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Does ESG Performance Affect Firm Value? Evidence from a New ESG-Scoring Approach for Chinese Enterprises

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Abstract: Proposing a new scoring method to evaluate the environmental, social, and corporate governance (ESG) performance of Chinese A-share listed companies over the period 2010–2019, this study investigates the impact of ESG on firm value, by taking Tobin's Q, Return on Assets (ROA) and Market-to-Book ratio (MB) as proxy variables for firm value. We find a significantly positive relationship between ESG composite performance and firm value, which supports the stakeholder theory. This result can hold when we carry out robustness checks, i.e., changing dependent variable, instrument variable (IV) regression, and Heckman's two-stage estimation. When an existing social responsibility rating (Hexun's CSR scores) is taken as the proxy of ESG performance, the main conclusion also keeps in line. For the three sub-dimensions, the positive impact of environmental (E) and social (S) performance on firm value can hold, while that of corporate governance (G) cannot pass all the robustness tests. In terms of heterogeneity, there is evidence that the enhancement effect of ESG on firm value for state-owned companies is stronger than that for non-state-owned companies. Besides, the enhancement effect is significant for the non-key pollution-monitored firms but insignificant for the key pollution-monitored firms.

Keywords: ESG performance; ESG quantitative scoring; firm value; stakeholder theory; Chinese enterprises

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1. Introduction

Nowadays, the term "ESG," referring to the acronym of Environmental, Social, and Governance, has become a new buzzword. It places corporate objectives in an interdependent and interconnected social network, introducing public interests into the corporate value system and paying more attention to enterprises' social role in the development process rather than single financial results. In 2006, the Principles of Responsible Investment (PRI) was officially launched by the United Nations to encourage people to incorporate ESG factors into investment and business decisions. As a result, more and more institutional investors gradually recognized ESG investment and progressively formed a mainstream investment trend in developed countries. The number of PRI signatories has increased from 63 in 2006 to 3826 in 2021, with the total assets under management increasing from $6.5 trillion in 2006 to $121.3 trillion in 2021 (https://www.unpri.org/pri/about-the-pri, accessed on 25 August 2022). Following the world's step, China successfully implemented measures to encourage ESG investment. As early as 2006, the Shenzhen Stock Exchange of China took the lead in issuing related policies for promoting and advocating the voluntary disclosure of listed companies' environmental (E) and social (S) information. In 2020, "carbon peak" and "carbon neutrality" were officially established as new strategic goals of China.

In terms of academic research, scholars in the field of economics and management have conducted extensive research on ESG [1], covering but not limited to ESG disclosure, ESG rating, impacts of ESG on financial performance [2–9], firm value [10–15], corporate risk and stock returns [16–19], etc. Throughout the existing literature, although scholars have conducted a series of studies on the relationship between ESG and firms' performance from various aspects, a core question has not been uniformly answered. That is, what is the relationship between ESG performance and firm value? This is a question posed from the company's perspective as to whether ESG has a value-creation effect. The answers to this question could, in part, determine whether companies are willing to fulfill more ESG-related responsibilities proactively.

Some previous studies deem that ESG performance is positively related to firm value or firm performance [2,4,5,9,12,13,20–22], while other scholars argue that they are negatively correlated [3,6]. Some scholars argue that it is very important to account for the convexity-concavity nature of such relations [23]. Besides, from the perspective of the regions involved in the ESG-related research objects, previous literature mainly interested in developed countries such as the United States [24–27], Germany [2,28], the United Kingdom [12], Japan [18] and Australia [17,29], followed by developing countries, especially emerging economies such as China [4,30], India [21], Malaysia [13,14]. Other studies take a global perspective, covering a wider range of countries [3,5,6,16,20,22,31–35]. Limited by the availability of ESG-related data for Chinese enterprises, there are very few studies on firms' ESG performance in China [3].

In this paper, we investigate the impact of ESG performance on firm value, taking Chinese A-share listed companies that disclosed ESG-related quantitative data from 2010 to 2019 as the sample. We firstly construct a hierarchical ESG scoring system to evaluate firms' ESG performance by mainly using the ESG-related quantitative data of Chinese A-share listed companies, generating the ESG composite score as well as three sub-dimensional scores (namely, E score, S score, and G score). In the second step, the unbalanced panel data of a total of 804 firms of the Chinese Shenzhen Stock Exchange and Shanghai Stock Exchange for 2010 to 2019 with 3069 observations are used to examine the impact of ESG on firm value, where Tobin's Q (TQ) and Return on Assets (ROA) are taken as indicators of firm value. The robustness of the main regression results was tested by a series of methodologies, such as changing the proxy of firm value to Market-to-Book ratio (MB), taking an existing social responsibility score as the proxy of ESG performance, advancing the explained variable by one stage, the instrumental variable (IV) estimation, and the Heckman's two-stage estimation. Finally, we further discuss the heterogeneity between state-owned enterprises and non-state-owned enterprises and the heterogeneity between the non-key pollution-monitored firms and the key pollution-monitored firms.

Our main empirical findings are as follows. Firstly, ESG comprehensive performance scores positively affect firm value, especially for non-key pollution-monitored enterprises. Secondly, the environmental (E) performance is significantly positively correlated with firm value for the non-key pollution-monitored companies rather than the key pollution-monitored companies. Thirdly, except for key pollution-monitored firms, social (S) performance has a significantly positive impact on firm value. Fourthly, the positive relationship between corporate governance (G) performance and firm value fails to pass all the robustness and heterogeneity tests, implying that the impact is unstable. Besides, when we take taking an existing social responsibility score (Hexun's CSR scores) as the proxy of ESG performance, the main results keep in line, indirectly highlighting the validity of the ESG-scoring method proposed in this study.

The contributions of this study are manifold. Firstly, considering the tremendous growth of responsible investment, academic studies on the ESG practice of Chinese firms are still limited. Our paper is the first study that investigates the relationship between ESG performance and firm value in China, evaluating ESG performance based on the ESG-related quantitative data disclosed by Chinese A-share listed companies in the past decade rather than using ESG scores obtained from the rating agencies. On ESG-related

information, some Chinese listed companies have begun to voluntarily disclose their standalone Corporate Social Responsibility (CSR) reports since 2006. More than 10 years have gone by, and the average disclosure ratio of CSR reports for Chinese-listed companies per year is still less than 30%. What is more, the disclosure ratio of quantitative information on environmental and social responsibilities is much less than that. Owing to the data availability, the number of Chinese A-share listed companies that are covered in the international ESG rating agencies, such as Thomson Reuters and Bloomberg, is very limited. In the past several years, some Chinese domestic agencies have chosen to launch ESG rating data, e.g., SynTao Green Finance ESG Ratings (June 2018), China Social Value Investment Alliance ESG Rating (December 2019), Huazheng ESG Rating (April 2020), Wind ESG Rating (June 2021), and Sino-Securities Index ESG Rating (July 2020). Among them, only SynTao Green Finance ESG Ratings goes back as far as 2015, covering the components of the Shenzhen-Shanghai 300 stock index. Moreover, only the Wind ESG rating provides scores for the three single sub-dimensions (E, S, and G), but it just covers A-share listed firms after 2018. In other words, we know very little about the ESG performance of Chinese companies over the past dozen years, especially before 2015. Our ESG-scoring objects include all the Chinese A-share listed companies that once disclosed quantitative information on both environmental and social aspects over the period 2010–2019, providing a relatively comprehensive sample to investigate the ESG performance of Chinese firms.

Secondly, we proposed a new method for evaluating ESG performance. According to the principle that companies are evaluated on what they disclose, we construct an ESG rating system based on the disclosed ESG-related quantitative information of Chinese A-share listed firms, including 3 pillars (E, S, and G), 12 second-level indicators, 57 third-level indicators, and 230 + fourth-level sub-indicators. On ESG performance scoring, we employ an entropy method to assign weights for the second-level indicators when we calculate scores for the three first-level indicators, avoiding the subjectivity caused by artificial weighting. Compared with existing ESG ratings, one advantage of our ESG scoring method is that data sources and calculation methods are more transparent. At present, there is no literature that is completely consistent with our methods and evaluation objects. Besides, we also use existing CSR scores to re-test our empirical results and the conclusions keep in line. The validity of our proposed ESG scoring method is indirectly verified.

Thirdly, our study contributes to the literature in the related field of firm value. We test the two conflicting theories on the impact of ESG performance on firm value, namely, the agency theory and the stakeholder theory, using a new and large data set from Chinese companies. The results of our study present significant evidence that engaging in more ESG activities can positively enhance a firm's value, especially for companies not listed in the key pollution-monitored list by the Environmental Protection Bureau. It is helpful for academic research on corporate management theory and policymakers in promoting ESG activities among Chinese companies.

Our research is structured as follows. Section 2 proposes research hypotheses based on a literature review; Section 3 describes ESG scoring and empirical model designing; Section 4 introduces data and descriptive statistics; Section 5 details the empirical results; and Section 6 concludes.

2. Literature Review and Hypothesis Development

The corporate finance literature on ESG and firm value has produced mixed findings [1]. However, overviewing previous literature exploring the relationship between ESG performance and firm value, conclusions can be typically divided into two main streams: one supports the stakeholder theory that ESG performance is positively correlated with firm value. In contrast, the other supports the agency theory that ESG performance negatively correlates with firm value.

According to the agency theory, ESG activities will produce agency problems between managers and shareholders. ESG expenditures are not in the shareholders' best interests because ESG activities waste corporate resources, and the direct cash outflows will reduce

profits and firm value. A strand of literature has found empirical evidence in line with the agency theory [3,6,28,36–41]. For example, Ref. [36] argues that managers may spend company resources to obtain private benefits and to carry out ESG activities for their interests. Ref. [37] deems that managers would overinvest in ESG-related activities to build a good reputation at the expense of shareholders [37]. Ref. [3] shows that the profitability of enterprise assets is negatively correlated with ESG, and the companies with the best ESG performance tend to have lower profits. Ref. [28] finds that ESG negatively affects corporate earnings management. Ref. [6] finds that the financial performance of multinational listed companies in emerging markets of Latin America has a statistically significant negative correlation with ESG score. In general, agency theory researchers suggest that the information asymmetry between corporate management and their stakeholders will encourage firms to use social responsibility activities as signals to either compensate for ESG weaknesses or prevent ESG risks [6]. To compensate for their social and environmental irresponsibility, companies that do bad things will instead do more good things to correct or improve their corporate image, which may harm the interests of shareholders. In other words, the agency theory supports the view that ESG performance negatively correlates with firm value.

However, the stakeholder theory holds that ESG activities align with stakeholders' interests and can improve corporate performance and firm value. Based on the stakeholder theory, a company will be more successful if it manages its relationships with all stakeholders well. A firm with a stronger ESG profile could realize higher growth than a firm with a relatively weaker ESG. The mechanisms for ESG activities to create value can be divided into two ways: the first holds that higher ESG performance increases the expected cash flow and lowers the discount rate [19]. The second argues that ESG activities can create corporate value by maximizing shareholder benefits [42,43]. For example, shareholders could assess the environmental or social consequences of ESG activities and the cash flows they generate. Under this option, shareholders benefit from owning companies that fulfill the ESG concept. Thus, ESG activities can synergistically influence a firm's market performance, such as that satisfied and happy employees are more motivated at work and satisfied suppliers offer more discounts, etc., which in turn enhances the business's reputation and leads to better financial performance. Ref. [42] shows that a company's philanthropy positively correlates with its future income growth in industries where consumers' perception is quite sensitive. Ref. [43] argues that corporate social responsibility and financial performance are positively correlated. Ref. [20] finds that higher ESG can reduce enterprise risks and increase enterprise value. At the same time, heightened public awareness and its potential factors on corporate reputation will affect the effect of ESG on corporate risk. Ref. [12] finds that ESG disclosure level is positively correlated with firm value and this kind of linkage is more pronounced when the CEO is more powerful. Ref. [13] finds that higher ESG reduces the cost of capital of the enterprise and increases the enterprise value. In addition, some other scholars have found similar conclusions [2,4,5,9,21,22], providing evidence for the positive relationship between ESG profile and firm value.

Ref. [44] summarized and conducted a meta-analysis of more than 2000 ESG-related empirical academic literature, finding that about 90% of the studies found a non-negative relationship between ESG and corporate financial performance. Thus, based on the previous literature review above, we formulate the central research hypothesis and three sub-hypotheses as follows:

H1. *Firms' environmental, social and corporate governance (ESG) composite performance positively affects firm value.*

H1a. *Firms' environmental (E) performance positively affects firm value.*

H1b. *Firms' social (S) performance positively affects firm value.*

H1c. *Firms' corporate governance (G) performance positively affects firm value.*

3. Methodology

To test the four hypotheses proposed in our paper, we start by constructing an ESG framework to evaluate firms' ESG composite performance and its three sub-dimensions' performance, then specify panel-data models to examine the impact of ESG performance on firm value. The details of ESG quantitative scoring, regression and variables design are introduced in the next two subsections.

3.1. ESG Quantitative Scoring

In this paper, we take three steps to evaluate firms' ESG performance as follows.

Step 1: Data collection and selection of ESG scoring objects. We collect ESG-related quantitative data disclosed by Chinese A-share listed companies in the past decade. Since there is no unified standard for ESG information disclosure and no fully mandatory ESG disclosure policy, ESG-related information of Chinese listed companies available to the public is very limited. It mainly relies on the voluntary ESG disclosure of enterprises. According to the principle of who discloses data is evaluated, we select those enterprises that have disclosed quantitative information in all three dimensions of ESG (environmental, social and governance) as the rating objects in our study, ignoring those companies that only disclose data in one or two dimensions.

Step 2: ESG rating formwork design. Our ESG rating framework has four layers. The first layer covers the Environmental (E), Social (S), and Governance (G) dimensions. The second level comprises 12 indicators supporting E, S, and G, including environmental management, resource consumption, pollution emission, production safety, public relations and social welfare, protection of shareholders' rights, protection of customer and consumer rights, protection of creditors' rights, protection of workers' rights and interests, protection of rights and interests of suppliers, shareholders governance, board of directors and management. Finally, the third layer comprises 57 criteria from approximately 230 + fourth-level sub-indicators. An overview of ESG quantitative scoring system tiers in this paper is shown in Table 1, and a more detailed illustration is presented in Appendix A for space limitation.

Table 1. Overview of ESG quantitative scoring system tiers in this paper.

