

# Can analyst coverage improve green innovation?- Empirical research based on China's heavy polluting enterprises

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**Abstract:** Due to the externality of green innovation and the profit-seeking nature of capital, heavy polluting enterprises usually lack effective incentives for green innovation and ignore the long-term sustainable development. In order to explore the impact of analyst coverage on the green innovation, this paper establishes a fixed effects model using panel data of heavy polluting listed enterprises in China from 2015 to 2021. We find that the analyst coverage can significantly improve the green innovation of heavy polluting enterprises. Compared with state-owned enterprises, analyst coverage has a more significant improving effect on green innovation performance in private heavy polluting enterprises. Compared with enterprises in central and western regions, analyst coverage can better promote green innovation of heavy polluting enterprises in eastern regions. This study provides empirical evidence for the guiding role of analyst coverage on the sustainable development of heavy polluting enterprises.

## 1. INTRODUCTION

Under the guidance of the development goals of carbon neutrality and carbon peak, sustainable development has become an important feature of China's economy turning to a high-quality development stage. Heavy polluting enterprises are the focus of environmental governance, and green technological innovation is an important support for promoting sustainable development of heavy polluting enterprises. However, the dual externalities of environmental and knowledge spillover effect often lead to the low willingness of heavy polluting enterprises to make green innovation, and the financing constraints and innovation risks usually restrict the green innovation ability of heavy polluting enterprises [1].

Analysts are not only an important information intermediary in the capital market, with a strong reputation transmission function, but also an important part of corporate external environmental governance. However, there are limited attention has been paid to the relationship between analyst coverage and green innovation in the existing literature, and few focus on heavy polluting enterprises. Taking the heavy polluting listed companies in China from 2015 to 2021 as the research sample, this paper empirically researches the impact of analysts coverage on enterprises green innovation, and put forward corresponding suggestions based on empirical results, so as to promote the green transformation development of heavy polluting enterprises.

## 2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Previous studies have shown various influencing factors of enterprises green innovation. From the perspective of internal enterprises mainly concerned with innovation resource, corporate governance and absorptive capacity [2]. And from the external there are pressures from three levels: first, national environmental regulatory policies such as R&D subsidy, emission charges and green credit; second, social governance of stakeholders such as media and investor attention; and third, the peer effect pressure of business competitors [3].

The analyst coverage is also the external influencing factor, and can promote green innovation in two ways. On the one hand, analyst coverage is an important part of corporate external environment governance. According to institutional theory, external governance pressure is an important driving force for enterprise green innovation. In the context of green development, the increasing attention of analysts will help increase the pressure of green innovation on heavy polluting enterprises, urge heavy polluting enterprises to actively improve production process and strengthen green technology research and development.

On the other hand, analysts are the transmission of internal green innovation information, and can help to improve the organizational transparency of heavy polluting enterprises [4]. The information asymmetry between enterprises and investors increases the difficulty of external financing, and thus limits the sustainability of enterprises green innovation. In this case, the analysts'

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dissemination of green innovation information can also help external investors to track the progress of green technology development, so as to reduce financing restricts and improve the green innovation of heavy polluting enterprises. Therefore, this paper proposes the following hypothesis:

H1. Analyst coverage can improve the green innovation of heavy polluting enterprises.

State ownership has import impact on financing and business environment of enterprises in China. Compared with state-owned heavy polluting enterprises, private heavy polluting enterprises often face more serious financing constraints, thus limiting the intensity of their green technology research and development. In this case, analysts coverage on the role of low financing costs have a more obvious appearance in private enterprises. At the same time, private capital has stronger profit motive, and the external supervision of analysts can better restrain the opportunistic behavior of private heavy polluting enterprises in pursuing economic benefits at the expense of environmental benefits. Therefore, this paper proposes the following hypothesis:

H2. Analyst coverage is more conducive to promote green innovation in private heavy polluting enterprises.

Enterprises in different regions face different institutional pressures. Compared with the central and western regions, the eastern part of China has a higher level of economic development, a higher density of population and thus a lower tolerance for environmental pollution. Heavy polluting enterprises in eastern China often face greater environmental regulatory pressure. When analyst coverage is higher, external stakeholders can understand the green R&D status of heavy polluting enterprises more specifically, so as to better urge enterprises to strengthen green technology R&D and reduce pollutant emissions. Meanwhile, the eastern region often provides relatively high environmental protection subsidies. Analysts' publicity of green innovation of heavy polluting enterprises will help improve the green reputation of enterprises, so as to obtain more preferential policies such as environmental protection subsidies and capital market financing, and promote the green innovation of heavy polluting enterprises in the eastern region. Therefore, this paper proposes the following hypothesis:

H3. Analyst coverage is more conducive to promote green innovation of heavy polluting enterprises in eastern regions.

