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# Resource dependence and enterprise ESG performance: an empirical study based on A-share listed companies

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The impact of resource dependence on social economy and environment lacks empirical evidence at the micro level. This article uses data from A-share listed companies from 2011 to 2020 to construct an econometric model to empirically test the impact of resource dependence on ESG performance of enterprises. We find that the corporate ESG scores in regions with high resource dependence will decline. After a series of robustness tests such as replacing the dependent variable, controlling province time fixed effect, eliminating extreme effects, and eliminate provinces with high resource dependence, the conclusion of this article still holds. In addition, we alleviate the endogeneity problem caused by OLS estimation by constructing a dynamic panel model. Further analysis indicates that there are differences in the effect of resource dependence on enterprises sub-scores, with a significant negative impact on the environmental dimension and social dimension, and no significant impact on the governance dimension. It has a greater impact on the ESG score of SOEs and has no significant impact on non-SOEs. The empirical results of this paper enrich the research on the influencing factors of enterprise ESG performance, and further expand the research framework of the socio-economic consequences of enterprise resource dependence.

## KEYWORDS

resource dependence, enterprise ESG score, enterprise sustainable development, China, A-share listed companies

## 1 Introduction

For a long time, economists have launched a series of theoretical and empirical investigations on the “gospel theory” and “curse theory” of natural resource endowment. The “gospel theory” advocates that abundant natural resources are an important factor for economic growth, which is conducive to the rapid development of regional economy and the rapid accumulation of capital. According to the theory of new economic geography, the

development of resource industries will attract the agglomeration of their upstream and downstream industries. The spatial agglomeration of industries saves transaction costs and helps to generate economies of scale, thereby promoting economic growth. Feyrer et al. (2017) used US data and found that resource extraction has a positive spillover effect on related industries. The benefits brought by the mining industry to the local area are higher than the mining costs. Resources are not a curse, but a blessing. Allcott and Keniston (2018) used micro data on the US manufacturing industry from 1969 to 2014 and found that resource prosperity contributes to the development of related manufacturing enterprises, while having no significant impact on non-related manufacturing enterprises. Asher and Novosad (2014) used data from India's three economic censuses and instrumental variable method to study and found that the economic growth effect brought about by resource prosperity is extensive, with a positive spillover effect on surrounding towns 50km away from mines. The "curse theory" believes that regions with abundant resources will cause serious negative effects on long-term economic growth through intermediary crowding out effects (Gylfason, 2001), institutional deterioration effects (Bodea et al., 2016) and price fluctuation effects (Leong and Mohaddes, 2011; Su et al., 2023), which are not conducive to the sustainable development of local enterprises. On the other hand, the over-exploitation of natural resources will bring a series of environmental problems such as ecological environment damage and natural environment deterioration, and the efficiency of environmental pollution management varies greatly among regions (Zhao et al., 2022). Therefore, as the main body of pollution discharge and treatment, enterprises face many challenges in their development (Lin et al., 2021; Qin et al., 2022; Su et al., 2022a). In 2020, China has proposed the social and economic development goal of carbon peaking and carbon neutrality. In this context, higher demands are placed on corporate sustainability (Su et al., 2022b; Su et al., 2022c). Investors also incorporate the performance of enterprises in environmental and social aspects into their investment decision-making functions. Enterprise ESG index is the concrete embodiment of this emerging investment concept.

Enterprise ESG indicators are obtained by combining the performance of enterprises in three aspects: environmental, social and governance. In recent years, companies have shifted from the short-term goal of profit maximization to the long-term goal of sustainable ESG performance (Min and Mentzer, 2004; Studer et al., 2006). Stakeholder theory suggests that ESG emphasizes the coordinated development of economy, environment, and society, advocates long-term goal orientation, promotes the pursuit of maximizing social value by enterprises, and helps to build trust in uncertain environments; At the same time, enterprises actively practice the concept of sustainability, increase corresponding investments, and form ESG advantages, which have a strong externality on their own business development. ESG performance of enterprises has been a hot topic studied by many scholars in the past decade (Halbritter and Dorfleitner, 2015; Van Duuren et al., 2016; Gillan et al., 2021; Pedersen et al., 2021). The current empirical research on corporate ESG mainly focuses on two aspects: the economic impact of corporate ESG and the various factors that affect corporate ESG performance. Several studies

