

# Study on the Impact of Institutional Investors' Shareholding on Corporate Carbon Emissions

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**Abstract.** As the global climate change problem is becoming more and more serious, reducing carbon emissions has become an important task for the sustainable development of enterprises. As an important participant in the capital market, the shareholding behaviour of institutional investors will have an important impact on the decision-making and behaviour of enterprises. In this paper, A-share industrial enterprises are selected as research samples from 2014 to 2022 to empirically test the impact of institutional investors' shareholding on corporate carbon emissions. It is found that institutional investor shareholding can significantly reduce corporate carbon emissions. In terms of classification, compared with sensitive institutional investors, pressure-resistant institutional investors represented by funds, social security funds, QFII, and enterprise annuities have a more obvious inhibiting effect on corporate carbon emissions. The study in this paper can help us to promote enterprises to pay more attention to carbon emissions from a micro perspective, improve the long-term value of enterprises, and help to achieve the dual-carbon goal in China.

**Keywords:** institutional investors; corporate carbon emissions; pressure-resistant institutional investors.

## 1. Introduction

Global climate change is one of the major challenges facing humankind, and its impacts are becoming increasingly significant. The frequent occurrence of extreme weather events caused by climate change, such as high temperatures, droughts, floods and sea-level rise, poses a great threat to human lives, property and ecosystems. Scientific studies have shown that the increasing concentration of greenhouse gases (GHGs) in the atmosphere is the main cause of global warming, and carbon dioxide (CO<sub>2</sub>) is one of the most important GHGs. In order to mitigate the effects of climate change, countries around the world are taking measures to reduce greenhouse gas emissions in order to achieve the goal of sustainable development. Enterprises, as one of the major sources of carbon emissions, have received increasing attention for their carbon emission behaviour. Reducing corporate carbon emissions not only helps mitigate climate change, but also enhances the social image and competitiveness of enterprises.

In the capital market, institutional investors have gradually become important shareholders of enterprises. Institutional investors have professional investment knowledge and rich experience, and their investment decisions will not only affect the share price and market value of the enterprise, but also have an impact on the enterprise's operational management and strategic decisions. In recent years, with the rise of the concept of socially responsible investment, more and more institutional investors have begun to pay attention to the environmental, social and governance (ESG) performance of enterprises, and carbon emissions, as one of the important indicators of environmental performance, have also received the attention of institutional investors.

The main contributions of this paper are: first, it expands the relevant research on the consequences of institutional investors' shareholding. More studies in the existing literature are on the impact of institutional investors' shareholding on corporate governance, corporate performance, corporate innovation, corporate social responsibility, etc. This paper directly explores the impact of institutional investors on corporate carbon emissions, which provides a new perspective for other scholars' studies in the future. Second, it enriches the research on the factors influencing corporate carbon emissions.



Thirdly, by studying the relationship between institutional investors' shareholding and corporate carbon emissions, it guides institutional investors to make value investments and standardise the operating behaviour of listed companies, which helps to promote the healthy development of the capital market and push forward the transformation of the country's economic development model to a low-carbon economic development model.