Tier 1	Tier 2	Tier 3 (Examples)
E (Environmental)	Environmental management	Pollution reduction; Emission standard; Resources saving; Green energy; Green finance; Environmental policy; Green patent; Treatment of pollutants; Environmental protection equipment/process; Environmental protection projects or products; Recycling of resources.
	Resource consumption	Water; Coal; Electricity; Oil; Natural gas; Heat energy; Other energy
	Pollution emission	Water pollution; Atmospheric pollution; Hazardous solid waste pollution; Noise pollution
S (Social)	Production safety	Production safety issues; Production safety management; Safety production input
	Public relations and social welfare	Laws and regulations; Employment of Special Groups; donation; Tax payment
	Protection of shareholders' rights	Handling of shareholders' suggestions; Shareholder satisfaction; Negative events of shareholder rights protection
	Customer and consumer rights protection	Customer/consumer satisfaction; Customer/consumer communication; Product advantage
	Protection of creditors' rights	The contract performance; Information compliance disclosure; Debt paying ability; Debt repayment
	Protection of workers' rights and interests	Satisfaction of employees; Employee communications; Employee training; Employee relationship strengths
	Protection of rights and interests of suppliers	Reimbursement of suppliers

Table 1. *Cont.*

Tier 1	Tier 2	Tier 3 (Examples)
G (Governance)	Shareholders governance	The concentration of ownership; Shareholders of scale; The general meeting of shareholders; Shareholding of directors, supervisors, and executives; Institution setting
	Board of Directors and Management	Diversity; Independence; Executive compensation; Other advantages of corporate governance

Notes: This table presents an overview of ESG scoring system tiers in this paper. See Appendix A for a more detailed metric hierarchy design and illustrations. (Source: Own elaboration).

Step 3: ESG score calculation. We use the data collected in the first step and the hierarchy indicator system proposed in the second step above to calculate ESG scores. Firstly, we compute scores for the fourth-level indicators. Each specific indicator is applied only to companies that disclose data related to that index. The calculating formulas for the fourth-level indicators can be described as follows.

$$\mathrm{S4C}^{\mathrm{E/S/G}}{}_{\alpha,t,j} = 10 \times \left(1 + \frac{\left(ID^{\mathrm{E/S/G}}{}_{\alpha,t,j} - MV_{t,j}^{\mathrm{E/S/G},ind} \right)}{ID^{\mathrm{E/S/G}}{}_{\alpha,t,j}} \right) \quad (1)$$

$$ID^{E/S/G}{}_{\alpha,t,j} = \sum_{\mathrm{k}=1}^{K} \mathrm{Value}^{\mathrm{E/S/G}}{}_{\alpha,t,j,k} \quad (2)$$

$$MV_{t,j}^{E/S/G,ind} = \frac{\sum_{n=1}^{N} ID_{n,t,j}^{E/S/G,\mathrm{ind}}}{N} \quad (3)$$

where $\mathrm{S4C}^{\mathrm{E/S/G}}{}_{\alpha,t,j}$ means the performance score for the fourth-level indicator j corresponding to E (environmental), S (social), or G (governance) dimension for a firm α at year t. $ID^{E/S/G}{}_{\alpha,t,j}$ means the quantitative value of the fourth-level indicator j corresponding to E, S, or G dimension for a firm α at year t; $\mathrm{Value}^{\mathrm{E/S/G}}{}_{\alpha,t,j,k}$ represents the value of the data point k corresponding to the fourth-level indicator j for a firm α at year t, and K represents the number of data points. It should be noted that K could be greater than one because different firms could have different disclosure styles. For example, some companies disclose the total value corresponding to the fourth-level index j, while others choose to disclose the detailed contents involved in the index j. For instance, in terms of water saving, some companies disclose the total amount of annual water savings. In contrast, others disclose details for water saving such as production water saving, office water saving, etc., which consequently needs to be summed up.

$MV_{t,j}^{E/S/G,ind}$ means the average value of the four-level indicator j in the industry ind at year t, and N represents the number of listed companies in the industry ind.

Next, scores for the third-level indicators are calculated by summing up the corresponding fourth-level scores as below:

$$S3C^{E/S/G}{}_{\alpha,t,\gamma} = \sum \left(\mathrm{S4C}^{\mathrm{E/S/G}}{}_{\alpha,t,j} \right) \Big|_{j \in \Theta\gamma} \quad (4)$$

where $S3C^{E/S/G}{}_{\alpha,t,\gamma}$ means the performance score for the third-level indicator γ corresponding to E, S, or G dimension for a firm α at year t. Θ_γ means the scope of fourth-level indicators corresponding to the third-level indicator γ.

Similarly, we calculate scores for the second-level indicators by summing up the corresponding third-level scores:

$$S2C^{E/S/G}{}_{\alpha,t,i} = \sum \left(\mathrm{S3C}^{\mathrm{E/S/G}}{}_{\alpha,t,\gamma} \right) \Big|_{\gamma \in \Theta i} \quad (5)$$

where $S2C^{E/S/G}{}_{\alpha,t,i}$ means the performance score for the second-level indicator i corresponding to E, S, or G dimension for a firm α at year t. Θ_i represents the scope of fourth-level indicators corresponding to the second-level indicator i.

For scoring the first-level indicators for three dimensions (E, S, and G), we use the entropy method to assign weights for the second-level indicators to avoid the subjectivity caused by artificial weighting. The weighting procedure is as below:

$$ {}^{+}Y^{E/S/G}{}_{\alpha,t,i} = \frac{S2C^{\mathrm{E/S/G}}{}_{\alpha,t,i} - \min\left(S2C^{\mathrm{E/S/G}}{}_{i}\right)}{\max\left(S2C^{\mathrm{E/S/G}}{}_{i}\right) - \min\left(S2C^{\mathrm{E/S/G}}{}_{i}\right)} \tag{6} $$

$$ {}^{-}Y^{E/S/G}{}_{\alpha,t,i} = \frac{\max\left(S2C^{\mathrm{E/S/G}}{}_{i}\right) - S2C^{\mathrm{E/S/G}}{}_{\alpha,t,i}}{\max\left(S2C^{\mathrm{E/S/G}}{}_{i}\right) - \min\left(S2C^{\mathrm{E/S/G}}{}_{i}\right)} \tag{7} $$

$$ p^{E/S/G}{}_{\alpha,t,i} = \frac{{}^{+/-}Y^{E/S/G}{}_{\alpha,t,i}}{\sum_{\alpha=1}^{M}\sum_{t=1}^{T} {}^{+/-}Y^{E/S/G}{}_{\alpha,t,i}}, \alpha = 1, \ldots, M, t = 1, \ldots, T \tag{8} $$

$$ F^{E/S/G}{}_{i} = -\frac{\sum_{\alpha=1}^{M}\sum_{t=1}^{T} p^{E/S/G}{}_{\alpha,t,i} \ln p^{E/S/G}{}_{\alpha,t,i}}{\ln(M \times T)} \tag{9} $$

$$ W^{E/S/G}{}_{i} = \frac{1 - F^{E/S/G}{}_{i}}{\sum_{i=1}^{H} F^{E/S/G}{}_{i}} \tag{10} $$

where ${}^{+/-}Y^{E/S/G}{}_{\alpha,t,i}$ means standardized second-level indicator i corresponding to E, S, or G dimension for a firm α at year t. ${}^{+}Y^{E/S/G}{}_{\alpha,t,i}$ is a positive indicator, while ${}^{-}Y^{E/S/G}{}_{\alpha,t,i}$ is a negative indicator. Except for the pollution emission in our sample, all the other second-level indicators are viewed as positive. $p^{E/S/G}{}_{\alpha,t,i}$ is the normalized form for the standardized second-level indicators. M is the number of companies and T the number of years in the sample. $F^{E/S/G}{}_{i}$ is the information entropy and $W^{E/S/G}{}_{i}$ is the weight of the corresponding second-level indicator i. Using the weights calculated by the entropy method, we continue to estimate scores for the first-level indicators, namely, the three single dimensions (E, S, and G) as below:

$$ Score^{E/S/G}{}_{\alpha,t} = \ln\left[10,000 \times \sum_{i=1}^{H}\left(W^{E/S/G}{}_{i,\cdot} p^{E/S/G}{}_{\alpha,t,i}\right)\right] \tag{11} $$

where $Score^{E/S/G}{}_{\alpha,t}$ means the performance score for the first-level indicator, namely, E score, S score, and G score for a firm α at year t, respectively.

Lastly, we calculate the ESG composite score by summing up the three single-dimension scores.

$$ Score^{ESG}{}_{\alpha,t} = Score^{E}{}_{\alpha,t} + Score^{S}{}_{\alpha,t} + Score^{G}{}_{\alpha,t} \tag{12} $$

where $Score^{ESG}{}_{\alpha,t}$, $Score^{E}{}_{\alpha,t}$, $Score^{S}{}_{\alpha,t}$ and $Score^{G}{}_{\alpha,t}$ represent ESG score, E score, S score, and G score for a firm α at year t, respectively.

3.2. Regression and Variables Design

To test our hypotheses, the regressions are specified as follows:

$$ FV_{i,t} = \alpha_{ESG} + \beta_{ESG} Score^{ESG}{}_{i,t} + \gamma_{ESG} Controls_{i,t} + \sum Indu + \sum Year + \varepsilon_0 \tag{13} $$

$$ FV_{i,t} = \alpha_{E} + \beta_{E} Score^{E}{}_{i,t} + \gamma_{E} Controls_{i,t} + \sum Indu + \sum Year + \varepsilon_E \tag{14} $$

$$ FV_{i,t} = \alpha_{S} + \beta_{S} Score^{S}{}_{i,t} + \gamma_{S} Controls_{i,t} + \sum Indu + \sum Year + \varepsilon_S \tag{15} $$

$$FV_{i,t} = \alpha_G + \beta_G Score^G{}_{i,t} + \gamma_G Controls_{i,t} + \sum Indu + \sum Year + \varepsilon_G \quad (16)$$

where $FV_{i,t}$ means the firm value for a firm i at year t. $Score^{ESG}{}_{i,t}$, $Score^{E}{}_{i,t}$, $Score^{S}{}_{i,t}$ and $Score^{G}{}_{i,t}$ represent ESG, E, S, and G scores for a firm α at year t, respectively. $Controls_{i,t}$ defines the control variables. We also control the industry fixed effect ($Indu$) and the year fixed effect ($Year$). Equations (13)–(16) are used to examine the hypotheses H1, H1a, H1b, and H1c, respectively. Based on the literature, we choose Tobin's Q (TQ) and Return on Assets (ROA) as proxy variables for firm value. In addition, we control for several firm characteristics that have been found to affect firm value, including the natural logarithm of sales volume ($SalesL$), sales growth rate ($SalesG$), the ratio of capital expenditures to total assets ($OutcapR$), leverage (Lev), cash holdings ($CashAR$), tangibility ($TangiAR$), fixed asset ratio ($FixAG$), asset growth ($AssetG$), R&D intensity (RD), labor productivity ($LabP$), dividend yield ($DivY$), firm size ($Size$) and firm age (Age). A description of variables with main references is shown in Table 2.

Table 2. Description of variables.

Variable	Description	Main References
TQ	Tobin's Q [(Market Value of Equity + Liabilities)/Total Asset]	[2,7,10,11,13–15,45–48]
ROA	Return on Assets (The ratio of net income to the book value of total assets)	[3,5–10,12,46,49]
$Score^{ESG}$	ESG composite score	
$Score^{E}$	E score	
$Score^{S}$	S score	
$Score^{G}$	G score	
$SalesL$	Sales (Natural logarithm of sales)	[11]
$SalesG$	Sales growth rate (The ratio of the previous year's sales to the current year's sales minus one)	[10,12,48,50]
$OutcapR$	Capital expenditures rate (The ratio of capital expenditures to total assets)	[10,48,50]
Lev	Leverage (The ratio of total debt to book value of equity)	[11,12,50,51]
$CashAR$	Cash Holdings (Cash and cash equivalents divided by total assets)	[13,48]
$TangiAR$	Tangibility (Net fixed assets divided by total assets)	[13,14]
$FixAG$	Fixed Asse rate (Ratio of the book value of fixed assets to the book value of total assets)	[48]
$AssetG$	Asset growth rate (The ratio of the previous year's assets to the current year's assets minus one)	[13]
RD	R&D Intensity (Ratio of research and development expense to total book asset measured)	[48,52]
$LabP$	Labor productivity (The ratio of sales to the number of employees)	[50]
$DivY$	Dividend yield (Dividend per share/stock price per share)	[10]
$Size$	Size (Natural log of the book value of total assets)	[2,10]
Age	Age (Natural log of the number of days since first listing)	[10]
$Indu$	The industry fixed effects are absorbed by the industry	
$Year$	The year-fixed effects are absorbed by the fiscal year	

Notes: This table shows the description of variables with the primary references used in our study. (Source: Own elaboration).

4. Data Analysis and Descriptive Statistics

In the previous section, we introduced the methodology of ESG performance evaluation and baseline model design in our study. In this section, we focus on illuminating the process of our sample selection and data sources, and showing the descriptive statistics and the correlation matrix of all the main variables that will be used in the empirical analysis.

4.1. Sample Selection and Data Sources

Our sample covers Chinese A-share listed companies which disclosed quantitative information in all three dimensions of ESG (environmental, social, and governance) from 2010 to 2019. Since 2006, some Chinese listed companies began to voluntarily disclose their standalone CSR reports that describe their activities on corporate social responsibility, following the encouragement policy issued by Shenzhen Stock Exchange. At the end of 2008, China Securities Regulatory Commission (CSRC) issued a policy forcing four types of listed companies to disclose social responsibility reports, including those companies which are included in the Shenzhen 100 Index, the SSE Corporate Governance board, the SSE financial companies, and the SSE listed companies which issue overseas listed foreign capital stocks.

Other A-share listed companies can choose to disclose their CSR reports voluntarily. Most of the enterprises that disclosed quantitative environmental and social environmental information disclosed it through standalone CSR reports. However, there are very few standalone CSR reports in the period 2006–2009 from our data sources. Thus, our sample starts from 2010, and the end time of the sample depends on the last full-year data available when we first started this study. Original data on environmental performance details are obtained from the "Company Research Series—Environmental Research" sub-database of the CSMAR database. Initial data on social performance details are obtained from the "Company Research Series—Social Responsibility" sub-database of the CSMAR database. Since an "environment and sustainable development" item is involved in the original social performance data, it is used to supplement the environmental performance data obtained from the "Company Research Series—Environmental Research" sub-database. That is, if two contents are entirely consistent, the duplicate one will be deleted. If the descriptive names of the two contents are the same, but the corresponding data are different, the data obtained from the "Company Research Series—Environmental Research" sub-database shall prevail. Next, we use the firm-year item for matching, removing samples that only have quantitative data on environmental (E) or social (S) dimensions, and the sample of companies that issued quantitative data on both the environmental and social dimensions is retained, generating 3612 observations for the sample of firm-year ESG score.

We further preprocess the original data, unifying the unit of measurement to make them comparable in each fourth-level indicator. Based on the firm-year list above, we collect original data on corporate governance (G) from the Wind data and CSMAR database, including the first big shareholder shareholding, the top 10 shareholders holding, Z-index, the number of shareholders, the shareholders' general meeting, executives' shareholding, the board size, etc. We also collect some data on CSR reports interpretation from the CNRDS database. More details on data sources of ESG scoring in our study can be seen in Appendix A. Other Financial data are obtained from the Wind and CSMAR databases. Since we only keep samples that have data on all the variables described in Table 2, there are 804 listed companies and 3609 observations in the final sample for the empirical regressions.

Panel A and B of Table 3 present our final sample's industrial and yearly distribution, respectively. The manufacturing industry has the highest quantitative ESG-related information disclosure, and the finance sector follows. The yearly distribution of the sample shown in Panel B of Table 3 shows an increasing trend in ESG disclosure of Chinese companies in the past decade.