showed that ESG has become an important source of corporate risk that can directly or indirectly affect a company's financial performance as well as profitability (Friede et al., 2015; Aouadi and Marsat, 2018; Byun and Oh, 2018; Broadstock et al., 2021; Wong et al., 2021). For example, research by Cheng et al., (2014) and Ghoul et al. (2017) found that companies that focus on environmental, social and governance development are more likely to obtain financial resources needed for operating activities at a lower cost. In terms of factors influencing corporate ESG performance, some researchers have studied from the perspectives of socio-cultural and legal systems (Alsayegh et al., 2020; Chen et al., 2022) and internal corporate management factors (Cucari et al., 2018; McBrayer, 2018). The former includes factors such as the level of economic development (Cai et al., 2016), market liberalization (Chemmanur et al., 2020; Yang et al., 2022), social and media attention (Garcia et al., 2017; Burke, 2022), and the legal system (Liang and Renneboog, 2017). The latter includes factors as the board and CEO (Cronqvist and Yu, 2017; Hegde and Mishra, 2019), institutional investors (Dyck et al., 2019; Chen et al., 2020), and management tenure (McBrayer, 2018). For example, Doran and Ryan (2016) found that regulation and customer pressure are feasible mechanisms to encourage enterprises to fulfill social and environmental responsibilities, thus improving their ESG performance. This paper attempts to empirically study the relationship between resource dependence and corporate ESG performance from the perspective of the company's external environment, that is, the resource dependence of the region where the company is located.

There is a large branch of literature revolving around the relationship between resource endowments and economic growth. Among them, the findings of Sachs and Warner, (1995) are the most representative. They selected the country-level variables of natural resources and economic growth, and studied the relationship between the two variables, finding that natural resources and economic growth were surprisingly negatively correlated, which overturned the traditional perceptions. Subsequently, Gylfason (2001); Papyrakis and Gerlagh, (2004) also found a monotonic negative relationship between resource stocks and economic growth in the long run for countries that use natural resources solely for economic development. There are also scholars who take a different view. For example, Boschini and Roine, (2007), Same (2008), and Haseeb et al. (2021) argue that natural resources are not the direct cause of the conundrum of economic growth problems in resource-based regions. A few studies have explored this issue from the perspective of corporate behavior. Torvik (2001) argues that in resource-rich countries, firms tend to engage in unproductive economic activities and benefit through rent-seeking, which is detrimental to economic growth. Lim and Morris (2022) found that state-owned enterprises can achieve higher-scale economies through production links with natural resources departments. In general, the existing research mainly verifies two questions: whether the resource curse exists and why it occurs. However, when investigating whether there is a resource curse in resource-based regions, we should not only consider the economic growth factor, the environmental consequences should be also included in the scope of the study (Boschini and Pettersson,

2007). Based on this, this paper comprehensively considers economic and environmental factors, and examines the impact of regional resource dependence caused by abundant resources on the ESG of its enterprises from the micro level.

The marginal contribution of this article is mainly reflected in the following aspects. Firstly, due to the fact that research on corporate ESG is still in its early stages, most studies on factors affecting corporate ESG are focused on the internal environment of the company. We discussed the impact of the external environment faced by the company, namely the resource dependence of the region where the company is located, on the ESG performance of the enterprise. This article explores the impact of enterprise resource dependence on its ESG performance from the perspective of enterprise resource acquisition, based on the theory of resource dependence. This article provides new empirical evidence for the literature on factors that affect corporate ESG performance. Secondly, current empirical studies on regional resource endowments and economic growth are mostly based on macro-level perspectives such as cross-country and domestic regions, while studies on resource endowments on micro-firm performance are still very limited. These studies have mostly focused on the economic performance of firms and rarely consider the environmental as well as social performance of firms. This paper provides micro-level evidence on this issue from the perspective of resource dependence on firm ESG performance. Last but not least, this paper further expands the research framework of the social and economic consequences of enterprise resource dependence. As an important consideration when making strategic decisions, resource dependence affects corporate social and environmental behavioral decisions, which in turn directly affects corporate ESG performance and has direct economic consequences.

Section 2 develops the theoretical hypothesis. Section 3 introduces the setting of the measurement model and the selection of variables. Section 4 shows the benchmark regression results and robustness test. Section 5 is a further analysis, exploring the impact of resource dependence on corporate ESG sub-score and the heterogeneity of the nature of enterprise ownership. Section 6 summarizes and puts forward policy recommendations and research prospects.