## **2. Literature Review and Research Hypotheses**

### **2.1. Literature review**

#### **2.1.1. Institutional investor shareholding and corporate governance**

As the proportion of institutional investors' shareholdings in enterprises continues to increase, their voice and influence in enterprises is growing, and their role in the development of enterprises and society as a whole is becoming increasingly apparent. Discussions around institutional investors at home and abroad have always been an important issue of academic concern. Regarding the relationship between institutional investors and corporate governance, there are currently three views in academia: the "effective supervision hypothesis", the "negative supervision hypothesis" and the "ineffective supervision hypothesis". The effective monitoring hypothesis argues that institutional investors' shareholding has a positive impact on corporate governance. Bronson et al. (2006)<sup>[1]</sup> (2006) argued that institutional investors are able to use proposals and voting to exert pressure on management and governance to strengthen corporate internal controls, and therefore the more management will take the initiative to improve internal management reporting. Helwege J et al. (2011)<sup>[2]</sup> (2011) found that when the proportion of shares held by institutional investors increases, institutional investors are able to actively participate in corporate management and avoid "voting with their feet" behaviour. Weng Hongbo and Wu Shinong (2007)<sup>[3]</sup> (2007) empirically studied the relationship between institutional investors and corporate governance, and the results show that institutional investors can effectively play their monitoring and governance functions, and the higher the proportion of institutional investor shareholding, the lower the possibility of listed companies to "pay out cash in bad faith". The negative monitoring hypothesis suggests that institutional investors' shareholding will have a negative impact on corporate governance. Long Zhenhai (2010)<sup>[4]</sup> analysed the role of institutional investors in China against the background of the tender offers that took place in Shenzhen and Shanghai between 2005 and 2008, and found that institutional investors could not increase the cumulative abnormal returns of the company during the trading period, and could not significantly increase the value of the company at the end of the trading period, which indicated that institutional investors could not play a positive role in the governance of the company in China. The view of ineffective monitoring hypothesis suggests that institutional investors hold shares only for market speculation and will not participate in corporate governance. Gillan and Starks (2003)<sup>[5]</sup> According to the stakeholder theory, when the business condition is good and institutional investors' own interests can be guaranteed, they will actively participate in corporate governance and work to improve the company's performance. However, when firms are not doing well, institutional investors will reduce their shareholdings and have a negative attitude towards corporate governance.

#### **2.1.2. Factors affecting corporate carbon emissions**

Currently, research on the factors influencing carbon emissions in academia mainly includes two levels: macro and micro. From the macro level, the existing domestic and foreign related literature mainly analyses from three perspectives: economic growth, financial development and financial structure. From the perspective of economic growth, the early environmental Kuznets curve found an inverted U-shaped relationship between economic growth and carbon emissions. Tu Zhengge (2012)<sup>[6]</sup> (2012) found that there is a significant positive correlation between economic scale and carbon emissions, and the larger the economic scale, the larger the carbon emissions of enterprises, specifically, a 1% increase in economic scale increases carbon emissions by 15 million tonnes. From the perspective of financial development, a developed financial sector promotes consumption, which

in turn increases carbon dioxide emissions.<sup>[7]</sup> (2011) found that an increase in the size of financial intermediation in China positively affects firms' carbon emissions, with the size of the stock market having an equivalent effect. From the perspective of financial structure, Ye Chusheng et al. (2019)<sup>[8]</sup> empirical analysis using systematic GMM found that market-based financial structure can promote corporate innovation to reduce carbon emissions, while Chen Xiangyang (2020)<sup>[9]</sup> on the other hand, found that a bank-led market can significantly increase CO<sub>2</sub> emissions. At the micro level, firms' own decision-making behaviour also affects carbon emission levels. Alam et al. (2019)<sup>[10]</sup> found that enterprises' increased investment in research and development significantly reduces their carbon emissions and improves their environmental performance. Wang Jintao et al. (2022)<sup>[11]</sup> The study concluded that green credit can promote enterprises to carry out research on green technology, which in turn reduces carbon emissions.

### **2.1.3. Institutional Investor Ownership and Corporate Carbon Emissions**

In the extant literature at home and abroad, there is little research on the relationship between institutional investors' shareholding and corporate carbon emissions. Most of the existing literature studies the impact of institutional investors on corporate environmental performance, and the vast majority of scholars believe that institutional investor shareholding is conducive to improving corporate environmental performance and enhancing corporate environmental performance. Guan Jian et al. (2020)<sup>[12]</sup> (2020) argue that institutional investors, as important external shareholders and stakeholders of enterprises, can participate in corporate governance and supervision, effectively reduce corporate environmental violations and urge enterprises to improve their environmental management level and environmental performance. Niu Biao et al. (2023)<sup>[13]</sup> (2023) take 2011-2021 Shanghai and Shenzhen A-share listed companies as research samples, empirical research found that common institutional investors can promote corporate environmental performance by improving corporate governance, optimising industry competition and alleviating financing constraints. On the one hand, most scholars believe that institutional investor shareholding positively affects corporate social responsibility performance, which in turn motivates corporations to take responsibility for the environment. Chen Tao et al. (2020)<sup>[14]</sup> constructed a two-stage instrumental variable model based on the Russell 3000 big data in the U.S. The empirical results show that there is a significant positive correlation between the shareholding ratio of institutional investors and the social responsibility performance of companies. Yuan Dongmei et al. (2021)<sup>[15]</sup> argued that institutional investors can enhance CSR performance by improving the company's information transparency and optimising the company's governance structure. On the other hand most scholars believe that institutional investors' shareholding will promote corporate environmental information disclosure, which promotes enterprises to strengthen environmental protection and improve corporate environmental performance. Wegene and Elayan (2013)<sup>[16]</sup> Using Canadian companies as a sample, the study found that institutional investor shareholding can significantly enhance the quality of corporate environmental information disclosure. Sheng Chunguang et al. (2021)<sup>[17]</sup> Taking 172 enterprises with rating B or above in China's 2015-2019 Shangdao Green Finance ESG database as a research sample, they argued that stable institutional investors pay more attention to the long-term value of enterprises, so they will strengthen enterprises' understanding of the concept of carbon neutrality through their own supervisory function and professional ability, which will then enhance the quality of enterprises' carbon information disclosure.