Table 3. Sample distribution.

	Freq.	Percent	Cum.
Panel A: Sample distribution by industry			
Agriculture, forestry, livestock farming, fishery	37	1.030	1.030
Mining	249	6.900	7.920
Manufacturing	2065	57.22	65.14
Utilities	231	6.400	71.54
Construction	106	2.940	74.48
Wholesale and retail	140	3.880	78.36
Transportation	188	5.210	83.57
Hotel and catering industry	7	0.190	83.76
Information transmission, software, and information technology service	66	1.830	85.59
Finance	300	8.310	93.90
Real estate	107	2.960	96.87
Leasing and commerce service	23	0.640	97.51
Scientific research and technology service	12	0.330	97.84
Water conservancy, environment, and public facilities management	53	1.470	99.31
Hygienism and social work	6	0.170	99.47

Table 3. *Cont.*

	Freq.	Percent	Cum.
Culture, sports, and entertainment	10	0.280	99.75
Comprehensive	9	0.250	100
Total	3609	100	
Panel B: Sample distribution by year			
2010	186	5.150	5.150
2011	255	7.070	12.22
2012	279	7.730	19.95
2013	304	8.420	28.37
2014	289	8.010	36.38
2015	378	10.47	46.86
2016	432	11.97	58.83
2017	453	12.55	71.38
2018	506	14.02	85.40
2019	527	14.60	100
Total	3609	100	

Note: This table shows sample distribution by year and industry. The industry is categorized by the Industry Classification Standard of the China Securities Regulatory Commission (CSRC). (Source: Own elaboration).

4.2. Descriptive Statistics and Correlation Analysis

Table 4 shows descriptive statistics of all the variables. Regarding the dependent variable, the mean, standard deviation, and minimum and maximum values of Tobin's Q (TQ) are 1.796, 1.236, 0.000, and 12.620, respectively. The mean, standard deviation, minimum and maximum values of return on assets (ROA) are 0.042, 0.060, −0.957, and 0.477, respectively. As can be seen in this table, the mean value and standard deviation of the ESG composite score ($Score^{ESG}$) are 17.530 and 1.802, respectively. Regarding the three single-dimension scores, the mean value of $Score^{E}$, $Score^{S}$ and $Score^{G}$ are 4.666, 5.654, and 7.215, respectively. At the same time, the standard deviation of $Score^{E}$, $Score^{S}$ and $Score^{G}$ are 1.238, 0.762, and 0.423, respectively.

Among the three single dimensions, the mean score for the environmental dimension is the lowest while its standard deviation is the highest, and the mean score for the governance dimension is the highest while its standard deviation is the lowest. The mean value and standard deviation of scores for the social dimension are in the middle. It suggests that Chinese listed companies perform relatively best in the corporate governance (G) dimension and worst in the environmental (E) dimension. The difference in corporate governance (G) performance among different companies is the smallest, while that of environmental (E) performance is the largest, and that for social (S) performance is in the middle.

Table 5 reports the correlation matrix for the variables. As can be seen in this table, the correlation coefficient between TQ and ROA is 0.396, indicating that they are positively correlated. Regarding correlation coefficients between the dependent variables and ESG performance scores, the correlation coefficient between TQ and $Score^{ESG}$ is −0.169 while that between ROA and $Score^{ESG}$ is 0.061, all of which are statistically significant at 1% significance level. The correlation coefficient between TQ and $Score^{E}$ is −0.177 and statistically significant at 1% level, while that between ROA and $Score^{E}$ is −0.020 but not statistically significant. The correlation coefficient between TQ and $Score^{S}$ is −0.091 while that between ROA and $Score^{S}$ is 0.101, all of which are statistically significant at 1% level.

Table 4. Descriptive statistics.

Variable	Obs.	Mean	SD	Min	25%	50%	75%	Max
TQ	3609	1.796	1.236	0.000	1.401	1.056	2.071	12.62
ROA	3609	0.042	0.060	−0.957	0.033	0.012	0.065	0.477
$Score^{ESG}$	3609	17.53	1.802	12.89	17.27	16.21	18.54	25.76
$Score^{E}$	3609	4.666	1.238	1.334	4.400	3.806	5.295	9.120
$Score^{S}$	3609	5.654	0.762	3.716	5.540	5.089	6.103	8.469
$Score^{G}$	3609	7.215	0.423	4.750	7.180	6.968	7.432	8.983
$SalesL$	3609	22.95	1.694	17.29	22.79	21.72	24.03	28.72
$SalesG$	3609	0.538	8.649	−1.771	0.081	−0.038	0.307	434.6
$OutcapR$	3609	0.049	0.046	0.000	0.036	0.015	0.069	0.392
Lev	3609	2.387	5.591	−182.3	1.238	0.624	2.388	152.2
$CashAR$	3609	0.136	0.104	0.001	0.110	0.0625	0.175	0.810
$TangiAR$	3609	0.935	0.088	0.185	0.960	0.927	0.982	1.000
$FixAG$	3609	0.162	0.838	−1.000	0.0425	−0.031	0.171	31.51
$AssetG$	3609	0.157	1.016	−0.973	0.0904	0.0181	0.186	47.93
RD	3609	0.014	0.0157	0.000	0.0089	0.0024	0.0193	0.184
$LabP$	3609	2.192	3.047	0.000	0.910	0.000	3.620	43.25
$DivY$	3609	198.4	335.1	10.19	128.3	73.73	225.9	8052
$Size$	3609	23.77	1.944	19.20	23.46	22.38	24.70	31.04
Age	3609	8.210	0.973	0.000	8.492	7.916	8.819	9.269

Notes: This table presents descriptive statistics for the variables used in our sample from 2010 to 2019. *TQ* represents Tobin's Q, which is measured as the ratio of the sum of the market value of equity and liabilities at the end of year t divided by the book value of total assets at the end of year t. *ROA* is the return on assets, calculated as the ratio of net income to the book value of the total asset. $Score^{ESG}$, $Score^{E}$, $Score^{S}$ and $Score^{G}$ represent ESG score, E score, S score, and G score in year t, respectively. *SalesL* is the size of sales, calculated as the natural logarithm of sales volume in year t. *SalesG* is the sales growth rate, measured as the ratio of the previous year's sales to the current year's sales minus one. *OutcapR* is the ratio of capital expenditures in year t, scaled by total assets at the end of year t. *Lev* is book leverage, measured as the ratio of total debt to book value of equity at the end of year t. *CashAR* is cash holdings, calculated as the ratio of cash and cash equivalents divided by total assets. *TangiAR* is tangibility, measured as the ratio of fixed assets to total assets at the end of year t. *FixAG* is the ratio of fixed assets to total assets at the end of year t. *AssetG* is the asset growth rate, measured as the ratio of the previous year's assets to current year's assets minus one. *RD* is the R&D intensity, measured as the ratio of research and development expense to total book assets at the end of year t. *LabP* is labor productivity, calculated as the ratio of sales to the number of employees at the end of year t. *DivY* is the dividend yield, calculated as dividend per share/stock price per share at the end of year t. *Size* is firm size, calculated as the natural log of the book value of total assets at the end of year t. *Age* is firm age, calculated as the natural log of the number of days since first listing at the end of year t. (Source: Own elaboration).

The correlation coefficient between TQ and $Score^{G}$ is −0.035 while that between ROA and $Score^{G}$ is 0.142, all of which are statistically significant at 1% level. it is worthy to be pointed out that the direction of the correlation coefficients between firms' ESG scores and the two selected proxy variables for firm value are not consistent. That is, except E score ($Score^{E}$), all the correlation coefficients between TQ and $Score^{ESG}$, $Score^{S}$ or $Score^{G}$ are negative, while those for ROA are all positive. The correlation coefficients are not enough to determine the relationship between the variables. The relationship between firm value and ESG performance is also affected by industry, year, and other variables, so it needs to be further investigated by controlling other factors. Regarding the control variables, except $SalesG$, TQ is significantly correlated with other control variables. ROA is also significantly associated with all the other control variables except $SalesG$ and $DivY$.

Table 5. Correlation matrix.

	TQ	*ROA*	$Score^{ESG}$	$Score^{E}$	$Score^{S}$	$Score^{G}$	*SalesL*	*SalesG*	*OutcapR*	*Lev*	*CashAR*	*TangiAR*	*FixAG*	*AssetG*	*RD*	*LabP*	*DivY*	*Size*	*Age*
TQ	1																		
ROA	0.396 ***	1																	
$Score^{ESG}$	−0.169 ***	0.061 ***	1																
$Score^{E}$	−0.177 ***	−0.020	0.878 ***	1															
$Score^{S}$	−0.091 ***	0.101 ***	0.749 ***	0.415 ***	1														
$Score^{G}$	−0.035 **	0.142 ***	0.345 ***	0.064 ***	0.173 ***	1													
SalesL	−0.407 ***	−0.032 *	0.578 ***	0.468 ***	0.513 ***	0.173 ***	1												
SalesG	−0.016	0.012	0.003	−0.026	0.023	0.052 ***	0.014	1											
OutcapR	0.093 ***	0.155 ***	0.085 ***	0.023	0.109 ***	0.098 ***	−0.072 ***	0.000	1										
Lev	−0.205 ***	−0.292 ***	0.082 ***	0.114 ***	0.002	0.012	0.291 ***	0.008	−0.190 ***	1									
CashAR	0.286 ***	0.272 ***	−0.059 ***	−0.105 ***	0.022	0.017	−0.195 ***	0.002	−0.074 ***	−0.175 ***	1								
TangiAR	−0.039 **	−0.031 *	0.016	0.011	0.028	−0.013	0.141 ***	−0.015	−0.126 ***	0.139 ***	0.095 ***	1							
FixAG	0.056 ***	0.072 ***	−0.024	−0.032 *	−0.014	0.018	−0.047 ***	0.162 ***	0.081 ***	−0.009	0.010	−0.058 ***	1						
AssetG	0.065 ***	0.066 ***	0.014	−0.018	0.031 *	0.061 ***	−0.045 ***	0.063 ***	0.028 *	0.010	0.042 **	−0.069 ***	0.172 ***	1					
RD	−0.220 ***	0.272 ***	0.214 ***	0.199 ***	0.140 ***	0.077 ***	0.395 ***	−0.020	−0.087 ***	0.144 ***	−0.047 ***	0.047 ***	−0.015	−0.025	1				
LabP	0.273 ***	0.081 ***	−0.084 ***	−0.110 ***	−0.051 ***	0.059 ***	−0.238 ***	−0.016	0.011	−0.162 ***	0.185 ***	−0.025	0.062 ***	0.019	−0.151 ***	1			
DivY	−0.128 ***	0.018	0.162 ***	0.121 ***	0.143 ***	0.082 ***	0.268 ***	0.015	−0.098 ***	0.059 ***	−0.059 ***	0.091 ***	0.001	−0.016	0.111 ***	−0.133 ***	1		
Size	−0.448 ***	−0.136 ***	0.480 ***	0.442 ***	0.339 ***	0.142 ***	0.861 ***	0.005	−0.171 ***	0.479 ***	−0.229 ***	0.135 ***	−0.013	0.007	0.434 ***	−0.270 ***	0.186 ***	1	
Age	−0.175 ***	−0.131 ***	−0.019	0.002	0.004	−0.097 ***	0.082 ***	0.014	−0.120 ***	−0.039 **	−0.097 ***	−0.017	−0.057 ***	−0.028 *	−0.026	−0.074 ***	0.105 ***	0.015	1

Notes: This table presents the correlation matrix of all the variables used in our sample from 2010 to 2019. *TQ* represents Tobin's Q, which is measured as the ratio of the sum of the market value of equity and liabilities at the end of year t divided by the book value of the total asset at the end of year t. *ROA* is the return on assets, calculated as the ratio of net income to the book value of the total asset.$Score^{ESG}$, $Score^{E}$, $Score^{S}$ and $Score^{G}$ represent ESG, E, S, and G scores in year t, respectively. *SalesL* is the size of sales, calculated as the natural logarithm of sales volume in year t. *SalesG* is the sales growth rate, measured as the ratio of the previous year's sales to the current year's sales minus one. *OutcapR* is the ratio of capital expenditures in year t, scaled by total assets at the end of year t. *Lev* is book leverage, measured as the ratio of total debt to book value of equity at the end of year t. *CashAR* is cash holdings, calculated as the ratio of cash and cash equivalents divided by total assets. *TangiAR* is tangibility, measured as the ratio of fixed assets to total assets at the end of year t. *FixAG* is the ratio of fixed assets to total assets at the end of year t. *AssetG* is the asset growth rate, measured as the ratio of the previous year's assets to current year's assets minus one? *RD* is the R&D intensity, measured as the ratio of research and development expense to total book assets at the end of year t. *LabP* is labor productivity, calculated as the ratio of sales to the number of employees at the end of year t. *DivY* is the dividend yield, calculated as dividend per share/stock price per share at the end of year t. *Size* is firm size, calculated as the natural log of the book value of total assets at the end of year t. *Age* is firm age, calculated as the natural log of the number of days since first listing at the end of year t. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. (Source: Own elaboration).

5. Empirical Results

In this section, we analyze and discuss the empirical results for the four hypotheses H1, H1a, H1b, and H1c proposed in our study. We first estimate the baseline models specified in Equations (13)–(16). Then, we employ five robustness checks, including alternative dependent variable, alternative independent variable, advancing the dependent variable by one period, instrument variable (IV) regression and Heckman's two-stage estimation method. We also further discuss some heterogeneity in the final step.

5.1. ESG Score and Firm Value

Table 6 reports regression results of the impact of firms' ESG composite performance on firm value, using the model specified in Equation (13), which is employed to test the central hypothesis H1.

Table 6. Regression results for the impact of ESG score on firm value.

Dependent Variable	**(1)**	**(2)**	**(3)**	**(4)**
	TQ	*ROA*	*TQ*	*ROA*
$Score^{ESG}$	0.0301 **	0.0026 ***	0.0368 ***	0.0022 ***
	(2.194)	(3.056)	(2.939)	(2.947)
SalesL			0.2429 ***	0.0337 ***
			(3.104)	(11.038)
SalesG			−0.0042 ***	0.0001
			(−5.351)	(0.744)
OutcapR			0.2386	0.1860 ***
			(0.291)	(7.082)
Lev			0.0014	−0.0010 ***
			(0.955)	(−6.268)
CashAR			0.7768 **	0.1260 ***
			(2.271)	(9.329)
TangiAR			0.2456	0.0462 *
			(0.367)	(1.875)
FixAG			0.0619 *	0.0026 *
			(1.884)	(1.908)
AssetG			0.0370	0.0046 ***
			(1.216)	(5.035)
DivY			−0.3511	0.8207 ***
			(−0.267)	(11.544)
RD			0.0018	−0.0014 **
			(0.136)	(−2.436)
LabP			0.0000	0.0000 **
			(0.141)	(2.084)
Size			−0.6300 ***	−0.0314 ***
			(−6.832)	(−9.772)
Age			0.0707	−0.0076 ***
			(0.975)	(−4.103)
Constant	2.0450 ***	0.0258 *	10.1151 ***	−0.0381
	(8.277)	(1.687)	(6.014)	(−0.622)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	3609	3609	3609	3609
adj. R^2	0.1666	0.0527	0.2070	0.0455
F	37.94	13.77	21.04	47.14

Notes: This table presents regression results of the impact of firms' environmental, social and corporate governance (ESG) composite performance on firm value using the model specified in Equation (13). As shown in this table, columns (1) and (2) reported the estimation results of the fixed-effect regressions without control variables, and columns (3) and (4) show the results of the fixed-effects regression with control variables. The dependent variable in columns (1) and (3) is Tobin's Q (*TQ*), while that in columns (2) and (4) is the return on assets (*ROA*). $Score^{ESG}$ represents the ESG score. See Table 2 for definitions of the control variables. T-statistics are in parentheses. 0.0000 represents a value less than 0.0001. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. (Source: Own elaboration).