## 2 Theoretical hypothesis

“Resource curse” theory suggests that abundant natural resources do not show a significant contribution to economic development, but rather a hindering effect. Numerous studies have shown that the crowding out effect of natural resources on investment in technology innovation and human capital leads to the occurrence of the resource curse (Gylfason, 2001). Due to the economic division of labor and long-term path dependence, regions with higher natural resource abundance are more likely to move towards a resource-dependent economic development path. The more resource-rich regions have labor-intensive attributes, and the local production is characterized by low-technology content (Ethier, 1985). Resource-dependent firms tend to aim for high revenues in the short term by engaging in production activities

that consume large amounts of natural resources, such as extraction the primary processing. These firms are usually less exposed to low growth and technology, and thus less motivated to invest in technology development (Li et al., 2020). The high income of the resource sector attracts more labor and capital, accelerating the transfer of funds from R&D to the primary product sector, causing the aggravation of the resource mismatch problem, which is not conducive to the technological innovation of enterprises, and to a certain extent hinders the green development of enterprises. Fulfillment of social, environmental and governance responsibilities by enterprises is an activity with significant externalities and high costs, and investors’ investment decision was made based on corporate ESG performance (Crifo et al., 2015; Alsayegh et al., 2020). Sufficient production resource guarantee enables enterprises to obtain higher revenues and achieve rapid development in the short term, with little demand for external investors. Therefore, enterprises with strong resource dependence lack the incentive to fulfill their social, environmental and governance responsibilities. On the other hand, resource-dependent enterprises usually adopt a crude production model with high input, high consumption, high pollution and low technological level. And their production activities are often accompanied by greater environmental destructiveness and difficulty in safe production, with high environmental management costs (Song et al., 2022). In areas of low resource abundance and dependence, firms are limited in their activities to obtain resources from external sources and rely more on resource accumulation and internal capital allocation, as well as technological innovation and organizational change to create opportunities (Zhang et al., 2022). At the same time, the low abundance and low dependence environment intensifies competition. At a time when low carbon development and environmental issues are widely emphasized, companies need to actively fulfill their social and environmental responsibilities and improve their ESG performance to gain an advantageous position in the market. Based on the above analysis, the rising dependence of companies on resources is not conducive to enhancing the fulfillment of integrated social, environmental and governance performance. Therefore, hypothesis one of this paper is proposed.

**Hypothesis 1:** The dependence of enterprises on resources is mainly characterized by the “resource curse”, which has a negative impact on the environmental, social and governance performance of enterprises.

Resource dependency is mainly reflected in the degree of importance and intensity of influence of resource-based industries on the industrial structure, employment structure, level of technological progress, development speed and direction of the regional economy, which means the level of status and role of resource-based industries in the regional economic development. Although natural resources can bring direct or indirect benefits to society (Pan et al., 2022), excessive dependence on natural resources and resource-based industries can create a “resource curse” effect (Gylfason and Zoega, 2006; Brunnschweiler and Bulte, 2008), and the long-term dependence of the production process on resources will squeeze out R&D activities and cause the outflow of technological factors, which is not conducive to the innovation of energy-saving

and environmental protection technologies. In addition, in terms of the regional distribution characteristics of natural resources in China, the degree of marketization in areas with high resource dependence is relatively low, so in terms of marketization environment, compared to areas with low resource dependence, enterprises in areas with high resource dependence have less incentive to innovate and their technological innovation level is relatively low. On the other hand, the crude production of resource-dependent enterprises is accompanied by a large amount of pollution emissions, and the technological base is not sufficient to compensate for the environmental management costs of the enterprises; therefore, the resource dependence of enterprises is not conducive to the fulfillment of their environmental responsibilities.

Enterprises are the main body of social responsibility. Social responsibility refers to the active engagement in socially responsible behavior that goes beyond the economic and legal requirements of the firm (Wood, 1991), and refers to the need for firms to take social responsibility for employees, consumers, suppliers, communities, and the environment in addition to generating profits and taking economic responsibility for shareholders (Clarkson, 1995). The resource-based theory suggests that whether a company takes more social responsibility depends on its own resources and capabilities (Barney, 1991; Grant, 1991; Hart, 1995), and that it is difficult for a company to meet the demands of all stakeholders at the same time due to limited financial resources. Resource dependence theory suggests that among many stakeholders, a firm will first focus on and deal with the interests of those who hold key resources to ensure its continued survival, and effective corporate governance is a necessary factor in the firm's goal of maximizing profits. For resource-dependent enterprises, in addition to improving the efficiency of corporate governance, their long-term path dependence on resources as the main factor for production, as well as the high income of the resource sector itself is more attractive to factors of production such as labor, social responsibility-related interest holders will not affect the development of the enterprise to a certain extent, therefore, enterprises lack the motivation and incentive to fulfill social responsibility. Moreover, the pollution effect generated by the crude development mode of resource-dependent enterprises has strong negative externality and adversely affects the living environment of the surrounding residents; therefore, the increase of resource dependence has a hindering effect on the performance of corporate social responsibility. Based on the above analysis, the increase of resource dependency of enterprises will reduce the environmental and social performance of enterprises, while the effect on corporate governance is not obvious. Therefore, the second hypothesis of this paper is proposed.