By combing the domestic and international literature, it can be found that institutional investors have a significant positive impact on corporate environmental performance, but few scholars have examined in detail whether they can have a certain positive impact on corporate carbon emission reduction.

## 2.2. Research hypotheses

### 2.2.1. The impact of institutional investors' shareholdings on corporate carbon emissions

In fact, the ability of institutional investors to influence corporate carbon emissions depends directly on whether they have sufficient motivation and ability to participate in corporate governance and play the role of "watchdog" in corporate governance, which in turn influences corporate carbon emissions.

From the perspective of motivation, institutional investors are concerned about corporate carbon emissions for both financial and social reasons. On the one hand, from the perspective of financial incentives, institutional investors, as shareholders of the company, aim to maximise their investment returns. According to the stakeholder theory, institutional investors will actively participate in the operation and management of the company in order to improve their own income, and help the company to develop more correct business strategies. Firstly, in terms of returns, foreign scholars Chapple et al. (2013)<sup>[18]</sup> found that the market value of companies with higher carbon emissions is about 8 per cent lower than that of companies with lower carbon emissions by using data from Australia. Domestic scholars have shown that there is a significant negative correlation between the level of corporate carbon emissions and corporate value, and higher carbon emissions will have a negative impact on corporate value. It can be said that higher corporate carbon emissions will have a negative impact on the company's profitability, thus reducing the company's value. Secondly, in terms of cost, the traditional "voting with feet" behaviour of institutional investors will lead to higher exit costs and search costs, so rational institutional investors gradually shift from "voting with feet" to "voting with hands". Therefore, rational institutional investors are gradually shifting from "voting with their feet" to "voting with their hands", actively participating in corporate governance and paying attention to the long-term value of the company (Gillan and Starks, 2003).<sup>[5]</sup> Institutional investors are therefore more active in corporate governance than in "voting with their feet". Therefore, after holding the shares of a company, institutional investors will be motivated to reduce carbon emissions to protect their own interests in order to avoid damage to the value of their own investment portfolios. On the other hand, according to the theory of CSR, national governments and the public are increasingly concerned about corporate social responsibility and environmental protection behaviour, so enterprises should actively fulfill their social responsibility while achieving their own interests. Faced with social moral constraints and public opinion pressure, institutional investors will actively promote enterprises to reduce carbon emissions in order to establish a good corporate image of environmental protection and responsibility and enhance social value (Azar et al., 2021)<sup>[19]</sup>.

From the perspective of capability, compared with ordinary individual investors, institutional investors are large in scale and have a lot of experience and strong capital, and have a deep understanding of the capital market and the industry itself, which makes them more capable of monitoring the behaviour of companies. At the same time, institutional investors are more professional and more inclined to obtain more benefits from long-term investment, so they can understand the importance of reducing carbon emissions more deeply and pay attention to the long-term development of enterprises. According to the theory of shareholder activism, once the management makes decisions related to polluting the environment, institutional investors have the ability to veto the unfavourable proposals of the management at the shareholders' meeting and actively exercise their right to monitor.

Therefore, the larger the proportion of shares held by institutional investors, the more effective they are in promoting corporate environmental protection and reducing corporate carbon emissions. In summary, when institutional investors hold shares, there is both the motivation and ability to reduce corporate carbon emissions.

Based on the above analyses, the following hypotheses are proposed in this paper:

H1: There is a significant negative correlation between institutional investors' shareholding and corporate carbon emissions, i.e. institutional investors' shareholding can promote corporate carbon emission reduction.