As shown in this table, columns (1) and (2) report the estimation results of the fixed-effect regressions without control variables, and columns (3) and (4) show the results of the fixed-effects regression with control variables. The dependent variable in columns (1) and (3) is Tobin's Q (TQ), while that in columns (2) and (4) is the return on assets (ROA). We concentrate on the coefficient of $Score^{ESG}$, reflecting the impact of ESG composite performance on firm value.

As can be seen in column (1) of Table 6, the estimated coefficient of $Score^{ESG}$ for TQ is 0.0301 and positively statistically significant at the 5% level. When other control variables are involved in the regression, the coefficient estimated coefficient of $Score^{ESG}$ for TQ is 0.0368, which is significant at the 1% level, as seen in column (3) of Table 6. It means that the comprehensive ESG performance of Chinese listed companies positively affects firm value measured by Tobin's Q. This result holds when controlling the influence from other factors such as firms' growth ability, scale, age, etc. When we change the proxy variable for firm value, the estimated coefficient of $Score^{ESG}$ for ROA is 0.0026 and positively statistically significant at 1% level.

Controlling other variables, the coefficient estimated coefficient of $Score^{ESG}$ for ROA is 0.0022, which is statistically significant at a 1% level, as seen in column (4) of Table 6. It suggests that the comprehensive ESG performance of Chinese listed companies also positively affects firm value measured by ROA. This result holds when controlling the influence of other factors. Summarized, the regression results support hypothesis H1: firms' environmental, social and corporate governance (ESG) composite performance positively affects firm value.

5.2. E Score and Firm Value

Table 7 reports regression results of the impact of firms' environmental (E) performance on firm value, using the model specified in Equation (14), which is employed to test the sub-hypothesis H1a. Similar to analysis for ESG composite performance, here we concentrate on the coefficient of $Score^{E}$, which reflects the impact of environmental (E) performance on firm value.

Table 7. Regression results for the impact of E score on firm value.

	(1)	**(2)**	**(3)**	**(4)**
	TQ	*ROA*	*TQ*	*ROA*
$Score^{E}$	0.0791 ***	0.0008	0.0856 ***	0.0011
	(4.229)	(0.787)	(4.800)	(1.189)
SalesL			0.1129 *	0.0342 ***
			(1.833)	(11.198)
SalesG			−0.0049 **	0.0001
			(−2.075)	(0.777)
OutcapR			−0.6909	0.1878 ***
			(−1.303)	(7.137)
Lev			0.0017	−0.0010 ***
			(0.513)	(−6.321)
			0.9901 ***	0.1286 ***
			(3.639)	(9.528)
TangiAR			−3.9936 ***	0.0442 *
			(−8.042)	(1.793)
FixAG			0.1008 ***	0.0026 *
			(3.729)	(1.903)
AssetG			0.0505 ***	0.0047 ***
			(2.716)	(5.126)
DivY			−6.3875 ***	0.8130 ***
			(−4.454)	(11.428)

Table 7. *Cont.*

	(1)	(2)	(3)	(4)
	TQ	*ROA*	*TQ*	*ROA*
RD			−0.0154	−0.0014 **
			(−1.318)	(−2.444)
LabP			−0.0000	0.0000 **
			(−0.635)	(2.114)
Size			−0.6729 ***	−0.0317 ***
			(−10.358)	(−9.825)
Age			0.0123	−0.0074 ***
			(0.329)	(−4.022)
Constant	1.5870 ***	0.0385 ***	18.5949 ***	−0.0099
	(17.928)	(8.364)	(15.277)	(−0.164)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	3609	3609	3609	3609
adj. R^2	0.2786	0.2864	0.1438	0.0482
F	17.89	0.619	25.96	46.50

Notes: This table presents regression results of the impact of firms' environmental (E) performance on firm value using the model specified in Equation (14). $Score^E$ represent the E score, *TQ* means Tobin's Q, and *ROA* is the return on assets. See Table 2 for definitions of the control variables. T-statistics are in parentheses. 0.0000 represents a value less than 0.0001. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. (Source: Own elaboration).

As in column (1) of Table 7, the estimated coefficient of $Score^E$ for *TQ* is 0.0791 and positively statistically significant at a 1% level. As reported in column (3) of Table 7, when other control variables are involved in the regression, the coefficient estimated coefficient of $Score^E$ for *TQ* is 0.0856, which is significant at 1% level. It means that firms' environmental performance positively affects firm value measured by Tobin's Q. This result holds when controlling the influence from other factors such as firms' growth ability, scale and age, etc.

However, as reported in columns (2) and (4) of Table 7, when we take *ROA* as the proxy variable of firm value, the estimated coefficients of $Score^E$ for *ROA* are 0.0008 and 0.0011, respectively, which are both positive but insignificant. It indicates that the performance of Chinese listed companies' environment (E) dimension has a fragile positive relationship with corporate profitability. As a whole, our results show that firms' environmental performance positively affects firm value measured as Tobin's Q significantly but positively affects that measured as *ROA* insignificantly. That is, the sub-hypothesis H1a cannot be supported by all the empirical results.

5.3. S Score and Firm Value

Table 8 shows regression results of the impact of firms' social (S) performance on firm value, using the model specified in Equation (15), which is employed to test the sub-hypothesis H1b. Here we concentrate on the estimated coefficient of $Score^S$, which reflects the impact of social (S) performance on firm value. As can be respectively seen in column (1) and column (3) of Table 8, the estimated coefficient of $Score^S$ for *TQ* in the regression without control variables is 0.0963 and that in the regression with control variables is 0.1069, all of which are statistically significant at 5% level, indicating that the social performance of companies positively affects their firm value measured as Tobin's Q.

As shown in column (2) of Table 8, the estimated coefficient of $Score^S$ for *ROA* in the regression without control variables is 0.0054, which is statistically significant at 5% significance level. As shown in column (4) of Table 8, the estimated coefficient of $Score^S$ for *ROA* in the regression with control variables is 0.0017, which is not statistically significant.

This means that under the control of other influencing factors, companies' performance score of social (S) responsibility is still positively correlated with firm value. The higher the social-dimension performance score, the higher profitability and firm value are. The impact of social performance on the firm value measured as Tobin's Q is larger than that on the firm

value measured as *ROA*. Overall, the empirical results above support the sub-hypothesis H1b, namely, firms' social (S) performance positively affects firm value.

Table 8. Regression results for the impact of S score on firm value.

Dependent Variable	**(1)**	**(2)**	**(3)**	**(4)**
	TQ	*ROA*	*TQ*	*ROA*
$Score^S$	0.0963 **	0.0054 **	0.1069 **	0.0017
	(2.170)	(2.334)	(2.488)	(0.850)
SalesL			0.2287 ***	0.0351 ***
			(2.872)	(3.773)
SalesG			−0.0043 ***	0.0001*
			(−5.665)	(1.841)
OutcapR			0.2182	0.1672 ***
			(0.268)	(2.674)
Lev			0.0010	−0.0010
			(0.682)	(−1.226)
CashAR			0.7999 **	0.1153 ***
			(2.342)	(6.946)
TangiAR			0.2548	0.0570
			(0.382)	(1.138)
FixAG			0.0621 *	0.0027
			(1.872)	(1.360)
AssetG			0.0364	0.0043 **
			(1.219)	(2.012)
DivY			−0.3326	0.8920 ***
			(−0.253)	(6.540)
RD			0.0008	−0.0002
			(0.061)	(−0.311)
LabP			0.0000	0.0000 ***
			(0.422)	(3.243)
Size			−0.6198 ***	−0.0283 *
			(−6.802)	(−1.947)
Age			0.0761	−0.0041 **
			(1.047)	(−2.388)
Constant	2.0197 ***	0.0400 ***	10.1776 ***	−0.1350
	(7.343)	(2.915)	(6.148)	(−0.748)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	3609	3609	3609	3609
adj. R^2	0.1677	0.0519	0.2079	0.2025
F	38.00	13.36	21.14	12.81

Notes: This table presents regression results of the impact of firms' social (S) performance on firm value using the model specified in Equation (15). $Score^S$ represent the S score, *TQ* means Tobin's Q, and *ROA* is the return on assets. See Table 2 for definitions of the control variables. T-statistics are in parentheses. 0.0000 represents a value less than 0.0001. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. (Source: Own elaboration).

5.4. G Score and Firm Value

Table 9 shows regression results of the impact of firms' corporate governance (G) performance on firm value, using the model specified in Equation (16), which is employed to test the sub-hypothesis H1c. As can be seen in column (1) of Table 9, the estimated coefficient of $Score^G$ for *TQ* is 0.1414 and positively statistically significant at 1% level. When other control variables are involved in the regression, the coefficient estimated coefficient of $Score^G$ for *TQ* is 0.1711, which is significant at 1% level, as seen in column (3) of Table 9. It means that the corporate governance performance of Chinese listed companies positively affects the firm value measured by Tobin's Q. This result holds when controlling the influence from other factors such as firms' growth ability, scale, age, etc.

Table 9. Regression results for the impact of G score on firm value.

Dependent Variable	**(1)**	**(2)**	**(3)**	**(4)**
	TQ	*ROA*	*TQ*	*ROA*
$Score^G$	0.1414 ***	0.0094 **	0.1711 **	0.0109 ***
	(2.578)	(2.260)	(1.994)	(2.837)
SalesL			0.2595 ***	0.0356 ***
			(3.355)	(3.861)
SalesG			−0.0045 ***	0.0001
			(−5.005)	(1.477)
OutcapR			0.2142	0.1666 ***
			(0.263)	(2.670)
Lev			0.0009	−0.0010
			(0.621)	(−1.234)
CashAR			0.7621 **	0.1124 ***
			(2.239)	(6.827)
TangiAR			0.2327	0.0566
			(0.349)	(1.138)
FixAG			0.0628 *	0.0027
			(1.933)	(1.380)
AssetG			0.0356	0.0042 **
			(1.189)	(1.982)
DivY			−0.2384	0.8964 ***
			(−0.179)	(6.520)
RD			0.0015	−0.0003
			(0.113)	(−0.442)
LabP			0.0000	0.0000 ***
			(0.057)	(3.030)
Size			−0.6365 ***	−0.0291 **
			(−7.048)	(−2.012)
Age			0.0527	−0.0058 ***
			(0.769)	(−3.023)
Constant	1.5592 ***	0.0036	9.4658 ***	−0.1832
	(3.873)	(0.118)	(5.572)	(−1.036)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	3609	3609	3609	3609
adj. R^2	0.0722	0.0521	0.2075	0.2054
F	57.00	12.86	20.96	12.74

Notes: This table presents regression results of the impact of firms' corporate governance (G) performance on firm value using the model specified in Equation (16). $Score^G$ represent the G score, *TQ* means Tobin's Q, and *ROA* is the return on assets. See Table 2 for definitions of the control variables. T-statistics are in parentheses. 0.0000 represents a value less than 0.0001. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. (Source: Own elaboration).

As can be seen in column (2) of Table 9, when we take the return on assets (*ROA*) as the proxy variable for firm value, the estimated coefficient of $Score^G$ for *ROA* in the regression without control variables is 0.0094, which is significant at 5% level. As seen in column (4) of Table 9, the estimated coefficient of $Score^G$ for *ROA* in the regression with control variables is 0.0109, which is significant at the 1% level. It suggests that corporate governance performance positively affects firm value measured by ROA. Summarized, the sub-hypothesis H1c can be held. Namely, firms' corporate governance performance positively affects firm value.

5.5. Robustness Checks

In previous subsections, we have found empirical evidence that overall support the four hypotheses H1, H1a, H1b, and H1c proposed in our study, namely, firms' ESG composite performance and corresponding three single dimension's performance (E, S, and G, respectively) positively affect firm value. In this subsection, we use several methods to re-examine the robustness of the conclusions obtained from the main regressions above, including replacing the dependent variable, replacing the independent variable, controlling

endogeneity caused by the possible reverse causality, instrumental variable (IV) estimation, and Heckman's two-stage estimation.

5.5.1. Alternative Dependent Variable

We employ an alternative proxy variable of firm value to execute an additional robustness check. Instead of Tobin's Q and ROA, we use the Market-to-Book ratio (MB) as a proxy variable for firm value, which is calculated as the ratio of the market value of equity to the book value of equity, similar to Ref. [10]. Using the alternative dependent variable, we re-estimate the regressions specified in Equations (13)–(16), respectively.

Table 10 reports the regression results. For space limitation, we focus on the estimated coefficients of ESG performance for firm value after controlling other factors, omitting the estimation results of control variables. As seen in this table, the estimated coefficient $Score^{ESG}$ is 0.0210, which is significant at the 10% level. The coefficient of $Score^{E}$ is 0.0720 and statistically significant at 1% level. The coefficient of $Score^{S}$ is 0.0294, which is significant at 5% level. The coefficient of $Score^{G}$ is 0.0702, which is significant at 1% level. Those results support the four hypotheses H1, H1a, H1b, and H1c, respectively, keeping in line with the main empirical results when taking TQ and ROA as proxy variables for firm value. That is, firms' ESG composite performance and three single-dimension's performance positively correlate with firm value.

Table 10. Regression results of the fixed-effects models for the alternative dependent variable (Market-to-Book).

Dependent Variable	**(1)**	**(2)**	**(3)**	**(4)**
	MB	*MB*	*MB*	*MB*
$Score^{ESG}$	0.0210 *			
	(1.686)			
$Score^{E}$		0.0720 ***		
		(5.437)		
$Score^{S}$			0.0294 **	
			(2.567)	
$Score^{G}$				0.0702 ***
				(6.737)
Constant	8.0171 ***	10.2319 ***	8.0185 ***	−1.8511 ***
	(12.107)	(11.223)	(12.433)	(−8.005)
Controls	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	3547	3547	3547	3547
adj. R^2	0.3611	0.163	0.3626	0.0762
F	38.75	22.57	38.77	40.10

Notes: This table presents regression results of the fixed-effects models for the alternative dependent variable, the market-to-book ratio (*MB*). Columns (1), (2), (3), and (4) report the estimation results of the fixed-effect regressions with control variables specified in Equations (13)–(16), respectively. $Score^{ESG}$, $Score^{E}$, $Score^{S}$ and $Score^{G}$ represent ESG, E, S, and G scores in year t, respectively. For space limitation, the estimation results of control variables are omitted from to report in this table. See Table 2 for the definition of the control variables in our study. T-statistics are in parentheses. 0.0000 represents a value less than 0.0001. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. (Source: Own elaboration).