**Hypothesis 2:** The inhibitory effect of increased resource dependence on corporate ESG performance is mainly reflected in the hindering effect on corporate fulfillment of social and environmental responsibilities.

State-owned enterprises (SOEs) are the mainstay of the national economy and an important subject responding to various national policies. Their main purpose is not to maximize corporate profits, but to maximize the welfare of the whole society. As important bearers of social responsibility, they are responsible for society and

the environment in the process of production and operation, and maximize the creation of comprehensive economic, social and environmental value to promote the sustainable development of the national economy. However, SOEs are owned by the local government, which makes it easier to obtain rent-seeking benefits and reduces the motivation of enterprises to build their own capabilities. Therefore, they are less efficient than non-SOEs (Nie and Jia, 2011). Moreover, most SOEs belong to energy industries such as power supply industry, oil and gas extraction industry, which consume more resources and emit more pollution. They enjoy government guarantees and financial support, and have many ways to obtain resources with less difficulty. Therefore, it is easier to form a resource-dependent development path and lack the motivation for technological innovation and green transformation. For non-SOEs, social, environmental and governance performance are important factors in attracting investors. In the fierce market competition, non-SOEs whose main goal is profit maximization have an accumulating effect (Huang et al., 2022), which makes them more motivated to fulfill their social and environmental responsibilities and improve their corporate governance efficiency. Based on the above analysis, the negative effect of resource dependence on the ESG rating of enterprises is mainly reflected in SOEs. Therefore, the third hypothesis of this paper is proposed.

**Hypothesis 3:** The effect of resource dependence on ESG performance is non-consistent for firms with different ownership properties, and the negative effect is particularly pronounced for state-owned enterprises.

## 3 Empirical strategy and data sources

### 3.1 Data sources

This paper uses the data of China's A-share listed companies as a research sample. Among them, the corporate ESG data comes from Bloomberg Financial Terminal, and the rest of the data comes from the Wind database, China Stock Market & Accounting Research Database (CSMAR) and national statistics Bureau, etc. Before the empirical analysis, preliminary screening and processing of sample data are carried out: companies in the financial industry are excluded; ST companies are excluded; companies whose ESG scores are missing values are excluded; companies whose main financial management data are missing values are excluded. Based on data availability and excluding the impact of the 2008 financial crisis, this article has chosen 2011-2020 as the research interval for this article.

### 3.2 Model and variables

Using the data of all A-share listed companies from 2011 to 2020, this paper constructs the following measurement model to examine the relationship between resource dependence and corporate ESG scores. The baseline estimation model used in this paper is as follows:

$$y_{i,t} = \beta_0 + \beta_1 \ln Resource_{i,t} + \beta_2 X_{i,t}^c + \sigma_j + t + \varepsilon_{i,t} \quad (1)$$

Among them,  $y_{i,t}$  indicates ESG score of corporate  $i$  in year  $t$ , using Bloomberg ESG score. Since 2009, Bloomberg has collected information on environmental, social and governance disclosures of listed companies, and based on this, a comprehensive ESG score and three sub-scores have been formed, representing the overall ESG performance of listed companies and the sub-performance of environmental, social and governance. Bloomberg ESG scores range from 0-100, representing a scale from “disclosing the least amount of ESG data points” to “disclosing every ESG data point collected by Bloomberg”. The higher the score, the better the corporate ESG performance. In  $Resource_{i,t}$  represents the resource dependence at the provincial level. Previous studies have used indicators such as the proportion of fixed asset investment in the extractive industry (Xu and Wang, 2006) and the proportion of the mining industry in the total population (Li and Zou, 2018) to measure resource dependence. Drawing on Hu and Yan, (2019), we use the ratio of the employed population in the mining industry to the total urban employed population as a proxy variable. In order to avoid potential heteroscedasticity and skewness problems, we take the logarithm of this ratio.  $\sigma_j$  is the industry fixed effect, and  $t$  is the year dummy variable.  $X_{i,t}^c$  represents the control variables at the enterprise level. This paper draws on the research of Harjoto and Wang (2020) and selects the control variables according to other factors that may affect the ESG performance of enterprises: enterprise age, enterprise size, return on equity, asset-liability ratio, enterprise ownership nature, board size, proportion of female directors in the board of directors, proportion of independent directors in the board of directors, and separation rate of two positions. The definitions of the variables are shown in Table 1.

