concentrated industry environment, they can efficiently use resources, improve production efficiency, and thus enhance their competitive position in

the market. Similarly, although large-scale enterprises also enhance their total factor productivity by improving ESG performance, their influence is smaller. Compared to small enterprises, large enterprises have more complex decision structures and operational models, which may affect their responsiveness and flexibility to industry changes. Moreover, since large enterprises usually already occupy a larger market share, even in highly concentrated industries, they might face a saturation problem in market share, which limits the improvement of their total factor productivity.

Table 9. Heterogeneity Analysis

	State-owned enterprises	Non-state-owned enterprises	Large-scale enterprises	Small-scale enterprises
	TFP (1)	TFP (2)	TFP (3)	TFP (4)
ESG	0.145***	0.202***	0.188***	0.202***
	(8.97)	(14.05)	(14.00)	(14.05)
HHI	0.618	0.869*	0.399	0.648***
	(1.02)	(1.70)	(0.85)	(2.81)
ESG×HHI	0.184	0.362***	0.171*	0.754***
	(1.55)	(3.26)	(1.73)	(4.21)
Size	0.023***	0.017***	0.015***	0.012***
	(7.23)	(4.04)	(2.65)	(1.73)
Age	0.013***	0.027***	0.023***	0.027***
	(4.30)	(12.53)	(11.50)	(12.53)
Share	0.004***	0.010**	0.008***	0.010***
	(3.83)	(9.58)	(8.65)	(9.58)
Growth	0.002	0.001	-0.002	0.001
	(0.35)	(0.03)	(-0.27)	(0.03)
Flow	0.004	0.415***	0.048	0.415***
	(0.03)	(2.87)	(0.41)	(2.87)
ROA	3.231***	2.097***	2.904***	2.097***
	(9.06)	(3.91)	(8.10)	(3.91)
LEV	2.108***	2.536***	2.450***	2.536***
	(20.49)	(25.78)	(26.15)	(25.78)
Time Fixed	Y	Y	Y	Y
Industry Fixed	Y	Y	Y	Y
_Cons	6.401***	3.222***	5.858***	5.594***
	(56.31)	(31.07)	(65.09)	(57.25)
N	2708	3847	3977	2578
R-sq	0.607	0.580	0.545	0.580
Adj . R-sq	0.595	0.570	0.535	0.570

6 CONCLUSION AND RECOMMENDATIONS

This study delves into the interrelations among corporate ESG performance, product market competition, and high-quality corporate development. It finds a positive correlation between a company's ESG performance and its high-quality development. Companies with good ESG performance are more inclined towards achieving high-quality development. Additionally, the relationship between product market competition and total factor productivity is negatively correlated, indicating that high industry concentration (i.e., weaker product market competition) is associated with improvements in corporate total factor productivity, further promoting high-quality corporate development. In this context, for companies with a strong market share, good ESG performance is particularly important for enhancing total factor productivity, thereby facilitating high-quality development. Furthermore, the impact of ESG performance on high-quality corporate development shows significant heterogeneity across different ownership and scale of companies. Based on the findings, the following policy recommendations are made: For companies, there should be increased investment in ESG practices, focusing on environmental protection, social responsibility, and good corporate governance as important pathways to enhance long-term competitiveness and achieve high-quality development. At the same time, companies should adapt actively to the market competition environment, enhancing their industry position through improved production efficiency and innovation capabilities. For policymakers, governments and regulatory bodies should encourage stronger ESG performance among enterprises through the formulation and implementation of relevant policies, such as tax incentives and financial subsidies. Moreover, a fair and healthy market competition environment should be promoted, preventing industry monopolies and ensuring more development opportunities for small and medium enterprises, thereby elevating the overall industry level of total factor productivity and high-quality development. Future research should further explore the similarities and differences in the impact of ESG performance on high-quality development among different industries and sizes of companies, as well as how to effectively promote corporate productivity through specific ESG practices. Additionally, companies should share their successes and challenges in ESG practices to provide references for other entities in the industry. Meanwhile, enterprises, governments, and all sectors of society should continue to focus on ESG issues, enhancing public awareness of corporate social responsibility. Public, consumer, and investor attention to corporate ESG performance should be elevated through media, education, and other means, thus creating a positive interaction that encourages companies to achieve both social value and environmental protection goals while enhancing their competitiveness.

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