5.5.2. Alternative Independent Variable

To test the robustness of our empirical results obtained from the baseline models, we take an alternative proxy for firms' ESG performance. In China, SynTao Green Finance ESG Ratings is the first ESG Rating, launched in June 2018. Its rating objects only cover the components of the Shenzhen-Shanghai 300 Index from 2015 to 2019 and the China Securities 500 Index from 2018 to 2019. Following SynTao Green Finance, there were some emerging third-party agencies to lunch ESG ratings for Chinese companies, such as China Social Value Investment Alliance ESG Rating (December 2019), Huazheng ESG Rating (April 2020), FTSE Russell ESG Rating (May 2020), Wind ESG Rating (June 2021), Sino-Securities

Index ESG Rating (July 2020), Dingli Corporate Governance TM (July 2021) and Weizhong Rating (July 2021). In terms of the presentation of ESG rating results, SynTao Green Finance, China Social Value Investment Alliance, Huazheng and Weizhong provide the graded ESG rating, while FTSE Russel, Wind, Sino-Securities Index, and Dingli Corporate Governance TM provide ESG scores. Among them, only the Wind ESG rating provides scores for the three single sub-dimensions (E, S, and G), but it just covers A-share listed firms after 2018. Besides, the number of Chinese A-share listed companies that are covered in the international ESG rating agencies, such as Thomson Reuters and Bloomberg, is very limited. In other words, it is hard to find existing ESG rating data that can cover our sample from 2010 to 2019. Thus, we choose the corporate social responsibility (CSR) sore that was launched by Hexun Information Technology Co. LTD (hereafter, Hexun) in 2010 to check the robustness of our conclusion and the effectiveness of the ESG rating score proposed in our study indirectly. We use the corporate social responsibility rating score obtained from the Hexun's CSR database as the alternative explanatory variable to re-test the impact of ESG performance on firm value. Hexun's CSR rating system consists of five parts: Shareholder responsibility, Employee responsibility, Supplier, customer and consumer rights responsibility, Environmental responsibility, and Social responsibility. Specifically, we take the total CSR score (CSR_HX) as the alternative variable for $Score^{ESG}$. We take the summing score of the three sub-dimensions, which include employee responsibility, customer and consumer rights responsibility, and social responsibility check, as the alternative variable for $Score^{S}$. We respectively take the environmental responsibility score and the shareholder responsibility as the alternative variables for $Score^{E}$ and $Score^{G}$. Using the alternative independent variable, we re-estimate the regressions specified in Equations (13)–(16). Tables 11 and 12 show the estimated results. All the estimated coefficients of CSR_HX for TQ, ROA, and MB are positive and significant (Table 11).

Table 11. Regression results of the fixed-effects models with the alternative explanatory variable (CSR_HX).

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	TQ	*ROA*	*MB*	*TQ*	*ROA*	*MB*
CSR_HX	0.0028 ***	0.0009 ***	0.0013 ***	0.0024 **	0.0007 ***	0.0014 ***
	(2.754)	(11.434)	(3.991)	(2.304)	(12.036)	(5.116)
SalesL				0.2410 ***	0.0325 ***	0.1386 ***
				(3.081)	(10.830)	(9.194)
SalesG				−0.0045 ***	0.0001	−0.0015 ***
				(−6.432)	(0.488)	(−2.768)
OutcapR				0.3149	0.1507 ***	0.3799 ***
				(0.467)	(5.776)	(2.876)
Lev				0.0016	−0.0010 ***	0.0002
				(1.104)	(−6.463)	(0.171)
CashAR				0.7576 **	0.1041 ***	0.0340
				(2.385)	(7.789)	(0.506)
TangiAR				0.2889	0.0792 ***	0.2634 **
				(0.424)	(3.309)	(2.197)
FixAG				0.0611 *	0.0028 **	0.0098
				(1.850)	(2.163)	(1.513)
AssetG				0.0286	0.0037 ***	0.0043
				(1.038)	(4.125)	(0.978)
DivY				−0.6970	0.7672 ***	−1.2291 ***
				(−0.531)	(10.659)	(−3.467)

Table 11. *Cont.*

	(1)	(2)	(3)	(4)	(5)	(6)
	TQ	*ROA*	*MB*	*TQ*	*ROA*	*MB*
RD				0.0057	−0.0002	0.0029
				(0.427)	(−0.336)	(0.942)
LabP				−0.0000	0.0000 **	−0.0000
				(−0.677)	(2.073)	(−0.619)
Size				−0.5340 ***	−0.0272 ***	−0.2940 ***
				(−4.759)	(−7.893)	(−16.354)
Age				0.0722	−0.0035 *	0.1251 ***
				(0.908)	(−1.746)	(9.229)
Constant	2.4099 ***	0.0191 ***	5.1278 ***	8.3922 ***	−0.1522 **	7.5925 ***
	(23.094)	(3.521)	(169.551)	(4.608)	(−2.169)	(21.081)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3580	3580	3520	3580	3580	3520
adj. R^2	0.1740	0.1236	0.2752	0.2026	0.0264	0.1736
F	38.40	23.83	74.84	20.24	39.78	67.53

Notes: This table presents regression results of the impact of firms' ESG composite performance on firm value using the alternative independent variable (*CSR_HX*), which is the corporate social responsibility rating score obtained from Hexun's CSR database. Columns (1), (2) and (3) show the estimation results of the fixed-effect regressions without control variables. Columns (4), (5) and (6) show the results of the fixed-effects regression with control variables. See Table 2 for definitions of the control variables. The dependent variable in columns (1) and (4) is Tobin's Q (*TQ*), that in columns (2) and (5) is the return on assets (*ROA*), while that in columns (3) and (6) is the market-to-book ratio (*MB*). T-statistics are in parentheses. 0.0000 represents a value less than 0.0001. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. (Source: Own elaboration).

Except the coefficients of *E_HX* and *S_HX* for TQ are not statistically significant (Table 12), all the other estimated coefficients of *E_HX* and *S_HX* for ROA and MB are significantly positive, and the estimated coefficients of *G_HX* for TQ, ROA and MB are all positively significant. It suggests that the main conclusions obtained from the baseline models can hold when we take the Hexun's CSR scores as proxies of ESG performance. It also indirectly highlights that the ESG rating scores calculated by the method proposed in our study can reflect firms' environmental, social and governance performance. The better ESG performance, the better firm value is.

5.5.3. Advancing the Dependent Variable by One Period

To solve the endogeneity problem caused by the possible reverse causality between ESG performance and firm value, we continue to re-estimate the regressions specified in Equations (13)–(16) with advancing the dependent variable by one period, respectively. Table 13 shows regression results of the fixed-effect models with advancing dependent variables by one period.

As shown in Panel A of Table 13, the coefficient of $Score^{ESG}{}_t$ for TQ_{t+1} is 0.0317, which is statistically significant at the 5% level. The coefficient of $Score^{ESG}{}_t$ for ROA_{t+1} is 0.0023, which is statistically significant at the 1% level. The coefficient of $Score^{ESG}{}_t$ for MB_{t+1} is 0.0645, which is statistically significant at the 10% level. This highlights that firms' comprehensive environmental, social and corporate governance (ESG) performance is still statistically positively related to firm value after controlling for endogeneity problems that may be caused by reverse causality. Besides, the conclusion still holds whether TQ, ROA or MB is used as the measurement proxy for firm value. Summarized, regression results of the fixed-effect models with advancing dependent variable by one period provide evidence supporting hypothesis H1, indicating that the conclusion obtained in the primary regression is robust.

Table 12. Regression results of the fixed-effects models with the alternative explanatory variables (*E_HX*, *S_HX*, and *G_HX*).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	TQ	*ROA*	*MB*	*TQ*	*ROA*	*MB*	*TQ*	*ROA*	*MB*
E_HX	0.0033	0.0003 **	0.0023 ***						
	(1.236)	(2.068)	(3.178)						
S_HX				0.0006	0.0004 ***	0.0009 *			
				(0.335)	(4.429)	(1.954)			
G_HX							0.0269 ***	0.0074 ***	0.0119 ***
							(5.129)	(41.306)	(10.902)
Constant	8.3984 ***	−0.1435 **	7.5955 ***	8.4210 ***	−0.1511 **	7.5923 ***	8.9708 ***	0.0078	7.8481 ***
	(4.588)	(−1.994)	(21.025)	(4.584)	(−2.105)	(20.983)	(5.024)	(0.138)	(22.119)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3580	3580	3520	3580	3580	3520	3580	3580	3520
adj. R^2	0.2013	−0.0231	0.1687	0.2009	−0.0175	0.1668	0.2151	0.3667	0.2007
F	20.36	32.05	66.44	20.09	32.89	66.01	20.71	125.7	73.81

Notes: This table presents regression results of the impact of firms' E, S, and G performance on firm value using the alternative independent variables, namely, *E_HX*, *S_HX* and *G_HX*, respectively. Since the corporate social responsibility rating sore (*CSR_HX*) obtained from Hexun's CSR database consists of five dimensions: Shareholder responsibility, Employee responsibility, Supplier, customer and consumer rights responsibility, Environmental responsibility, and Social responsibility. In order to compare with the ESG rating scores proposed in our study, we take the score of environmental responsibility as a proxy of environmental performance, which is marked as *E_HX*. We take the total score of employee responsibility, Supplier, customer and consumer rights responsibility, and social responsibility as a proxy of social performance, which is defined as *S_HX*. We take the shareholder responsibility as a proxy of corporate governance performance, which is marked as *G_HX*. Columns (1), (2) and (3) show the estimation results for the impact of *E_HX* on firm value. Columns (4), (5) and (6) show the estimation results for the impact of *S_HX* on firm value, while columns (7), (8) and (9) show the estimation results for the impact of *G_HX*. For space limitation, the estimation results of control variables are omitted in this table. See Table 2 for definitions of the control variables. *TQ* means Tobin's Q, and *ROA* is the return on assets, and *MB* is the market-to-book ratio. T-statistics are in parentheses. 0.0000 represents a value less than 0.0001. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. (Source: Own elaboration).

As reported in Panel B of Table 13, the estimated coefficients of $Score^E{}_t$ for TQ_{t+1}, ROA_{t+1} and MB_{t+1} are 0.0347, 0.0022, and 0.0252, respectively, all of which are statistically significant at the 5% level. This means that, after controlling for the endogeneity problems that may be caused by reverse causality, the environmental (E) dimension performance of listed companies still has a positive relationship with corporate value. Moreover, this positive relationship holds regardless of whether ROA or MB is used as the measurement proxy for firm value. Those results support hypothesis H1a again.

As reported in Panel C of Table 13, the estimated coefficients of $Score^S{}_t$ for TQ_{t+1},ROA_{t+1} and MB_{t+1} are 0.0734, 0.0038, and 0.0726, respectively, with the corresponding statistical significance level respectively being 5%, 10%, and 1%. This indicates that, after controlling for the endogeneity problems caused by possible reverse causality, the social responsibility (S) dimension performance of listed companies still has a positive relationship with corporate value. Moreover, this positive relationship will not change with the replacement of the proxy variable for firm value, which again supports hypothesis H1b.

As seen in Panel D of Table 13, the estimated coefficient of $Score^G{}_t$ for TQ_{t+1} is 0.0151, which is positive but not statistically significant. The estimated coefficients of $Score^G{}_t$ for ROA_{t+1} and MB_{t+1} are 0.0098 and 0.1495, respectively significant at 10% and 1% levels. This means that, after controlling for endogeneity problems caused by possible reverse causality, the performance of governance dimension (G) of Chinese listed companies is significantly positively correlated with the firm value, which is measured as ROA and MB rather than that measured as TQ. In other words, hypothesis H1c is partly supported.

Table 13. Regression results of the fixed-effect models with advancing dependent variable by one stage.

	(1)	**(2)**	**(3)**
	TQ_{t+1}	ROA_{t+1}	MB_{t+1}
Panel A: Effect of ESG score on firm value			
$Score^{ESG}{}_t$	0.0317 **	0.0023 ***	0.0645 *
	(2.400)	(2.708)	(1.837)
Constant	10.9077 ***	0.4882 ***	8.6200 ***
	(3.608)	(3.704)	(2.849)
Controls	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	3567	3609	3567
adj. R^2	0.1772	0.0715	0.1588
F	21.07	5.820	16.68
Panel B: Effect of E score on firm value			
$Score^{E}{}_t$	0.0349 **	0.0022 **	0.0252 **
	(2.442)	(2.358)	(1.980)
Constant	11.0701 ***	0.4995 ***	8.7325 ***
	(3.624)	(3.764)	(2.862)
Controls	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	3567	3609	3567
adj. R^2	0.1770	0.0708	0.1588
F	21.10	5.829	16.64
Panel C: Effect of S score on firm value			
$Score^{S}{}_t$	0.0734 **	0.0038 *	0.0726 ***
	(2.555)	(1.800)	(2.749)
Constant	10.9799 ***	−0.3188 **	8.6586 ***
	(3.663)	(−2.175)	(2.894)
Controls	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	3567	2422	3567
adj. R^2	0.1770	0.2973	0.1597
F	21.37	13.70	17.04
Panel D: Effect of G score on firm value			
$Score^{G}{}_t$	0.0151	0.0098 *	0.1495 ***
	(0.151)	(1.724)	(3.161)
Constant	13.8153 ***	−0.3620 **	9.3649 ***
	(6.819)	(−2.358)	(3.016)
Controls	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	2422	2422	3567
adj. R^2	0.2631	0.2984	0.1606
F	16.07	13.62	16.89

Notes: This table presents the egression results of the fixed-effect models with advancing dependent variables by one stage. The sample period of dependent variables is from 2011 to 2020, while that of explanatory variables is from 2010 to 2019. Panel A, B, C, and D report the results of models specified in Equations (13)–(16), respectively. $Score^{ESG}{}_t$, $Score^{E}{}_t$, $Score^{S}{}_t$ and $Score^{G}{}_t$ represent ESG, E, S, and G scores in year t, respectively. The estimation results of control variables are omitted in this table for space limitation. T-statistics are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. (Source: Own elaboration).

5.5.4. Instrument Variable (IV) Regression

Next, we use an instrumental variable (IV) regression method to further test whether the previous conclusion is disturbed by the endogeneity problem between ESG performance and firm value. Referring to Attig et al. (2013) and El Ghoul et al. (2011) [53,54], the industry-year average of ESG composite score (*ESG_ind*), the industry-year average of E score (*E_ind*), the industry-year average of S score (*S_ind*) and the industry-year average

of G score (*G_ind*) are used as instrumental variables. Finally, we employ a two-step regression to estimate the IV model.