## 4 Empirical results

### 4.1 Descriptive statistics

The descriptive statistics of the variables are shown in Table 2. In all samples, the mean value of corporate ESG score is 1.240, which is far lower than the median of 19.835, indicating that the ESG evaluation of sample companies is average and needs to be further improved. At the same time, the maximum value of the ESG score of the sample companies is 64.115, the minimum value is 1.240, and the standard deviation is 7.023. It can be seen that there are great differences in the ESG scores among the sample companies.

### 4.2 Benchmark regression results

This part conducts regression analysis on the correlation between enterprise ESG score and resource dependence according to Equation 1, and the results are listed in Table 3. Column (1) is the regression result that only controls the industry-fixed effect. The regression result shows that resource dependence has a significant negative impact on the ESG score of enterprises. Column (2) further

TABLE 1 Definition and description of main variables.

Type	Variable name	Symbol	Description
Explained variable	Corporate ESG Score	ESG	Bloomberg ESG Score
Explanatory variables	resource dependency	Resource	Mining Employment/Urban Employment
	business age	Age	2022-year of establishment of the company
	Enterprise size	Size	Total assets
	Roe	Roe	Net Profit/Total Owner's Equity
	Assets and liabilities	Lev	Total Liabilities/Total Assets
Control variable	nature of ownership	Sate	1=state-owned enterprise, 2=private, 3=foreign capital, 4=other
	Board size	Board	Board of Directors
	Proportion of women on the board	Woman	Number of women on board/Number of board members
	Proportion of independent directors in the board of directors	Indep	Number of Independent Directors/Number of Board of Directors
	Separation rate of two jobs	Dual	Separation rate of two jobs

controls the year-fixed effect, and the coefficient of resource dependence is still significantly negative at the 5% level. Column (3) adds a series of control variables, and the coefficient is still significantly negative at the 1% level. The benchmark regression results show that resource dependence has a strong explanatory power on corporate ESG scores, that is, companies in areas with high resource dependence have worse ESG performance and sustainable development. From Table 3, the estimated value of the coefficient for resource dependency is 0.420, it means for every 10% increase in resource dependence, the ESG score of the enterprise decreases by 0.04%.

As far as the coefficients of the control variables are concerned, the coefficient of  $\ln Size$  is positive and significant at the 1% level, indicating that larger firms are more likely to have the advantage of economies of scale and thus perform better in ESG scores. The coefficient of  $\ln Age$  is significantly positive at the level of 1%, which indicates that the older the enterprise is, the stronger its motivation to pursue sustainability and the better its ESG performance. The coefficient of  $\ln ROE$  is significantly positive, which indicates that good company operations are conducive to improving a corporate ESG performance. The coefficient of  $\ln Lev$  is significantly negative at the level of 1%, which indicates that the higher the ratio of total liabilities to total assets, the less incentive a company has to improve its ESG performance. In addition, the significant positive correlation between  $Indep$  and the ESG score of the company

TABLE 2 Variable definitions and descriptive statistics.

variable	N	mean	sd	min	p50	max
ESG	9892	20.698	7.023	1.240	19.835	64.115
Resource	9892	0.020	0.031	0.000	0.006	0.222
Age	9892	23.846	5.256	6.000	24.000	55.000
Size	9892	16.750	84.040	0.003	3.577	2733.000
Roe	9892	0.090	5.372	-207.397	0.068	713.204
Lev	9892	0.438	0.524	-0.195	0.418	63.971
State	9892	1.664	0.600	1.000	2.000	4.000
Board	9892	8.582	1.707	0.000	9.000	18.000
Woman	9892	0.146	0.130	0.000	0.111	0.800
Indep	9892	0.376	0.056	0.167	0.364	0.800
Dual	9892	4.632	7.533	-7.640	0.000	56.109

indicates to some extent that independent directors play an important role in the long-term development of the company.

### 4.3 Robustness test

#### 4.3.1 Replace the measurement of the explained variable

In order to test the reliability of the relationship between resource dependence and enterprise ESG score, we replace the measurement method of the explained variable to test the robustness. We use the ESG rating data of SynTao Green Finance as the proxy variable of enterprise ESG. Due to data availability, the time frame here is 2015–2020. Since 2015, SynTao Green Finance's ESG rating has been used to rate the ESG performance of listed companies based on the public information of listed companies and the announcement documents of regulatory authorities. It is constructed from 3 primary indicators (environmental, social and governance), 13 secondary indicators and multiple tertiary indicators, which can comprehensively reflect the ESG performance of listed companies. The rating of SynTao Green Finance consists of ten grades: A+, A, A-, B+, B, B-, C+, C, C-, and D. We assign 1–10 to these ten grades from low to high. The first column of Table 4 is the regression result of SynTao Green Finance ESG rating as the explained variable. The regression result shows that the coefficient of resource dependence is still significantly negative, which is consistent with the benchmark regression result.