## **2.2.2. The Impact of Heterogeneous Institutional Investor Shareholdings on Corporate Carbon Emissions**

Institutional investors are significantly heterogeneous, and if heterogeneity is not taken into account in studies examining the role of institutional investors in influencing corporate carbon emissions, the resulting structure may obscure some of the role of institutional investors. Brickley et al. (1988)<sup>[20]</sup> categorised institutional investors into pressure-sensitive and pressure-resistant based on whether they have possible business ties with investee firms. The difference between pressure-resistant and pressure-sensitive institutional investors is that the former are relatively independent and subject to capital market regulation, and will take the initiative to monitor management and major shareholders and actively participate in corporate governance for the sake of long-term development, demanding more specific, timely and robust information reporting so as to improve the quality of information disclosure of investee firms and to actively participate in corporate governance to enhance corporate governance and promote the growth of corporate value. The following are some examples of stress-sensitive investors. Comparatively speaking, pressure-sensitive investors have business dependence with investee companies, pay more attention to immediate interests, are susceptible to the control of major shareholders and management, and lack the independence of information disclosure, which leads to the phenomenon of "voting with one's feet", thus damaging the value of the enterprise. Therefore, pressure-resistant institutional investors are more capable of understanding the importance of carbon emission reduction, and are more motivated and capable of pushing enterprises to innovate environmental protection technology and reduce carbon emissions.

Based on the above analyses, the following hypotheses are proposed in this paper:

H2: Stress-resistant institutional investors' shareholdings can have a more significant dampening effect on corporate carbon emissions than stress-sensitive institutional investors.

## **3. Research design**

### **3.1. Data sources**

This paper selects the industrial listed companies in Shenzhen and Shanghai A-shares from 2014 to 2022 as the initial sample, based on the principle of sample specification, this paper screens or treats the sample as follows: (1) exclude ST, \*ST companies and samples with missing main variables; (2) to reduce the impact of outliers, this paper shrinks the tail of all the continuous variables at the 1% level; and finally obtains 19,759 observations. The data used include institutional investors' shareholding ratio, corporate carbon emissions, basic information of listed companies, financial data, and trading data. The carbon emissions, fossil energy consumption, and electricity and heat consumption used in this paper are manually collected from the social responsibility reports, sustainable development reports, and environmental reports disclosed by enterprises every year, and other data are from CSMAR database and WIND.

### **3.2. Selection of variables**

#### **3.2.1. Explained variables**

The explanatory variable in this paper is corporate carbon emissions (GHG), drawing on Wang Hao et al. (2022)<sup>[21]</sup>'s methodology, corporate carbon emissions can be categorised into three scopes according to the GHG Accounting System. Scope 1 is direct GHG emissions, which arise from sources owned or controlled by the enterprise, such as combustion emissions from boilers, furnaces, and vehicles owned or controlled by the enterprise; and emissions from chemical production from process equipment owned or controlled by the enterprise. Scope II accounts for indirect GHG emissions from purchased electricity and heat consumed by an enterprise. Scope III emissions take into account all other indirect emissions that are the result of a company's activities but do not arise from sources owned or controlled by the business. Examples include raw materials purchased for mining and production, fuels purchased for transport, as well as the use of products and services sold,

and transport rides taken by employees and customers. Scope I and Scope II carbon emissions are mandatory disclosures required by the System of Greenhouse Gas Accounting (SGGA), and the total carbon emissions examined in this paper refer to the sum of Scope I and Scope II emissions, as measured by the natural logarithm of carbon emissions.

### 3.2.2. Explanatory variables

The explanatory variable in this paper is the institutional investor shareholding ratio (INST), which is the number of shares held by institutional investors as a percentage of the number of shares outstanding, and the data is obtained from the WIND database. In addition drawing on Yang Haiyan et al. (2012)<sup>[22]</sup> et al. (2012), this paper categorises funds, social security funds, QFIIs, and corporate pensions as pressure-resistant institutional investors (Preresi), while pressure-sensitive institutional investors (Presenti) include insurance companies, trust companies, and brokerage wealth management products.