Table 14 shows regression results of the instrumental variable (IV) model for ESG composite score and firm value. In the first stage, the estimated coefficient of *ESG_ind* is 1.0215 and statistically significant at 1% level, indicating that ESG comprehensive performance ($Score^{ESG}$) is positively and significantly correlated with its instrumental variable (*ESG_ind*), namely, firms' ESG comprehensive performance is highly correlated with the average ESG performance in their industry. In the second stage, the coefficients of $Score^{ESG}$ for TQ, ROA and *MB* are 0.3074, 0.0042 and 0.2601, respectively, all of which are positive and statistically significant.

Table 14. Results of the 2SLS regression for ESG composite score and firm value.

Dependent Variable	**(1)**	**(2)**	**(3)**	**(4)**
	First Stage	**Second Stage**		
	$Score^{ESG}$	*TQ*	*ROA*	*MB*
$Score^{ESG}$		0.3074 ***	0.0042 **	0.2601 ***
		(9.090)	(2.383)	(8.953)
ESG_ind	1.0215 ***			
	(24.39)			
SalesL	0.5807 ***	−0.1064 ***	0.0120 ***	−0.0803 **
	(14.250)	(−2.869)	(6.960)	(−2.462)
SalesG	−0.0004	−0.0038 **	0.0000	−0.0023
	(−0.180)	(−1.963)	(0.356)	(−1.406)
OutcapR	1.7669 ***	−0.1053	0.1707 ***	−0.3726
	(3.310)	(−0.236)	(7.762)	(−0.977)
Lev	−0.0105 ***	0.0060 *	−0.0011 ***	0.0039
	(−2.830)	(1.949)	(−6.624)	(1.113)
CashAR	0.9349 ***	1.0656 ***	0.1260 ***	0.2211
	(3.600)	(4.846)	(12.050)	(1.174)
TangiAR	−0.6948 *	0.2389	0.0019	0.5371 **
	(−1.900)	(0.789)	(0.140)	(2.033)
FixAG	−0.0098	0.0596 ***	0.0034 ***	0.0235
	(−0.400)	(2.923)	(3.424)	(1.352)
AssetG	0.0219	0.0386 **	0.0033 ***	−0.0045
	(1.160)	(2.485)	(4.156)	(−0.345)
DivY	0.5826	−3.9317 ***	1.1111 ***	−4.5724 ***
	(0.380)	(−3.109)	(17.650)	(−4.273)
RD	0.0516 ***	0.0215 ***	−0.0003	0.0123 *
	(5.500)	(2.857)	(−0.796)	(1.890)
LabP	0.0001	−0.0001	0.0000 **	−0.0001
	(1.420)	(−1.247)	(2.371)	(−1.273)
Size	−0.0200	−0.3499 ***	−0.0162 ***	−0.3040 ***
	(−0.530)	(−11.302)	(−12.098)	(−11.073)
Age	0.0650 **	−0.0560 **	−0.0073 ***	0.1088 ***
	(2.370)	(−2.487)	(−7.057)	(4.514)
Constant	−13.5044 ***	7.3109 ***	0.0980 ***	4.8189 ***
	(−13.280)	(12.599)	(3.926)	(9.168)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	3609	3609	3609	3547

Notes: This table presents the results of the 2SLS regression for ESG composite score and firm value. The industry-year average of the ESG composite score (*ESG_ind*) is selected as an instrumental variable. $Score^{ESG}$ represents ESG score. Column (1) reports the estimation results in the first stage, which $Score^{ESG}$ is the dependent variable and *ESG_ind* the independent variable. Columns (2), (3), and (4) show the regression results of the second stage, in which Tobin's Q (*TQ*), return on assets (*ROA*), and market-to-book ratio (*MB*) are the dependent variables, respectively. See Table 2 for definitions of the control variables. T-statistics are in parentheses. 0.0000 represents a value less than 0.0001. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. (Source: Own elaboration).

The results show that endogeneity does not drive our main results, namely, the regression results of the instrumental variable model once again support hypothesis H1.

Panel A, B, and C of Table 15, respectively report regression results of the IV model for impacts of the three single dimension scores (E, S, and G) on firm value, in which the estimated results for the control variables are ignored for space limitation. We concentrate on results in the second stage. As shown in Panel A of Table 15, the coefficients of $Score^E$ for TQ, ROA and *MB* are respectively 0.2224, −0.0090, and 0.0791, as shown in column (4) of Panel A of Table 15. The coefficient of $Score^E$ for TQ is statistically significant at the 5% level, that for ROA is statistically significant at the 10% level, while that for *MB* is insignificant. This shows that, after controlling for endogeneity, environmental performance still significantly positively correlates with Tobin's Q, which is consistent with the previous conclusion. It is still positively correlated with MB, but insignificant, which is slightly different from the previous conclusion. Interestingly, using the instrumental variable method, the performance of environment (E) dimension has a significant negative relationship with ROA. In other words, those results cannot fully support hypothesis H1a.

Table 15. Results of the 2SLS regressions for the three single-dimension scores (E, S, and G) and firm value.

Dependent Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	First Stage			**Second Stage**		
	$Score^E$	$Score^S$	$Score^G$	*TQ*	*ROA*	*MB*
Panel A: E score and firm value						
$Score^E$				0.2224 **	−0.0090 *	0.0791
				(2.357)	(−1.655)	(1.051)
E_ind	0.8569 ***					
	(9.890)					
Controls	Yes			Yes	Yes	Yes
Industry FE	Yes			Yes	Yes	Yes
Year FE	Yes			Yes	Yes	Yes
Observations	3609			3609	3609	3547
Panel B: S score and firm value						
$Score^S$				0.3291 ***	0.0033	0.2287 ***
				(4.490)	(0.875)	(3.600)
S_ind		0.9825 ***				
		(26.020)				
Controls		Yes		Yes	Yes	Yes
Industry FE		Yes		Yes	Yes	Yes
Year FE		Yes		Yes	Yes	Yes
Observations		3609		3609	3609	3547
Panel C: G score and firm value						
$Score^G$				−0.4945 ***	0.0161 ***	−0.4993 ***
				(−5.167)	(3.211)	(−6.347)
G_ind			0.9852 ***			
			(33.050)			
Controls			Yes	Yes	Yes	Yes
Industry FE			Yes	Yes	Yes	Yes
Year FE			Yes	Yes	Yes	Yes
Observations			3609	3609	3609	3547

Notes: This table presents the results of the 2SLS regressions that estimate the impact of the three single-dimension scores (E, S, and G scores) on firm value. $Score^E$, $Score^S$ and $Score^G$ represent E, S, and G scores, respectively. *E_ind* means the industry-year average of the E score, *S_ind* means the industry-year average of the S score and *G_ind* means the industry-year average of the G score. The estimation results of control variables are omitted in this table for space limitation. See Table 2 for definitions of the control variables. Columns (1), (2), and (3) report the estimation results in the first stage, in which $Score^E$ $Score^S$ and $Score^G$ are the dependent variables, while *E_ind S_ind* and *G_ind* are the corresponding independent variables, respectively. Columns (4), (5), and (6) show the regression results of the second stage, in which Tobin's Q (*TQ*), return on assets (*ROA*), and market-to-book ratio (*MB*) are the dependent variables, respectively. T-statistics are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. (Source: Own elaboration).

As shown in Panel B of Table 15, when TQ is used as the proxy variable of firm value, the coefficient of $Score^S$ is 0.3291, which is significant at the 1% level. When ROA is used as the proxy variable of firm value, the coefficient of $Score^S$ is 0.0033, which is not statistically significant. When MB is used as a proxy variable for firm value, the coefficient of $Score^S$ is 0.2287, which is significant at the 1% level.

This shows that the social dimension performance of companies is still significantly positively correlated with Tobin's Q and market-to-book ratio, after controlling for the endogeneity. It also has a positive impact on ROA, but the effect is weak. Summarized, the results support hypothesis H1b.

As can be seen in Panel C of Table 15, the coefficient of $Score^G$ for TQ, ROA and MB are respectively -0.4945, 0.0161, and -0.4993, all of which are significant at 1% level. After controlling for the endogeneity, the performance of the G-dimension is still significantly positively correlated with ROA, which is consistent with the previous conclusion. However, when the instrumental variable estimation is adopted, the relationship between corporate governance performance and TQ or MB becomes negative, which contradicts the previous conclusion. It highlights that the positive relationship between G-dimension performance and firm value is unstable. Therefore, those results cannot fully support hypothesis H1c.

5.5.5. Heckman Two-Stage Estimation Method

To solve the endogeneity problem that may be caused by sample selection bias, that is, the positive relationship between ESG performance and firm value may be due to the biased regression results caused by the fact that the samples are all listed companies with high ESG performance, we refer to Ref. [12] and use Heckman's (1979) two-stage estimation procedure to correct the potential specification for endogeneity [55]. We redefine the ESG composite performance, E-dimension performance, S-dimension performance, and G-dimension performance into dummy variables, namely, *ESG_dum*, *E_dum*, *S_dum* and *G_dum*, respectively. If a firm's ESG score is greater than the median value of ESG scores in its industry at period t, the value of *ESG_dum* is set to 1, otherwise, it is 0. The value of *E_dum*, *S_dum* and *G_dum* are developed similarly.

In the first stage, probit model regressions are carried out, in which *ESG_dum*, *E_dum*, *S_dum* and *G_dum* are used as the dependent variable, respectively. Besides all the control variables from the baseline models described in Table 2, the instrument variables (*ESG_ind*, *E_ind*, *S_ind* and *G_ind*) are also respectively used as additional control variables in the first-stage probit model regressions. The estimated parameters from the first-stage probit model regressions are respectively used to calculate the self-selection parameters (*emr_ESG*, *emr_E*, *emr_S* and *emr_G*), which are also called inverse Mill's ratios. In the second stage, we incorporate the inverse Mills ratios as additional control variables to re-estimate the regressions specified in Equations (13)–(16), where the dummy variables (*ESG_dum*, *E_dum*, *S_dum* and *G_dum*) are respectively used to replace the original corresponding explanatory variables ($Score^{ESG}$, $Score^E$, $Score^S$ and $Score^G$).

Table 16 summarizes the estimated results of Heckman's two-stage regression models for testing whether ESG performance enhances firm value. Panel A, B, C, and D of Table 16 report estimated results for the impacts of ESG, E, S, and G performances on firm value, respectively. The coefficients of *emr_ESG*, *emr_E*, *emr_S* and *emr_G* are all significant in the second-stage regression, implying that firm value is significantly influenced by the firm characteristics making them choose to perform more ESG-related activities.

Table 16. Results of Heckman's two-stage regressions for the testing impact of ESG on firm value.

Dependent Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
	First Stage				**Second Stage**		
	ESG_dum	*E_dum*	*S_dum*	*G_dum*	*TQ*	*ROA*	*MB*
Panel A: Heckman two-stage regressions with ESG composite performance							
ESG_dum					0.0981 **	0.0019	0.0601 *
					(2.548)	(0.921)	(1.773)
emr_ESG					−0.3807 ***	−0.0179 ***	−0.5176 ***
					(−3.523)	(−6.465)	(−5.225)
ESG_ind	0.7618 ***						
	(5.443)						
Controls	Yes				Yes	Yes	Yes
Industry FE	Yes				Yes	Yes	Yes
Year FE	Yes				Yes	Yes	Yes
Observations	3609				3609	3609	3547
Panel B: Heckman two-stage regressions with E-dimension performance							
E_dum					0.0760 *	−0.0005	0.0714 *
					(1.807)	(−0.243)	(1.950)
emr_E					−0.6999 ***	−0.0135 **	−0.7309 ***
					(−7.358)	(−2.481)	(−9.599)
E_ind		0.9799 ***					
		(15.924)					
Controls		Yes			Yes	Yes	Yes
Industry FE		Yes			Yes	Yes	Yes
Year FE		Yes			Yes	Yes	Yes
Observations		3609			3609	3609	3547
Panel C: Heckman two-stage regressions with S-dimension performance							
S_dum					0.1017 **	0.0004	0.0900 **
					(2.322)	(0.170)	(2.473)
emr_S					−0.2711 ***	−0.0042	−0.1283 **
					(−3.618)	(−1.140)	(−2.164)
S_ind			1.9121 ***				
			(16.549)				
Controls			Yes		Yes	Yes	Yes
Industry FE			Yes		Yes	Yes	Yes
Year FE			Yes		Yes	Yes	Yes
Observations			3609		3609	3609	3547
Panel D: Heckman two-stage regressions with G-dimension performance							
G_dum					0.0596 *	0.0059 ***	0.0545 *
					(1.704)	(2.893)	(1.662)
emr_G					1.1678 ***	−0.0627 ***	0.2577 ***
					(3.308)	(−3.599)	(4.723)
G_ind				1.0464			
				(0.945)			
Controls				Yes	Yes	Yes	Yes
Industry FE				Yes	Yes	Yes	Yes
Year FE				Yes	Yes	Yes	Yes
Observations				3609	3609	3609	3547

Notes: This table presents the results of Heckman's two-stage regressions. Panel A, B, C, and D report estimated results for the impacts of ESG composite performance, E-, S- and G-dimension performance on firm value, respectively. Columns (1), (2), (3), and (4) summarize the results of the first-stage probit model regressions. Columns (5), (6), and (7) summarize the estimated results of the second-stage OLS regressions. The estimation results of control variables are omitted in this table for space limitation. See Table 2 for definitions of the control variables. T-statistics are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. (Source: Own elaboration).

The second-stage regression results in column (5) of Table 16 suggest that the positive impact of ESG performance on firm value which is measured by Tobin's Q (TQ) is maintained, where the estimated coefficients of *ESG_dum*, *E_dum*, *S_dum* and *G_dum* for TQ respectively are 0.0981 (t-statistics = 2.548), 0.0760 (t-statistics = 1.807), 0.1017

(t-statistics = 2.322) and 0.0596 (t-statistics = 1.704). Following the same procedure, we implement robustness tests for the other two proxies of firm value.

As shown in column (7) of Table 16, the positive relationship between ESG performance on firm value is also maintained when MB is used as a proxy variable. Consequently, our hypotheses H1, H1a, H1b, and H1c still hold. As a whole, no matter which robustness test method is adopted, the research concluded that ESG comprehensive performance is significantly positively correlated with firm value is valid, supporting hypothesis H1. The study concluded that the social (S) dimension performance is significantly positively correlated with firm value is also valid, supporting hypothesis H1a. However, the positive relationship between the performance of environment (E) dimension and corporate governance (G) dimension of listed companies and corporate value does not entirely pass all the robustness tests mentioned above, indicating that these two positive relationships are not stable, namely the hypotheses H1b, and H1c conditionally hold.

5.6. Further Discussion: Heterogeneity

In this subsection, we further discuss heterogeneities in the relationship between ESG and firm value. In 2003, China's Environmental Protection Bureau issued a policy requiring companies on the key pollution monitoring list to disclose environmental information. Those companies on the list are viewed as key pollution-monitored firms, while those not on the list are marked as non-key pollution-monitored firms. In our sample, the number of non-key pollution monitored firms accounts for 72%, and that of key pollution monitored firms accounts for 28%. Except for key pollution-monitored firms, China Securities Regulatory Commission (CSRC) issued policies to mandate four types of listed companies to disclose their annual standalone CSR reports, including constituent stocks of the Shenzhen 100 Index, constituent stocks of the Shanghai Corporate Governance Index, listed financial enterprises in Shanghai Stock Exchange and those listed companies who issue overseas shares in Shanghai Stock Exchange since 2008.