#### 4.3.2 Controlling province-time fixed effect

Although we control for a range of control variables at the firm level, provincial-level influences on corporate ESG performance may still be missed in the benchmark regression analysis because our explanatory variables are resource-dependent data at the provincial level. Provinces may have different economic development trends and social environments over time. For example, provincial-level environmental regulations may impose

energy-saving and emission reduction constraints on local enterprises, thereby affecting their ESG performance. Therefore, we will incorporate provincial-level environmental regulations (ER, ER is measured by the chemical oxygen demand emissions in the province where the enterprise is located) into the model for regression analysis. In addition, to avoid the impact of other provincial level economic and social environments that change over time on corporate ESG, we further add the interaction term of province and year to the model for regression analysis. The results in column (2) of Table 4 show that after controlling for the ER and province-year fixed effect, the coefficient of resource dependence is still significantly negative at the 1% level.

#### 4.3.3 Eliminating extreme effects

Winsorization is a commonly used method for robustness testing, which replaces values beyond the set percentile with values at the percentile to effectively avoid the impact of extreme values on the model estimation results. This article winsorize 1% and 5% for continuous variables, and then re-regresses using the winsorized variable values. According to the regression results in columns (3) and (4) of Table 4, the estimated coefficient of resource dependence is significantly negative at the 1% level. Therefore, the conclusion that resource dependence has a negative impact on corporate ESG performance is still robust and reliable after eliminating extreme effects.

#### 4.3.4 Eliminate provinces with high resource dependence

China has a vast territory, and the distribution of natural resources is very unbalanced among regions. There are many resource-based cities in the central and western regions. At the same time, from the descriptive statistical results, there is a large gap between the median and the maximum resource dependence level. In order to avoid the influence of extreme values on the benchmark regression results, we exclude resource-dependent provinces from the sample. The criteria for the exclusion of resource-based provinces here are first to select the first few provinces in

TABLE 3 Benchmark regression results.

variable	(1) ESG	(2) ESG	(3) ESG
lnResource			-0.501***
			-0.349**
	(0.148)	(0.169)	(0.128)
lnSize			2.253***
			(0.169)
lnAge			2.506***
			(0.762)
lnRoe			0.598*
			(0.336)
lnLev			-2.650**
			(1.134)
lnBoard			0.834
			(0.835)
Woman			-1.437
			(1.001)
Indep			3.731**
			(1.608)
Dual			0.0046
			(0.0138)
State			-0.836**
			(0.339)
Industry fixed effects	YES	YES	YES
year fixed effect	NO	YES	YES
Observations	9588	9588	8966
R <sup>2</sup>	0.114	0.164	0.320

The values in parentheses are the standard errors of clusters at the provincial level; \*\*\*, \*\*, and \* represent the significance levels of 1%, 5%, and 10%, respectively.

TABLE 4 Robustness test regression results.

Variable	(1) ESG	(2) ESG	(3) ESG	(4) ESG	(5) ESG
lnResource	-0.506**	-0.381***	-0.426***	-0.462***	-0.345**
	(0.232)	(0.113)	(0.128)	(0.141)	(0.157)
Enterprise Control Variables	YES	YES	YES	YES	YES
Industry fixed effects	YES	YES	YES	YES	YES
year fixed effect	YES	YES	YES	YES	YES
Province-Year Fixed Effects	NO	YES	NO	NO	NO
ER	NO	YES	NO	NO	NO
Observations	2773	8966	8966	8966	7901
R <sup>2</sup>	0.167	0.323	0.312	0.280	0.337

The values in parentheses are the standard errors of clusters at the provincial level; \*\*\* and \*\* represent the significance levels of 1% and 5%, respectively.

descending order of the proportion of the mining industry in urban employment, and then refer to the list of national resource-based cities in the National Sustainable Development Plan for Resource-based Cities (2013-2020). Provinces with more resource-based cities and districts are supplemented. Finally, we exclude Shanxi, Liaoning, Xinjiang, Qinghai, Inner Mongolia, Heilongjiang, Guizhou, Shaanxi, and Ningxia for regression. The regression results are shown in Column (5) of Table 4. We can find that the coefficient of resource dependence is still significantly negative at the 1% level.