### 3.2.3. Control variables

Drawing on previous studies, this paper takes other variables that may affect the carbon emissions of enterprises as control variables, including: enterprise size, gearing ratio (Lev), return on assets (ROA), cashflow ratio (Cashflow), growth rate of operating income (Growth), book-to-market ratio (BM), the company's founding years (Age), R&DIntensity, industry (Industry), year (Year). RDIntensity), Industry, Year.

**Table 1.** Definition of variables

Nature of the variable	variable name	variable symbol	Variable Definition
explanatory variable	carbon footprint	GHG	Natural logarithm of carbon emissions
	Institutional investors' shareholding	INST	Number of shares held by institutional investors as a percentage of shares outstanding
explanatory variable	Stress-resistant institutional investors	Preresi	Funds, social security funds, QFIIs, enterprise pensions
	Stress-sensitive institutional investors	Presenti	Financial products of insurance companies, trust companies and brokerage firms
control variable	Enterprise size	Size	Natural logarithm of total assets for the year
	gearing	Lev	Total liabilities at year-end divided by total assets at year-end
	return on assets	ROA	Net profit/average balance of total assets
	Cash flow ratio	Cashflow	Net cash flows from operating activities divided by total assets
	Growth rate of operating income	Growth	Current year's operating income/previous year's operating income - 1
	Book-to-market ratio	BM	Book value/total market value
	Years of incorporation	Age	Ln (current year - year of incorporation + 1)
	R&D investment intensity	RDIntensity	R&D expenditure divided by operating revenue
	sector	Industry	Industry dummy variables
	year	Year	Annual dummy variables

### 3.3. Econometric modelling

The basic empirical model of this paper is as follows:

$$GHG_{it} = \alpha + \beta INST_{it} + \gamma Control_{it} + \sum Industry + \sum Year + \varepsilon_{it} \quad (1)$$

In the regression equation, the explanatory variable  $GHG_{it}$  is the natural logarithm of carbon emissions, and the main explanatory variable is the shareholding of institutional investors in the company, denoted by  $INST_{it}$  denoted.  $Control_{it}$  represents the control variable, and  $\varepsilon_{it}$  represents the random error term.

## 4. Empirical findings

### 4.1. Descriptive statistics

Table 2 shows the descriptive statistics of the main variables in this paper. The mean value of carbon emissions of enterprises is 11.56, the maximum value is 15.75, and the minimum value is 8.568, and there is a certain gap between the carbon emissions of enterprises. Meanwhile, the mean value of institutional shareholding ratio is 37.2, which indicates that institutional investors have occupied an important position in the shareholding structure of listed companies in China, and thus their influence on corporate governance decisions should not be ignored. The statistical values of other variables are basically consistent with previous literature.

**Table 2.** Descriptive statistics

variable	N	mean	p50	sd	min	max
GHG	19759	11.56	11.40	1.455	8.568	15.75
INST	19759	0.372	0.378	0.243	0	0.885
Size	19759	22.29	22.08	1.335	20.02	26.41
Lev	19759	0.412	0.403	0.201	0.0590	0.884
ROA	19759	0.0460	0.0420	0.0620	-0.192	0.227
Cashflow	19759	0.0520	0.0510	0.0660	-0.138	0.239
Growth	19759	0.177	0.113	0.382	-0.495	2.355
BM	19759	1.042	0.636	1.252	0	7.711
Age	19759	2.946	2.996	0.301	2.079	3.526
RDIntensity	19759	3.998	3.460	3.840	0	21.69

### 4.2. Benchmark regression results

Table 3 shows the results of the baseline regression of the effect of institutional shareholding on firms' carbon emissions, where the explanatory variable is the natural logarithm of firms' carbon emissions. The coefficient of institutional investors' shareholding ratio in column (1) of Table 3 is significantly negative at the 1% level, indicating that institutional investors can significantly reduce corporate carbon emissions. After controlling for industry and year in the regression in column (2), the sign of the regression coefficient remains consistent with significance, verifying hypothesis 1.