### 3. RESEARCH DESIGN

#### 3.1. Data sources and sample selection

This paper took heavy polluting listed enterprises in China from 2015 to 2021 as the initial research sample, and the definition of heavy pollution industries is according to the Guidelines for Environmental Information Disclosure of Listed Companies issued by the Ministry of Ecology and Environment in 2010. Considering the availability of data and business stability, the data were processed as follows: eliminated samples

with unstable business operations such as ST (special treatment) and PT (particular transfer); eliminated samples without important data or outliers. Then, continuous variables were winsorized at the 1% and 99% levels to mitigate concerns of extreme values. Finally, 5397 company-annual sample observations were obtained. The green patent data of heavy polluting enterprises were mainly from the Chinese Research Data Services (CNRDS), and were supplemented by manual retrieval and search. The remaining financial performance data were used from the China Stock Market and Accounting Research Database (CSMAR).

#### 3.2. Variable Definitions

##### 3.1.1 Dependent Variables

Green innovation is measured by the number of green patent applications (Gpat) and grants (Gpatg) of heavy polluting enterprises in this paper. Compared with input perspective, the green innovative measure from the output perspective can more accurately judge the green innovation ability and innovation quality of enterprises [5].

##### 3.1.2 Independent Variables

Analyst coverage (AC) is measured by the natural logarithm of the number of analysts following plus one, and it reflects the extent to which companies are concerned by analysts and capital markets [6].

##### 3.1.3 Control Variables

In order to fully consider the influencing factors of green innovation, the control variables are respectively selected from three aspects of enterprise based on previous studies on green innovation: financial performance, including enterprise size(Size), enterprise leverage (Lev), return on assets (Roa), cash flow (Cash), enterprise growth (Growth), listing age (Age); governance structure, including two jobs in one (Dual), board size(Board); and environmental characteristics, including industry competition(HHI). Also, industry and year fixed effects are considered.

#### 3.3. Research model

In order to test the influence of analyst coverage on the green innovation of heavy polluting enterprises, this paper constructs the following fixed effects model:

$$Gpat_{i,t} = \alpha + \beta AC_{i,t} + \gamma Controls_{i,t} + \sum Year + \sum Ind + \varepsilon_{i,t} \quad (1)$$

$$Gpatg_{i,t} = \alpha + \beta AC_{i,t} + \gamma Controls_{i,t} + \sum Year + \sum Ind + \varepsilon_{i,t} \quad (2)$$

The regression coefficient  $\beta$  in formula (1) and (2) is the focus of this paper, and positive  $\beta$  represents positive effect of analyst coverage on green innovation.

## 4. RESULTS AND DISSUSION

### 4.1. Descriptive Statistics

Table 1 presents the descriptive statistical results for the main variables. Among all the 5793 samples, the average number of enterprise green patent applications and grants are only 0.390 and 0.330, and the standard deviation are 0.780 and 0.675 respectively. This indicates that the average green innovation level of Chinese heavy polluting enterprises is generally low, and the difference between the sample enterprises is large. The average value of analyst coverage in the total sample is 1.228, and varies widely from company to company. All the other control variables are distributed within a reasonable range.

**Table 1.** Descriptive statistics of the variables.

Variable	N	Mean	Std.dev	Min	Median	Max
Gpat	5793	0.390	0.780	0.000	0.000	5.037
Gpatg	5793	0.330	0.675	0.000	0.000	4.828
AC	5793	1.228	1.165	0.000	1.099	3.784
Size	5793	22.126	1.163	20.015	21.971	25.479
Lev	5793	0.410	0.193	0.070	0.399	0.937
Roa	5793	0.034	0.073	-0.340	0.036	0.205
Cash	5793	0.051	0.066	-0.142	0.048	0.242
Growth	5793	0.176	0.387	-0.525	0.117	2.327
Age	5793	2.157	0.759	0.693	2.197	3.332
Dual	5793	0.305	0.461	0.000	0.000	1.000
Board	5793	2.224	0.159	1.792	2.303	2.639
HHI	5793	0.163	0.041	0.121	0.137	0.252

### 4.2. Analyst coverage and green innovation

Table 2 reports the impact of analyst coverage on the green innovation of heavy polluting enterprises. It can be seen that the regression coefficient of analyst coverage is 0.053 in formula (1), and 0.022 in formula (2), significant at 1% and 5% levels respectively. This indicates that whether measured by the number of green patent applications or the number of grants, analyst coverage has a strong positive correlation with the green innovation of high polluting enterprises. Hypothesis 1 is proved.