## 5 Further analysis

### 5.1 Dynamic panel model

Due to the impact of previous ESG performance on current ESG performance, we use a dynamic panel model to measure the relationship between resource dependence and enterprise ESG performance through generalized moment estimation, in order to reduce estimation bias. In Equation 2,  $\varnothing_1$  is the estimation coefficient, and  $y_{i,t-1}$  represents a period of lag in the enterprise's ESG, this variable can be set to control for the endogeneity caused by lagging ESG;  $\beta_1$  is the estimated coefficient we are interested in. From the results in Table 5, the econometric results of generalized moment estimation show that the impact of resource dependence on firm's ESG is still negative and significant.

$$y_{i,t} = \beta_0 + \beta_1 \ln Resource_{i,t} + \varnothing_1 y_{i,t-1} + \beta_2 X_{i,t}^c + \sigma_j + t + \varepsilon_{i,t} \quad (2)$$

### 5.2 The sub-item impact of resource dependence on ESG

Enterprise ESG indicators are composed of three aspects: environment, society and governance. Therefore, in order to uncover the black box of the impact of resource dependence on ESG performance, we regressed the three sub-indicators to resource

TABLE 5 Dynamic panel.

Variable	(1) ESG	(2) ESG	(3) ESG
lnResource	-0.072**	-0.063**	-0.098***
	(0.030)	(0.030)	(0.030)
IESG	0.938***	0.918***	0.901***
	(0.008)	(0.010)	(0.010)
Enterprise Control Variables	NO	YES	YES
Industry fixed effects	YES	NO	YES
year fixed effect	YES	YES	YES
Observations	8516	7958	7958
R <sup>2</sup>	0.839	0.841	0.844

The values in parentheses are the standard errors of clusters at the provincial level; \*\*\* and \*\* represent the significance levels of 1% and 5%, respectively.

dependence. The sub-item data of corporate ESG adopts the data of Bloomberg Financial Terminal, and the sample interval is 2011-2020. Referring to the method of Harjoto and Wang (2020), we construct the econometric model as Equation 3:

$$y_{it}(E, S, G) = \alpha_0 + \alpha_1 \ln Resource_{i,t} + \alpha_2 X_{i,t}^c + \sigma_j + t + \varepsilon_{i,t} \quad (3)$$

The explained variables are the sub-score of corporate environment, sub-score of corporate society and sub-score of corporate governance, and the control variables are the same as the benchmark regression model. The itemized regression results are shown in Table 6.

Column (1) of Table 6 is the regression result of ESG comprehensive score on resource dependence. Columns (2) - (4) are the regression results of the sub-scores of environment, society and governance on the resource dependence, respectively. The regression result in Column (2) is significantly negative and the absolute value of the coefficient is larger than that in Column (1), which indicates that the environmental performance of enterprises in regions with high resource dependence is poor. Similarly, the regression result of Column (3) is also significantly negative, and the absolute value of the coefficient is greater than the first two columns, indicating that corporate social performance in regions with higher resource dependence is worse. This may be due to the fact that firms in these regions face greater challenges

TABLE 6 Itemized regression results.

Variables	(1) ESG	(2) E	(3) S	(4) G
lnResource	-0.421***	-0.436***	-0.751***	-0.199
	(0.128)	(0.149)	(0.168)	(0.117)
Enterprise Control Variables	YES	YES	YES	YES
Industry fixed effects	YES	YES	YES	YES
year fixed effect	YES	YES	YES	YES
Observations	9588	9588	9588	9588
R <sup>2</sup>	0.164	0.114	0.166	0.907

The values in parentheses are the standard errors of clusters at the provincial level; \*\*\* represents the significance levels of 1%.

in environmental and social dimensions. The coefficient in Column (4) is not significant, which shows that resource dependence has no impact on the corporate governance dimension, indicating that corporate governance is still more affected by internal factors.

### 5.3 Heterogeneity in enterprise ownership

Compared with non-SOEs, SOEs are more affected by the local resources and environment, and thus the ESG performance of SOs may be more vulnerable to the impact of resource dependence. Based on this, this paper further explores the heterogeneous impact of resource dependence on ESG performance from the perspective of the nature of enterprise ownership. Column (1) of Table 7 shows the regression results of SOEs. It shows that the coefficient of resource dependence is significantly negative at the level of 1%, which indicated the ESG performance of SOEs is more affected by the local resource endowment. As for non-SOEs, they are more affected by market competition, and therefore pay more attention to their investment value. Non-SOEs are more motivated to win the favor of investors through good ESG performance. Therefore, investors' attention to enterprise ESG performance will encourage non-SOEs to improve their ESG scores.