**Table 3.** Institutional investor shareholdings and corporate carbon emissions

	(1) GHG	(2) GHG
INST	-0.142*** (-5.869)	-0.128*** (-5.305)
Size	0.730*** (67.689)	0.732*** (66.576)
Lev	0.302*** (7.364)	0.301*** (7.247)
ROA	1.425*** (17.447)	1.392*** (17.066)
Cashflow	0.505*** (8.120)	0.446*** (7.121)
Growth	0.326*** (35.562)	0.332*** (35.775)
BM	-0.011** (-1.966)	-0.022*** (-3.593)
Age	0.481*** (14.357)	0.098 (1.070)
RDIntensity	-0.024*** (-11.200)	-0.027*** (-12.381)
cons	-6.254*** (-31.073)	-5.045*** (-13.432)
N	19759	19759
R <sup>2</sup>	0.485	0.490
Industry	NO	Yes
Year	NO	Yes

Note: t-values are in parentheses. Errors are robust values. \* indicates significant at the 10 per cent level, \*\* indicates significant at the 5 per cent level, and \*\*\* indicates significant at the 1 per cent level.

### 4.3. Heterogeneity analysis

The regression results are shown in Table 4, and columns (1) and (2) show the regression coefficients of the shareholding ratio of resistant and sensitive institutional investors on the carbon emissions of enterprises, respectively. It can be seen that the regression coefficient of resistant institutional shareholding is -0.127 and significant at 1% level, while the regression coefficient of sensitive institutional shareholding is not significant. This indicates that there is heterogeneity in the impact of different types of institutional investors on corporate carbon emissions. Compared with pressure-sensitive institutional investors, pressure-resistant institutional investors' shareholding can inhibit corporate carbon emissions more significantly, which verifies Hypothesis 2.

**Table 4.** Shareholdings of different types of institutional investors and corporate carbon emissions

	(1) GHG	(2) GHG
Preresi	-0.127*** (-5.266)	
Presenti		-0.056 (-0.192)
Size	0.732*** (66.573)	0.727*** (66.315)
Lev	0.302*** (7.267)	0.299*** (7.182)
ROA	1.391*** (17.058)	1.398*** (17.120)
Cashflow	0.446*** (7.125)	0.446*** (7.121)
Growth	0.333*** (35.778)	0.332*** (35.646)
BM	-0.022*** (-3.599)	-0.020*** (-3.316)
Age	0.098 (1.066)	0.084 (0.918)
RDIntensity	-0.027*** (-12.373)	-0.027*** (-12.423)
cons	-5.042*** (-13.426)	-4.931*** (-13.139)
N	19759	19759
R <sup>2</sup>	0.490	0.490
Industry	Yes	Yes
Year	Yes	Yes

Note: t-values are in parentheses. Errors are robust values. \* indicates significant at the 10 per cent level, \*\* indicates significant at the 5 per cent level, and \*\*\* indicates significant at the 1 per cent level.

## 5. Endogeneity analysis and robustness tests

### 5.1. Endogenous analysis

To address the endogeneity between institutional investor shareholding and firms' carbon emissions, i.e., firms with lower carbon emissions may be more attractive to institutional investors for shareholding, this paper re-runs the regression test of model (1) using the instrumental variables approach. Drawing on Rubin and Smith (2009)<sup>[23]</sup>, Ye Jianfang et al. (2009)<sup>[24]</sup> and Chuntao Li et al. (2018)<sup>[25]</sup> approach, this paper selects the annual stock turnover rate (Turn) as an instrumental variable

for institutional investors' shareholding ratio. The reason why the annual stock turnover rate is selected as an instrumental variable for institutional shareholding is that the annual stock turnover rate is the frequency of stock turnover in the market within a certain period of time, and since the annual stock turnover rate is only based on the daily average data of the past year, and there is no correlation with the company's carbon emissions, which makes the selection of the annual stock turnover rate as an instrumental variable for institutional shareholding satisfy the "exogenous" nature of the instrumental variable to a certain extent. "exogenous" condition.

After controlling for the endogeneity of the model, model (1) is re-regressed and the instrumental variable regression results are presented in Table 5. column (1) presents the first stage regression results, from which it can be seen that institutional investor shareholding is significantly negatively correlated with the annual stock turnover rate. The under-identification test and the weak identification test indicate that the instrumental variables in this paper are valid. Column (2) shows the regression results of institutional investors' shareholding on firms' carbon emissions after controlling for the endogeneity of the model, which is consistent with the previous benchmark regression results.