**Table 2.** Analyst coverage and green innovation.

Variable	(1)	(2)
	Gpat	Gpatg
AC	0.053***	0.022**
	(0.011)	(0.010)
Size	0.158***	0.150***
	(0.014)	(0.013)
lev	0.381***	0.272***
	(0.059)	(0.052)
roa	0.278*	0.079
	(0.142)	(0.128)
Cash	0.092	-0.023
	(0.156)	(0.134)
Growth	-0.084***	-0.077***

	(0.023)	(0.021)
Age	-0.103***	-0.102***
	(0.015)	(0.013)
Dual	-0.011	-0.009
	(0.021)	(0.018)
Board	0.293***	0.258***
	(0.061)	(0.054)
HHI	-1.760**	-0.776
	(0.700)	(0.612)
Constant	-3.793***	-3.626***
	(0.310)	(0.280)
YEAR	YES	YES
IND	YES	YES
Obs.	5793	5793
Adj R2	0.132	0.116

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Standard errors are in parenthesis. Same in the table below.

### 4.3. Analyst coverage, state ownership and green innovation

Table 3 reports the impact of state ownership on the relationship between analyst coverage and green innovation of heavy polluting enterprises. It can be seen that the regression coefficients of analyst coverage in state-owned subsamples are not significant, but both positive significant at 1% level in private samples. This indicates that external regulatory pressure and information intermediary of analyst coverage can more effectively promote the green innovation of private heavy polluting enterprises. H2 is proved.

**Table 3.** Analyst coverage, state ownership and green innovation

Variable	state-owned		private	
	(1)	(2)	(3)	(4)
	Gpat	Gpatg	Gpat	Gpatg
AC	0.010	-0.032	0.086**	0.055**
	(0.025)	(0.022)	(0.011)	(0.010)
Constant	-	-	-	-
	5.559***	5.463***	2.066**	2.184**
	(0.678)	(0.596)	(0.347)	(0.334)
Controls	YES	YES	YES	YES
YEAR	YES	YES	YES	YES
IND	YES	YES	YES	YES
Obs.	1655	1655	4138	4138
Adj R2	0.163	0.157	0.100	0.085

### 4.4. Analyst coverage, regional difference and green innovation

Table 4 reports the impact of regional difference on the relationship between analyst coverage and green innovation of heavy polluting enterprises. The regression coefficients of analyst coverage in eastern regions subsample are more significant than in central and

western regions subsample. This indicates that analyst coverage can more effectively promote the green innovation of heavy polluting enterprises in eastern regions. H3 is proved.

**Table 4.** Analyst coverage, regional difference and green innovation

Variable	eastern region		central and western region	
	(1)	(2)	(3)	(4)
	Gpat	Gpatg	Gpat	Gpatg
AC	0.057** *	0.030**	0.046**	0.015
	(0.014)	(0.012)	(0.019)	(0.017)
Constant	- 3.919** *	- 3.498** *	- 3.392** *	- 3.573** *
	(0.439)	(0.393)	(0.442)	(0.407)
Controls	YES	YES	YES	YES
YEAR	YES	YES	YES	YES
IND	YES	YES	YES	YES
Obs.	3733	3733	2060	2060
R2	0.134	0.111	0.130	0.124

#### 4.5. Robustness and endogeneity test

This paper takes two ways to make robustness and endogeneity test. First, we adopt Tobit regression approach to make empirical test considering censored data attributes of patent data. Second, we performed a one-stage lag on all independent variables to mitigate the endogeneity caused by reverse causation. The empirical results are shown in table 5, which support the conclusion of this paper.

**Table 5.** Robustness and endogeneity test.

Variable	Tobit		T+1	
	(1)	(2)	(3)	(4)
	Gpat	Gpatg	F.Gpat	F.Gpatg
AC	0.184***	0.111***	0.059***	0.037***
	(0.034)	(0.032)	(0.012)	(0.010)
Constant	- 15.164* **	- 14.620* **	- 3.782***	- 3.468***
	(1.028)	(0.949)	(0.340)	(0.299)
Controls	YES	YES	YES	YES
YEAR	YES	YES	YES	YES
IND	YES	YES	YES	YES
Obs.	5793	5793	4680	4680
Adj R2	0.077	0.069	0.136	0.117

### 5. CONCLUSION

At present, environmental problems are becoming more and more serious, and the level of green innovation of heavy polluting enterprises needs to be improved. This paper discusses the influence of analyst coverage on green innovation taking 2015-2021 heavy polluting

listed enterprises as sample. The results of this paper support that analyst coverage can alleviate the information asymmetry, provide stakeholder governance pressure, and thus improve the green innovation performance of heavy polluting enterprises. Meanwhile, compared with state-owned ownership enterprises, analyst coverage is more conducive to improve green innovation of private heavy polluting enterprises; compared with central and western regions, analyst coverage is more conducive to improve green innovation of heavy polluting enterprises in eastern regions.

The main findings of this paper imply several policy recommendations. Firstly, it is necessary for government to create an incentive environment for corporate green innovation through measures such as increasing the analyst coverage. Secondly, analysts should seriously realize and think highly of the value related green innovation information embodied in heavy polluting enterprises in China. Thirdly, heavy polluting enterprises should standardize information disclosure and reduce the degree of information asymmetry by inviting analysts for research and other ways, so as to obtain external investors' fully support for their green innovation.

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