Although there is no relevant policy explicitly requiring state-owned listed companies to disclose environmental and social responsibility information, the ratio of state-owned enterprises (about 64%) in our sample is higher than that of non-state-owned enterprises (about 36%), in which more than ninety percent of state-owned firms are in the four types of companies that are mandated to disclose ESG information. It indicates that state-owned listed companies and non-state-owned listed companies have differences in ESG disclosure willingness, and there is also a difference between key and non-key pollution-monitored firms. Therefore, it is necessary to examine heterogeneities by dividing our total sample into subsamples according to pollution status (key or non-key pollution-monitored firms) and enterprise attributes (state-owned or non-state-owned firms). Using the sub-samples, we re-estimate the regressions specified in Equations (13)–(16), respectively.

5.6.1. State-Owned and Non-State-Owned Firms

Table 17 reports comparing the results of state-owned and non-state-owned firms. In this table, columns (1), (2), (3), and (4) respectively show estimated results of the impact of $Score^{ESG}$, $Score^{E}$,$Score^{S}$ and $Score^{G}$ on firm value for state-owned listed companies, while columns (5), (6), (7) and (8) respectively show those for non-state-owned listed companies. Similar to the previous subsection, Tobin's Q (TQ), return on assets (ROA), and market-to-book ratio (MB) are taken as proxies of firm value, corresponding results being respectively shown in Panel A, B, and C of Table 17.

Table 17. Comparing results of state-owned or non-state-owned firms.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	State-Owned Firms				**Non-State-Owned Firms**			
Panel A: Dependent variable-TQ								
$Score^{ESG}$	0.0522 ***				0.0869 ***			
	(3.868)				(2.947)			
$Score^{E}$		0.0483 ***				0.1678 ***		
		(3.049)				(4.634)		
$Score^{S}$			0.1091 **				0.1082 *	
			(2.052)				(1.684)	
$Score^{G}$				−0.1762 ***				0.3769 ***
				(−3.174)				(3.192)
adj R^2	−0.0805	−0.0838	0.2146	−0.0834	−0.0290	−0.2366	0.2465	0.2576
F	21.19	20.72	17.73	20.79	14.50	8.086	14.52	14.20
Panel B: Dependent variable-ROA								
$Score^{ESG}$	0.0021 **				0.0010			
	(2.300)				(0.696)			
$Score^{E}$		0.0012				0.0014		
		(1.161)				(0.861)		
$Score^{S}$			0.0025				0.0022	
			(1.140)				(0.621)	
$Score^{G}$				0.0128 ***				0.0120 **
				(3.470)				(2.274)
adj R^2	0.0354	0.0333	0.0333	0.0389	−0.1181	−0.1601	−0.1182	0.1928
F	39.55	39.19	39.18	40.18	10.14	13.02	10.13	6.113
Panel C: Dependent variable-MB								
$Score^{ESG}$	0.0429 ***				0.0432 *			
	(3.633)				(1.778)			
$Score^{E}$		0.0486 ***				0.1347 ***		
		(3.500)				(4.531)		
$Score^{S}$			0.1235 ***				0.0829 **	
			(4.072)				(1.995)	
$Score^{G}$				−0.1235 *				0.0690
				(−1.959)				(0.876)
adj R^2	−0.1174	−0.1180	0.2704	0.0077	−0.0133	−0.2220	0.1736	0.2659
F	16.21	16.14	33.53	21.42	15.32	9.235	23.49	17.87
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2276	2276	2276	2276	1271	1271	1271	1271

Notes: This table reports comparing the results of state-owned and non-state-owned firms. Columns (1), (2), (3), and (4) respectively show estimated results of the impact of $Score^{ESG}$, $Score^{E}$, $Score^{S}$ and $Score^{G}$ on firm value for state-owned listed companies, while columns (5), (6), (7) and (8) respectively show those for non-state-owned listed companies. Tobin's Q (TQ), return on assets (ROA), and market-to-book ratio (MB) are taken as proxies of firm value, corresponding estimated results being respectively shown in Panel A, B, and C of this table. The estimation results of control variables are omitted in this table for space limitation. See Table 2 for definitions of the control variables. T-statistics are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. (Source: Own elaboration).

Firstly, we compare the estimated results of state-owned and non-state-owned firms on the relationship between ESG composite performance and firm value (Table 17, Columns (1) and (5)). For state-owned firms, the estimated coefficients of $Score^{ESG}$ for TQ, ROA, and MB, respectively, are 0.0522 (t-statistics = 3.868), 0.0021 (t-statistics = 2.300), and 0.0429 (t-statistics = 3.633), highlighting a significantly positive relationship between ESG composite performance and firm value for state-owned enterprises, on matter which proxy variable is used for firm value. For non-state-owned firms, the estimated coefficients of $Score^{ESG}$ for TQ, ROA and MB respectively are 0.0869 (t-statistics = 2.947), 0.0010 (t-statistics = 0.696) and 0.0432 (t-statistics = 1.788). It suggests that the positive relationship between ESG composite performance and firm value for non-state-owned enterprises is just statistically significant when the measurement of firm value is based on market value (TQ or MB),

while the positive impact of ESG on profitability (ROA) of non-state-owned enterprises is weak and insignificant. Summarized, the effect of ESG composite performance on firm value for state-owned companies is stronger than that for non-state-owned companies in China.

Secondly, we compare the estimated results of state-owned and non-state-owned firms on the relationship between environmental (E) performance and firm value. For state-owned firms (Table 17, Columns (2)), the estimated coefficients of $Score^E$ for TQ, ROA and MB respectively are 0.0483 (t-statistics = 3.049), 0.0012 (t-statistics = 1.161) and 0.0486 (t-statistics = 3.500). For non-state-owned firms (Table 17, Columns (6)), the estimated coefficients of $Score^E$ for TQ, ROA and MB respectively are 0.1678 (t-statistics = 4.634), 0.0014 (t-statistics = 0.861) and 0.1347 (t-statistics = 4.531). It suggests that the positive relationship between environmental (E) performance and firm value is just statistically significant when the measurement of firm value is based on market value (TQ or MB), while the positive impact of environmental performance on profitability (ROA) is weak and insignificant, for both state- and non-state-owned listed companies in China.

Thirdly, we compare the estimated results of state-owned and non-state-owned firms on the relationship between social (S) performance and firm value. For state-owned firms (Table 17, Columns (3)), the estimated coefficients of $Score^S$ for TQ, ROA and MB, respectively are 0.1019 (t-statistics = 2.052), 0.0025 (t-statistics = 1.140) and 0.1235 (t-statistics = 4.072). For non-state-owned firms (Table 17, Columns (7)), the estimated coefficients of $Score^S$ for TQ, ROA and MB, respectively, are 0.1082 (t-statistics = 1.684), 0.0022 (t-statistics = 0.621) and 0.0829 (t-statistics = 1.955). It suggests that the positive relationship between social (S) performance and firm value is just statistically significant when the measurement of firm value is based on market value (TQ or MB), while the positive impact of that on profitability (ROA) is weak and insignificant, for both state-owned and non-state-owned listed companies in China, which is similar with the compared result for environmental dimension.

Fourthly, we compare the estimated results of state-owned and non-state-owned firms on the relationship between corporate governance (G) performance and firm value (Table 17, Columns (4) and (8)). The estimated coefficient of $Score^G$ for ROA is 0.0128 (t-statistics = 3.470) in the subsample of state-owned firms, and that is 0.0120 (t-statistics = 2.274) in the subsample of non-state-owned firms, indicating a significant positive relationship between corporate governance performance and profitability in both state- and non-state-owned listed companies in China. However, the coefficients of $Score^G$ for TQ and MB are respectively -0.1762 (t-statistics = -3.174) and -0.1235 (t-statistics = -1.959) in the subsample of state-owned firms while those are respectively 0.3769 (t-statistics = 3.192) and 0.0690 (t-statistics = 0.876) in the subsample of non-state-owned firms. It implies that the relationship between G-dimension performance and firm value measured based on market value (TQ or MB) is positive for non-state-owned listed companies but negative for state-owned listed companies in China.

Summarized, our hypothesis H1 can hold in both state- and non-state-owned Chinese listed companies. The enhancement effect of ESG comprehensive performance on firm value for state-owned companies is even higher than that for non-state-owned companies. The sub-hypotheses H1a and H1b also can be supported by both state- and non-state-owned subsamples, namely, environmental (E) and social (S) performance positively affect firm value, especially when TQ and MB are taken as proxies of firm value. On the other hand, the sub-hypothesis H1c only can be supported by the subsample of non-state-owned companies. Although the impact of corporate governance performance of state-owned companies on ROA is positive, but that on TQ or MB is negative. It also provides potential reasons for the fact that the positive relationship between governance performance and firm value did not pass all the robustness tests with the total sample in the previous subsection of our paper.

5.6.2. Key and Non-Key Pollution Monitored Firms

From Table 18, it can be seen visually that there is apparent heterogeneity between key and non-key pollution-monitored firms on the relationship between ESG and firm value. Except for the coefficient of $Score^G$ for ROA, none of the estimated coefficients of $Score^{ESG}$, $Score^E$, $Score^S$ and $Score^G$ is statistically significant at least on 10% level for the key pollution-monitored firms, which are shown in columns (5), (6), (7) and (8) of Table 18. However, when the non-key pollution-monitored firms are considered, all the estimated coefficients of $Score^{ESG}$ for the proxy variables of firm value (Table 18, Column (1)) are positive and statistically significant at 1% level, in which the coefficients of $Score^{ESG}$ for TQ, ROA, and MB are respectively 0.0981, 0.0022 and 0.0671. Furthermore, all the estimated coefficients of $Score^E$ and $Score^S$ for the three proxy variables of firm value (Table 18, Columns (2) and (3)) are positive, all of which are statistically significant at the 1% level except the coefficient of $Score^E$ for ROA. The coefficient of $Score^G$ (Table 18, Column (4)) is significantly positive for ROA but negative for TQ and MB.

Table 18. Comparing results of key and non-key pollution-monitored firms.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Non-Key Pollution-Monitored Firms				**Key Pollution-Monitored Firms**			
Panel A: Dependent variable-TQ								
$Score^{ESG}$	0.0981 ***				0.0184			
	(5.710)				(0.848)			
$Score^E$		0.0937 ***				0.0180		
		(4.619)				(0.683)		
$Score^S$			0.1966 ***				0.0245	
			(4.730)				(0.438)	
$Score^G$				−0.0420				0.0474
				(−0.673)				(0.501)
adj R^2	0.2133	0.2205	0.2198	0.2339	0.4877	0.4883	0.489	0.4889
F	17.94	17.04	17.13	15.38	6.443	6.422	6.400	6.405
Panel B: Dependent variable-ROA								
$Score^{ESG}$	0.0022 ***				0.0015			
	(2.685)				(0.778)			
$Score^E$		0.0002				0.0024		
		(0.163)				(1.043)		
$Score^S$			0.0053 ***				−0.0071	
			(2.710)				(−1.423)	
$Score^G$				0.0149 ***				0.0173 **
				(5.158)				(2.057)
adj R^2	0.0395	0.0435	0.0395	0.029	0.397	0.3959	0.3936	0.3884
F	43.57	42.89	43.58	45.39	9.568	9.610	9.692	9.886
Panel C: Dependent variable-MB								
$Score^{ESG}$	0.0671 ***				0.0215			
	(4.556)				(1.167)			
$Score^E$		0.0827 ***				0.0231		
		(4.806)				(1.030)		
$Score^S$			0.1280 ***				0.0482	
			(3.595)				(1.010)	
$Score^G$				−0.2120 ***				−0.0254
				(−3.869)				(−0.313)
adj R^2	0.2239	0.2224	0.2291	0.2277	0.6053	0.6061	0.6062	0.6088
F	16.90	17.08	16.27	16.43	3.194	3.171	3.168	3.097
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 18. *Cont.*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Non-Key Pollution-Monitored Firms				**Key Pollution-Monitored Firms**			
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2556	2556	2556	2556	991	991	991	991

Notes: This table compares the results of key pollution-monitored firms and non-key pollution-monitored firms. Columns (1), (2), (3), and (4) respectively show estimated results of the impact of $Score^{ESG}$, $Score^{E}$, $Score^{S}$ and $Score^{G}$ on firm value for the non-key pollution-monitored firms, while columns (5), (6), (7) and (8) respectively show those for the key pollution-monitored firms. Tobin's Q (TQ), return on assets (ROA), and market-to-book ratio (MB) are taken as proxies of firm value, corresponding results being respectively shown in Panel A, B, and C. The estimation results of control variables are omitted in this table for space limitation. See Table 2 for definitions of the control variables. T-statistics are in parentheses. *** $p < 0.01$, ** $p < 0.05$. (Source: Own elaboration).

Our hypothesis H1 can hold in non-key pollution-monitored firms. The estimated coefficients in the subsample of key pollution-monitored firms are also positive, but all of them are not significant, suggesting a stronger positive effect of ESG composite performance on firm value for non-key pollution-monitored firms, compared with key pollution-monitored firms. As for the sub-hypotheses H1a and H1b, they are also mainly supported by the non-key pollution-monitored firms rather than the key pollution-monitored firms. The sub-hypothesis H1c cannot be fully supported. Namely, the positive relationship between corporate performance and firm value is unstable in key and non-key pollution-monitored firms.

6. Discussion and Conclusions

In this paper, we investigate the impact of ESG performance on firm value by using a sample of Chinese A-share listed companies over the period 2010–2019. We start with constructing an ESG-scoring framework by sorting the items on ESG-related quantitative information that was disclosed by Chinese A-share listed companies in the past decade, calculating ESG composite score, E score, S score and G score to, respectively, evaluate firms' ESG composite performance and their performance on the three individual dimensions. Using the ESG scores obtained in the first step, we examine the impact of ESG on firm value, which is measured by Tobin's Q (TQ), Return on Assets (ROA), and Market-to-book ratio (MB). We construct four panel-data models as the baseline regressions to empirically test their relationship, and also implement various robustness checks, e.g., using an alternative independent variable, advancing the dependent variable by one period, using the IV approach and taking Heckman's two-stage estimation approach. In the last step, based on the attributes of Chinese enterprises and the specific policies of the government on ESG information disclosure, we further analyze the heterogeneity of the relationship between ESG and firm value between state-owned and non-state-owned enterprises and that between key pollution-monitored enterprises and non-key pollution-monitored enterprises.