**Table 5.** Instrumental variable regression results

	(1) First-stage regression INST	(2) Second-stage regression GHG
Turn	-0.039*** (-20.349)	
INST		-1.132*** (-6.498)
Size	0.048*** (13.681)	0.776*** (56.191)
Lev	0.018 (1.320)	0.327*** (7.555)
ROA	-0.042 (-1.595)	1.374*** (15.938)
Cashflow	0.003 (0.136)	0.499*** (7.653)
Growth	0.008*** (2.686)	0.334*** (34.338)
BM	-0.014*** (-7.290)	-0.023*** (-3.594)
Age	0.118*** (4.040)	0.616*** (14.561)
RDIntensity	0.001 (0.769)	-0.023*** (-10.360)
cons	-0.954*** (-7.947)	- -
N	19759.000	19384.000
R <sup>2</sup>	0.085	0.432
Industry	Yes	Yes
Year	Yes	Yes

Note: t-values are in parentheses. Errors are robust values. \* indicates significant at the 10 per cent level, \*\* indicates significant at the 5 per cent level, and \*\*\* indicates significant at the 1 per cent level.

## 5.2. Robustness tests

### 5.2.1. Replacement of explanatory variables

The explanatory variables in this paper are defined as the natural logarithm of the firm's carbon emissions from Scope I direct GHG emissions and Scope II indirect GHG emissions from purchased electricity and heat consumed by the firm. Scope III emissions take into account all other indirect

emissions that are the result of the firm's activities but do not arise from sources owned or controlled by the firm. The natural logarithm of Scope I corporate carbon emissions, which is also referenced in this paper in Wang Hao et al. (2022)<sup>[21]</sup> The regression results are shown in Table 6, which shows that regardless of whether the indirect emissions in Scope 3 are taken into account or not, the proportion of institutional investors' shareholding is significantly negatively correlated with the carbon emissions of enterprises. emissions are significantly negatively correlated. Meanwhile, if carbon emission intensity is used to measure corporate carbon emissions, the proportion of institutional investors' shareholding still has a significant negative impact on it.

**Table 6.** Measurement of replacement of explanatory variables

	(1) GHG	(2) GHG1	(3) GHGint	(4) GHGint1
INST	-0.128*** (-5.305)	-0.128*** (-5.304)	-0.152*** (-13.017)	-0.325*** (-12.976)
Size	0.732*** (66.576)	0.733*** (66.603)	-0.041*** (-7.644)	-0.087*** (-7.589)
Lev	0.301*** (7.247)	0.299*** (7.189)	0.019 (0.935)	0.038 (0.869)
ROA	1.392*** (17.066)	1.389*** (17.028)	0.171*** (4.291)	0.365*** (4.269)
Cashflow	0.446*** (7.121)	0.448*** (7.150)	-0.101*** (-3.347)	-0.215*** (-3.309)
Growth	0.332*** (35.775)	0.332*** (35.742)	0.083*** (18.330)	0.178*** (18.337)
BM	-0.022*** (-3.593)	-0.022*** (-3.620)	0.012*** (4.062)	0.026*** (4.077)
Age	0.098 (1.070)	0.101 (1.104)	-0.144*** (-3.229)	-0.302*** (-3.167)
RDIntensity	-0.027*** (-12.381)	-0.027*** (-12.378)	-0.000 (-0.042)	-0.000 (-0.041)
cons	-5.045*** (-13.432)	-4.294*** (-11.430)	1.874*** (10.294)	3.993*** (10.221)
N	19759	19759	19495	19495
R <sup>2</sup>	0.490	0.490	0.064	0.064
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes

Note: t-values are in parentheses. Errors are robust values. \* indicates significant at the 10 per cent level, \*\* indicates significant at the 5 per cent level, and \*\*\* indicates significant at the 1 per cent level.

### 5.2.2. Split-sample regression

Drawing on Ailing Pan et al. (2019)<sup>[26]</sup> (2009), this paper divides the sample into two samples of heavily polluted industries and lightly polluted industries, and the identification of heavily polluted industries is mainly based on the Guidelines for Industry Classification of Listed Companies revised by the China Securities Regulatory Commission in 2012, the Management List of Industry Classification for Environmental Verification of Listed Companies formulated by the Ministry of Environmental Protection in 2008 (Letter of Huanban [2008] No. 373), and the Guidelines for Disclosure of Environmental Information of Listed Companies ( Environmental Office Letter [2010] No. 78), the group regression results are shown in Table 7. The regression coefficients of institutional investors' shareholding are significantly negative in both heavily polluted and lightly polluted industries, indicating that the results of the benchmark regression are robust, but institutional investors' shareholding in heavily polluted industries has a greater negative impact on corporate carbon emissions.