## 6 Conclusion

This article uses data from A-share listed companies from 2011 to 2020 to find that the higher the resource dependence of the company's location, the worse the ESG performance of the enterprise. This conclusion still holds after a series of robustness tests. Through regression analysis of regional resource dependence from three dimensions: environment, society, and governance, it was found that resource dependence has a significant negative impact on environmental and social performance. In areas with high resource dependence, the negative impact on enterprises may outweigh the growth effect brought by resources. The sub sample regression results based on the nature of enterprise ownership indicate that the resource dependence of state-owned enterprises has a significant negative impact on their ESG scores. However, no significant correlation was found in the sample of non-state-owned enterprises. The reason may be that non-state-owned



TABLE 7 Regression results grouped by nature of ownership.

Variable	(1) ESG	(2) ESG
InResource	-0.492***	-0.317
	(0.074)	(0.237)
Enterprise Control Variables	YES	YES
Industry fixed effects	YES	YES
year fixed effect	YES	YES
Observations	4829	4137
R <sup>2</sup>	0.353	0.235

The values in parentheses are the standard errors of clusters at the provincial level; \*\*\* represents the significance levels of 1%; the state variable is not included in the Enterprise Control Variables.

enterprises are more actively seeking the comprehensive development of ESG due to fierce market competition and financing pressure, offsetting the negative impact of resource dependence.

Based on the above analysis, we propose the following suggestions: Firstly, the particularity of the development of resource dependent regions determines that we cannot rely solely on market tools to enhance the enthusiasm and initiative of enterprises to fulfill social and environmental responsibilities. Government support and policy guidance are the practical conditions for promoting green transformation of enterprises. At the macro policy level, it is necessary to further enhance the stability of policies, form a foreseeable long-term benefit driven mechanism for the green transformation and development of enterprises, make improving social and environmental performance a consensus for the development of resource-based enterprises, and reduce the short-term risks and costs of companies fulfilling social and environmental responsibilities. At the micro policy level, in the short term, it is necessary to reduce the costs, risks, and uncertainties of implementing green transformation and fulfilling social and environmental responsibilities for high resource dependent enterprises through tilted allocation of production factors, tax incentives, and subsidies, so as to provide stable profit margins for enterprises that actively fulfill social and environmental responsibilities. At the local government level, it is necessary to continuously improve the software and hardware infrastructure of resource-based areas, actively promote the development of non resource-based enterprises, and reduce the resource dependence of regional development and the opportunity cost of green development for enterprises. Secondly, from the perspective of the capital market, relevant financial institutions should further improve their ESG ratings to provide investors with a reliable value investment foundation, thereby pointing the direction for the sustainable development of enterprises. Again, from the perspective of enterprises, resource-based state-owned enterprises are the economic mainstay of resource-based regions and the guarantee of national resource and energy strategic security. They will inevitably undertake new historical missions in the context of low-carbon transformation. On the one hand, resource-based state-owned enterprises need to improve resource utilization efficiency, enhance resource recycling level, achieve green transformation, and better fulfill social and environmental responsibilities. On the other hand, resource-

based state-owned enterprises are large and strong. They should effectively drive the social and environmental performance of industries, improve the efficiency of industrial green transformation, drive the development of resource-based regional green transformation, and improve the regional environment through the positive externalities generated by their own green transformation.

This article attempts to analyze in depth the impact of resource dependence on corporate social and environmental performance when studying the relationship between resource dependence and corporate behavior. Some conclusions have been drawn, which are consistent with the research results of relevant literature and provide reference for future research ideas and directions. With the deepening of research on enterprise resource dependence and social environmental behavior, it is necessary to improve research methods and incorporate more influencing factors, mechanism channels, and situational factors into the analysis framework. For example, the micro mechanism of the impact of resource dependence on corporate ESG performance can be explored through field research. In addition, the theoretical model of resource dependent corporate behavior still needs further expansion. The vast majority of literature typically only considers one type of corporate behavior, and there are few studies that comprehensively consider the comprehensive impact of multiple corporate behaviors. Therefore, establishing a unified theoretical framework that considers the interaction between resource dependent corporate behavior from three aspects: social, environmental, and corporate governance, and measuring its relative importance, is an important direction for future research.

## Data availability statement

The original contributions presented in the study are included in the article/supplementary material. Further inquiries can be directed to the corresponding author.

## Author contributions

YF: Formal Analysis, Methodology, Software, Writing – original draft. LF: Investigation, Software, Writing – review & editing. ZL: Methodology, Supervision, Validation, Writing – review & editing. WL: Conceptualization, Data curation, Writing – original draft.

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## Conflict of interest

Authors YF, LF, and ZL were employed by Huzhou Power Supply Company, State Grid Zhejiang Electric Power Co., Ltd.

The remaining author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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