Some interesting findings are generated in our study. In terms of ESG composite performance, we find that the ESG composite score is positively associated with firm value, supporting the stakeholder theory. This finding is consistent with Ref. [12], which finds a positive impact of ESG on Tobin's Q and ROA, by using a sample of UK firms from the Bloomberg ESG database. It is in line with the study of Ref. [9], which investigates whether ESG has an impact on ROA, taking a sample of Islamic firms with Thomson Reuters' ESG scores. It also partly keeps in line with Ref. [2], which finds a positive relationship between ESG and ROA in a sample of companies listed on the German Prime Standard. Besides, taking Tobin's Q as the proxy, Ref. [11] (using Bloomberg's ESG score for global companies), Ref. [15] (using Thomson Reuters' ESG scores for Top 100 Global Energy Leaders), Ref. [13] and Ref. [14] (using Bloomberg ESG rating for firms in Malaysia) found evidence of a positive relationship between ESG and firm value, which are also in line with ours. However, our finding conflicts with those studies of Ref. [3] (using a sample of 365 listed companies from BRICS with Thomson Reuters' ESG scores), Ref. [8] (using Thomson Reuters's ESG scores for listed Banks in GCC countries), and Ref. [6] (using

a sample of 104 multinationals from Brazil, Chile, Colombia, Mexico and Peru), which support a negative relationship between ESG and ROA. It also seems to go against the study of Ref. [21], which deems that ESG practices cannot positively moderate the relationship between controversies and firm performance (Tobin's Q, ROE and ROA). Ref. [2] does not find a significant impact of ESG on Tobin's Q, which is also inconsistent with ours.

Similar to Refs. [3,6,9,11,15], we further examine the three individual dimensions' impact on firm value. On the dimension of environmental (E) dimension, we find that the positive impact of environmental performance on firm value can be supported by empirical results obtained from the main regressions and the robustness tests. This sub-finding is consistent with Refs. [9,11,15], but inconsistent with Refs. [3,6]. On the dimension of social (S) dimension, we find a positive relationship with firm value, which is also against Refs. [3,6] but in line with Refs. [9,11,15,47,49]. However, on the dimension of governance (G) dimension, the positive relationship between corporate governance and firm cannot pass all the robustness tests in our study, indicating that this relationship is mixed, which is different from those studies that provide clear evidence of whether the relationship is positive or negative [3,6,9,11,15]. Some previous studies could provide an interpretation of those conflicting conclusions. Economic activities in real life are often much more complex than what is depicted in one academic study. Many other factors, such as financial slack [9], institutional ownership [48], environmental sensitivity [3], investors and regulatory agents [3], firm visibility [10], advertising [52], customer awareness [52], stock ownership of board members [45] and CEO-Chair separation [46], could influence the relationship between ESG and firm value.

Different from the previous studies mentioned above, our study provides some special evidence for the relationship between ESG performance and firm value in China. That is, the enhancement effect of ESG composite performance on firm value is stronger for state-owned listed companies than that for non-stated listed companies, and this positive relationship is significant in non-key pollution-monitored firms but insignificant in key pollution-monitored firms. As to the environmental (E) dimension, the impact of environmental performance on firm value is positive in both state-owned and non-state-owned companies, especially significant when firm value is measured by TQ or MB. In addition, this positive relationship is significantly reflected in non-key pollution-monitored firms rather than key pollution-monitored companies. For the social (S) dimension, the impact of social performance on firm value is respectively positively stronger in state-owned and non-key pollution-monitored companies, compared with non-state-owned and key pollution-monitored companies, respectively. For the corporate governance (G) performance, except for the significant evidence of the positive relationship between G score and ROA in all four subsamples, we do not find consistent evidence supporting the enhancement effect of governance performance on firm value that is measured by TQ or MB.

Our study has some theoretical and practical contributions. For example, it is the first study that investigates the relationship between ESG performance and firm value in China by evaluating ESG performance based on the ESG-related quantitative data disclosed by Chinese companies, which covers more than 95% of Chinese A-share listed companies that once disclosed quantitative information on both environmental and social aspects. It not only provides new evidence for the debate on whether the agency theory or the stakeholder theory is supported by the effect of ESG on firm value but also provides a new way to evaluate the ESG performance of Chinese listed companies. It investigates not only the impact of ESG composite performance on firm value but also further tests those of the three sub-dimensions (E, S, and G) on firm value. Based on the characteristics of Chinese enterprises and relevant ESG information disclosure policies, it not only discussed the heterogeneity between state-owned and non-state-owned companies but also discussed that between key and non-key pollution-monitored firms. Finally, it provides a glance at ESG performance in Chinese companies and their impact on firm value. Besides, our results provide robust evidence that the composite ESG performance is positively related to firm value. Thus, we advise market participants to take into account a firm's overall ESG

performance rather than a single aspect when they engage in ESG investment. Based on the empirical results of heterogeneity analysis, we suggest ESG investors pay more attention to state-owned listed companies that are not on the list of key pollution-monitored enterprises, which is defined by China's Environmental Protection Bureau.

However, there is also some room for improvement and further studies in the future. First, although the rating objects of the ESG scoring system in this study have covered almost all the Chinese A-share listed enterprises that have disclosed ESG information in recent years, there is still room for further expansion in the number of samples. The expansion of ESG data depends on the policy guidance on ESG information disclosure or the possible introduction of mandatory disclosure rules in China in the future. Second, as to the relationship between ESG and firm value, we only focus on those listed companies that have disclosed ESG quantitative information, ignoring those that did not disclose environmental and social quantitative information. In real life, whether a firm chooses to disclose ESG information may be related to firm value. Our study ignores the discussion on companies' motivation to disclose ESG information. This could be another interesting topic for future research. Third, there is an implicit assumption that the ESG information disclosed by listed companies is accurate and complete in our study. In other words, this paper does not discuss the quality of ESG information disclosure. Fourth, we find evidence of the positive impact of ESG performance on firm value, but we did not investigate its influencing mechanism. We could further explore other factors influencing this relationship, such as macroeconomic policies, policy uncertainty, institutional shareholding, financial restrictions, etc. We also could further retest this relationship by considering the convexity-concavity nature of this relation, following methods such as Ref. [35] in the future. Besides, following Ref. [23], it also could be interesting to discuss the impact of COVID-19 on this relationship when we update the ESG scores for Chinese companies after 2020 in the future.

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Appendix A

Table A1. ESG Quantitative Scoring System Tiers.

Tier 1	Tier 2	Tier 3	Tier 4
Environmental (E)			
	Environmental management		
		Pollution reduction	
			Exhaust gas reduction
			Sewage reduction
			Hazardous solid waste reduction
			Noise reduction
			Unit emission reduction
			Pollution reduction rate
			Other
		Emission standard	
			Regulated emission rate
		Resources saving	
			Energy saving rate/consumption saving rate
			Water conservation
			Electricity conservation
			Gas conservation

Table A1. *Cont.*

Tier 1	Tier 2	Tier 3	Tier 4
			Paper conservation
			Coal conservation
			Paperless working
			Unit energy saving efficiency
			Other
		Green energy	
			Clean energy utilization rate
			Natural gas supply
			Clean electricity supply
			Other
		Green finance	
			The proportion of green loans
			Loan ratio to industries with excess capacity
			Green credit ratio
			The replacement rate of electronic banking counter transactions
			Video equipment coverage
			Electronic business scale
			The scale of green credit
			Green purchasing
			Other
		Environmental policy	
			"Three at the same time" implementation rate
			Incidence of environmental problems/safety incidents
			Improvement rate of environmental problems
			Number of participants for environmental emergency practice
			Number of environmental emergency practice
			Duration of environmental emergency practice
			Number of environmental accidents/complaints/violations
			Amount of penalties for environmental violations
			Environmental safety emergency treatment drill
			Number of self-checking environmental problems/rectification
			Investment in environmental protection
			Other
		Treatment of pollutants	
			Pollutant treatment efficiency
			Wastewater treatment capacity
			Waste gas treatment capacity
			Hazardous solid waste treatment capacity
			Other
		Environmental protection equipment/process	
			Quantity of environmental protection equipment
			Operation rate/equipment rate of environmental protection equipment
			Environmental protection process efficiency
		Environmental protection projects or products	
			Environmental protection projects
			Environmental protection product
		Recycling of resources	
			Recovery/recycling/comprehensive utilization rate
			Recovery of water
			Recovery and utilization of hazardous solid waste
			Recycle other waste
			The volume of gas/liquid recovered
			Recovery of heat energy
			Conversion amount of resource recycling
			Other

Table A1. *Cont.*

Tier 1	Tier 2	Tier 3	Tier 4
		Ecological and environmental protection	
			Green construction rate
			Mining area recovery rate
			Goaf backfill rate
			Mine reclamation rate
			Green purchase rate
			Afforestation rate
			Amount of ecological restoration
			Biodiversity
			Vegetation planting
			Other
		Green patent	
			Number of green patents
		Qualitative indicators of environmental superiority	
			Environmentally beneficial products $^{(0,1)}$ *
			Measures to reduce three wastes $^{(0,1)}$ *
			Circular economy $^{(0,1)}$ *
			Energy saving $^{(0,1)}$ *
			Green Office $^{(0,1)}$ *
			Environmental certification $^{(0,1)}$ *
			Environmental Recognition $^{(0,1)}$ *
	Resource consumption		
		Water	
			The total water consumption
			Water consumption per unit of power generation
			Water consumption per unit product
			Per capita water consumption
		Coal	
			Quantity of coal consumption
			Coal for unit power supply
		Electricity	
			Electricity rates
			Total electricity
			Power consumption per unit product
			Water consumption per unit of output
			Power consumption per unit area (volume)
			Per capita electricity consumption
		Oil	
			Amount of fuel consumption
		Paper	
			Weight of paper consumption
			Number of paper consumption
			Paper consumption per person
		Natural gas	
			The total amount of gas consumption
			Unit gas consumption
		Heat energy	
			Consumption of thermal energy
		Other energy	
			Other energy consumption
	Pollution emissions		
		Water pollution	
			Wastewater/sewage discharge
		Atmospheric pollution	
			Exhaust gas emission
			Air pollutant discharge

Table A1. *Cont.*

Tier 1	Tier 2	Tier 3	Tier 4
		Hazardous solid waste pollution	
			Hazardous solid waste discharge
			Quantity of solid waste
		Noise pollution	
			Noise emission
Social (S)			
	Production safety		
		Production safety issues	
			Industrial injury rate
			The death rate due to service
			Incidence of occupational diseases
			Safety accident rate
			Product recall/complaint rate due to safety issues
			Product safety pass rate
			Production safety problem correction rate
			Other safety matters compliance rate
			Number of casualties/injuries/occupational diseases
			Number of safety accidents
			Number of product quality and safety incidents
			Number of other incidents involving production safety
			Amount of compensation for safety accidents
			Amount of penalty for safety accidents
			Other indicators related to product safety issues
		Production safety management	
			Security check/troubleshooting
			Rectification of safety problems
			Safety hazard remediation
			Identify hazard/safety risks
			Production safety training
			Production safety Conference
			Production safety emergency drill
			Other production safety management-related indicators
		Safety production input	
			Amount of investment in safe production
	Public relations and social welfare		
		Laws and regulations	
			Number of violations/violations/lawsuits/penalties
			The amount of money paid for violations/lawsuits/fines
		Employment of Special Groups	
			Disability employment rate
			Local employment rate
			Employment of persons with disabilities
			Employment of ethnic minorities
			Hire migrant workers/poor people
			Hiring veterans
			Hiring fresh students/graduates/campus recruitment
			Hire other special personnel
		Donation	
			Donate
		Advantage qualitative indicators of charity and volunteer activities	
			Support education $^{(0,1)}$ *
			Support charity $^{(0,1)}$ *
			Volunteer activities $^{(0,1)}$ *
			International aid $^{(0,1)}$ *
			Drive employment $^{(0,1)}$ *
			Boost the local economy $^{(0,1)}$ *
		Tax	
			Total taxes payment *

Table A1. *Cont.*

Tier 1	Tier 2	Tier 3	Tier 4
	Protection of shareholders' rights		
		Handling of shareholders' opinions	
			Shareholder opinion completion rate
		Shareholder satisfaction	
			Shareholder satisfaction
		Shareholder rights protect negative events	
			Number of violations/penalties by the regulatory authorities
	Customer and consumer rights protection		
		Customer/consumer satisfaction	
			Customer satisfaction
			Number of times praised by customers
			Customer satisfaction survey
		Customer/consumer communication	
			Effective customer complaint rate
			Complaint handling rate
			Number of customer/consumer complaints received
			Other customer and consumer information
		Product advantage qualitative indicators	
			Quality system $^{(0,1)}$ *
			After-sales service $^{(0,1)}$ *
			Customer Satisfaction survey $^{(0,1)}$ *
			Quality honor $^{(0,1)}$ *
			Anti-corruption measures $^{(0,1)}$ *
			Strategic sharing $^{(0,1)}$ *
			Integrity business philosophy $^{(0,1)}$ *
	Protection of creditors' rights		
		The contract performance	
			Contract performance rate
		Information compliance Disclosure	
			Information disclosure compliance rate
		Debt paying ability	
			Provision coverage ratio
			Asset-liability ratio #
			Cash flow interest protection multiple #
		Debt repayment	
			The interest payments
			Repayment of the bank loan amount
			Other
	Protection of workers' rights and interests		
		Satisfaction of employees	
			Satisfaction of employees
		Employee communications	
			Handling of employee comments/complaints
		Employee training	
			Investment in vocational training
		Qualitative indicators of employee relationship strengths	
			Employee equity participation $^{(0,1)}$ *
			Employee benefits $^{(0,1)}$ *
			Safety Management System $^{(0,1)}$ *
			Production safety training $^{(0,1)}$ *
			Occupational Safety Certification $^{(0,1)}$ *
			Vocational Training $^{(0,1)}$ *
			Employee communication channels $^{(0,1)}$ *
			Other
	Protection of rights and interests of suppliers		
		Reimbursement of suppliers	
			Accounts payable turnover #

Table A1. *Cont.*

Tier 1	Tier 2	Tier 3	Tier 4
Governance (G)			
	Shareholders		
		Concentration of ownership	
			The shareholding ratio of the top 10 shareholders *
			Z-index (the ratio between the largest shareholder and the second largest shareholder) *
			The shareholding ratio of the largest shareholder *
		Shareholders of scale	
			The number of shareholders
		The general meeting of shareholders	
			Number of meetings of shareholders #
	Board of Directors and Management		
		Shareholding of directors, supervisors, and executives	
			The proportion of executive ownership *
			Level of managerial share ownership *
			The shareholding ratio of the Board *
			The shareholding ratio of the Board of Supervisors *
		Institution setting	
			Board Size *
			Size of Board of Supervisors *
			Number of committees
			Number of executives
		Diversity	
			The party member (0, 1) *
			Female executives (0,1) *
			Female board seats (0,1) *
			Innovative Human Resources Project (0,1) *
		Independence	
			Double duty (0,1) *
			Percentage of independent directors *
		Executive compensation	
			High salary of directors *
			Top 3 executive salaries *
			Remuneration of the first 3 directors *
		Other advantages of corporate governance	
			Comprehensive CSR reporting (0,1) *
			CSR column (0,1) *
			CSR organization (0,1) *
			CSR vision (0,1) *
			CSR training (0,1) *
			CSR report reliability (0,1) *

Notes: (0,1) represents the qualitative indicator. If the indicator item exists, the value is 1; otherwise, it is 0. * means that the original data is from the CNRDS database. # indicates that the original data is from the Wind database. If there is no special identification, the original data source is the CSMAR database.

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