**Table 7. Split-sample regression**

	(1) Heavily polluting industries GHG	(2) Lightly polluting industries GHG
INST	-0.187*** (-4.547)	-0.105*** (-3.553)
Size	0.671*** (35.280)	0.757*** (53.615)
Lev	0.161** (2.364)	0.434*** (8.082)
ROA	1.353*** (10.156)	1.455*** (14.115)
Cashflow	0.344*** (3.133)	0.485*** (6.403)
Growth	0.311*** (18.659)	0.339*** (29.855)
BM	-0.019 (-1.609)	-0.016** (-2.167)
Age	0.348** (2.139)	0.040 (0.359)
RDIntensity	-0.022*** (-5.703)	-0.028*** (-10.688)
cons	-4.522*** (-7.679)	-5.666*** (-12.740)
N	6819	12940
R <sup>2</sup>	0.480	0.493
Industry	Yes	Yes
Year	Yes	Yes

Note: t-values are in parentheses. Errors are robust values. \* indicates significant at the 10 per cent level, \*\* indicates significant at the 5 per cent level, and \*\*\* indicates significant at the 1 per cent level.

## 6. Summary

This paper selects the data of Chinese A-share industrial enterprises from 2014 to 2022 to empirically test the relationship between institutional investors and corporate carbon emissions, and examine the impact of heterogeneous institutional investors on corporate carbon emissions. The results show that (1) institutional investor shareholding can significantly reduce corporate carbon emissions, and the higher the proportion of institutional investor shareholding, the lower the corporate carbon emissions; (2) compared with pressure-sensitive institutional investors, pressure-resistant institutional investors are better able to understand the importance of corporate carbon emission reduction, and are more motivated and capable of reducing corporate carbon emissions. (3) Further using instrumental variables to test endogeneity, replacing the explanatory variables, and sub-sample regression for robustness testing, the regression results are still robust.

The policy recommendations of this paper are as follows:(1) Regulator level. Regulators should improve the relevant institutional safeguards, enhance the timeliness and reasonableness of supervision, and encourage institutional investors to concentrate on investment and actively participate in field research in order to effectively play their role of supervision and governance. At the same time, it is necessary to strengthen the supervision of corporate carbon emissions and enhance the attention of corporate managers to the issue of carbon emissions. Require enterprises to regularly disclose their carbon emissions data, including direct and indirect emissions. And transparent environmental, social and governance (ESG) disclosure requirements should be formulated in accordance with international standards and frameworks. A carbon tax or carbon trading market can be constructed to increase the economic cost of carbon emissions, encourage enterprises to reduce emissions, and set a gradually rising carbon price to prompt them to invest in low-carbon technologies.

Tax incentives, financial subsidies or low-interest loans can also be provided to encourage financial institutions and investors to increase investment in low-carbon and green projects. (2) Institutional investors. Institutional investors should actively correspond to the call of national policies, take the initiative to assume social responsibility, focus on investing funds in companies with good environmental performance and carbon emission reduction targets, and carry out long-term value investment. They should collect, collate and analyse relevant reports and other disclosure information issued by enterprises in a timely manner, pay attention to financial performance while taking into account social performance, so as to identify relevant risks in a timely manner, assess investment returns, make reasonable investment decisions and achieve long-term returns. (3) Enterprise level. Enterprises themselves should raise their awareness of environmental protection and fully understand the importance of carbon emission reduction. Enterprises that pursue short-term performance returns at the expense of the environment when carrying out production and operation will not only be penalised by the relevant regulatory authorities, but will also damage their reputation level and face the risk of shutting down production and closing down. Great importance should be attached to the role of carbon performance evaluation indicators in the financial market in order to enhance enterprises' awareness of their environmental and social responsibilities, reduce information asymmetry and win investors' trust by improving their corporate governance structure and providing more information to investors. In addition, enterprises should fully implement the concept of "carbon neutrality" and incorporate carbon emission data disclosure and carbon performance indicators into their corporate assessment.

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