



Study on voluntary environmental regulation and ESG performance based on PSM-DID model

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Abstract. China's social and economic growth has advanced at an unprecedented rate. However, a number of governance and environmental risk concerns, such as excessive emissions by factories, recurrent safety mishaps, and internal mismanagement, have surfaced in the setting of economic development. The environmental, social, and governance performance of the corporation has grown in importance as a metric for sustainable civilization and development. The government's supporting is also necessary for the green transition since it will encourage businesses to adopt environmental responsibility. Voluntary environmental management is becoming more and more recognized as a cutting-edge policy. In addition, managers' green perspective contributes to environmental governance and management. This study examines A-share businesses from 2012 to 2022. Through the PSM-DID test and stabilization test, the results show that voluntary environmental regulations can improve the performance of manufacturing enterprises. Tests of the mediation mechanism show that the green vision it manages is an intermediary between voluntary environmental regulations and ESG performance.

Keywords: voluntary environmental regulation, ESG performance, Executive green cognition, PSM-DID.

1 INTRODUCTION

China's manufacturing sector is still too reliant on surplus material resources and an industrial development model that is energy-intensive and emits large amounts of emissions. The business has contributed particularly to ESG by integrating ecological, social, and managerial components. At the same time, the important strategic value of ESG performance for sustainable development largely depends on the efficiency of relevant policy formulation and implementation. In addition, few studies have revealed the influence mechanism of ESG performance from the internal perspective of executive cognition. As the micro-subject of enterprise management, high-level green cognition is the key factor to determine whether enterprises can actively undertake environmental protection and social responsibility.

Many academics have studied the effects of spontaneous and participatory environmental regulation on all aspects of business. Franchetti(2011) survey of 121

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manufacturing enterprises in the United States showed that ISO14001 system certification effectively reduced the rate of solid waste generation¹. Comoglioc et al.(2012) tested the Italian automobile manufacturing industry and proved that environmental management system certification can improve the environmental performance of enterprises². Martin et al.(2011) found that the more executives pay attention to environmental issues, the more likely enterprises are to adopt environmentally friendly technologies and equipment in production activities³. Zhou et al.(2021) took 133 mining enterprises as research objects. They believe that when facing external formal and informal pressure, enterprise managers bear huge environmental responsibilities, and members of the top management team are aware of the importance and legitimacy of environmental protection, so they adopt positive coping mechanisms⁴. Zhang et al.(2015) concluded that executive environmental sustainability commitment has a significant impact on corporate environmental strategic activities⁵. Belal et al. (2007) pointed out that managers' concerns about the threat of environmental legitimacy and the need to improve corporate image are the driving forces for environmental management practices⁶. KING (2000) believes that when the voluntary adoption of standardized environmental management systems is popularized to a certain extent, enterprises in the industry begin to regard this behavior as a manifestation of appropriateness⁷. Comoglioc et al. (2012) believe that environmental management system certification can improve the environmental performance of enterprises⁸.

Previous studies have mainly studied the impact mechanism of environmental regulation on ESG performance from the perspective of traditional environmental regulation. Relatively few studies have been conducted on the impact of voluntary environmental regulation on ESG performance of enterprises, and the influencing factors mainly focus on the characteristics of managers and corporate culture. It is also necessary to combine the flexibility of voluntary environmental regulation to enrich the theoretical and empirical analysis of ESG performance of enterprises. Existing studies on executives' green cognition mainly focus on the impact of executives' green cognition on enterprises' green innovation and environmental performance, etc. However, taking executives' green cognition as an intermediary to study of the impact of VER on the performance of ESG still needs additional research. Therefore, this paper selects some A-share enterprises from 2012 to 2022 as samples. By introducing managers' green cognition as a mediating variable, this paper discusses the relationship between VER and ESG performance through PSM-DID model test, parallel trend test and placebo test.

2 THEORETICAL ANALYSIS AND RESEARCH HYPOTHESIS

2.1 Voluntary environmental regulation and ESG performance

The voluntary environmental protection behavior of enterprises belongs to the signaling activity of capital market, which can reduce the uncertainty of environmental information. In addition, environmental certification of enterprises releases "quality and

safety signals" to the outside world, so that consumers choose green products, improve consumer demand for green products, and improve the ability of enterprises to undertake social responsibilities. Additionally, given the significance of the environmental certification ISO 14001., Businesses will freely assume risks and contribute capital to sustainable development initiatives., so as to promote research and development innovation and improve the capacity for environmentally friendly growth of companies.

Hypothesis 1: Voluntary participatory environmental regulation can improve the ESG performance of enterprises.

2.2 Voluntary environmental regulation and Executive green cognition

Executives' concern for the environment has a certain impact on corporate strategic decisions. In the case of strict regulations, the environmental awareness of corporate executives urges enterprises to actively implement the terminal governance measures. The stronger the green perception of consumer demand is, the more inclined corporate executives are to provide more green products to consumers through green production, assume social responsibility, promote corporate environmental information disclosure, and enhance the sustainable development awareness of stakeholders.

Hypothesis 2: Voluntary participation in environmental regulation can improve executives' green cognition

2.3 Mediating effect of executives' green cognition

The policy effect of voluntary environmental regulation depends to a large extent on the cognition of corporate executives, because the cognition and behavior of executives are affected by the environment to a certain extent. Voluntary environmental regulation has a low operating cost and the most direct effect on environmental improvement.

Hypothesis 3: In the process of the effects of voluntary participatory environmental regulation on ESG performance, executives' green cognition plays a mediating role.

3 EMPIRICAL ANALYSIS

3.1 Sample selection

The research focus of this study involves A-share manufacturing listed firms from 2012 to 2022; ST and *ST enterprises as well as samples with irregular data loss are not considered. The Wind and CSMAR databases provided the original data. All variables in this study are treated by 1% and 99% indentation in order to get 14,566 observed values, as extreme values may cause bias in the results.

3.2 Variable definition

The ESG performance is the variable that is being explained. The China Securities ESG grading system's ESG score is used. The ESG performance improves with a greater overall score.

The voluntary environmental regulation (VER) is the explanatory variable. One method of voluntary environmental control is the use of the ISO14001 ecological management system standard. VER is 1 on the event that a business obtains ISO14001 environmental certification;

The intermediary variable is executive green cognition (EGP). word frequency statistics are carried out on the annual reports of listed manufacturing companies from 2012 to 2022 to measure the green cognition of executives of listed companies.

3.3 Model setting

The policy dummy variable `post_ver` is generated using multi-phase DID for estimation, indicating whether enterprise *i* executes the policy in year *t*. If the company has passed ISO14001 certification in that year, the `post_ver` for that year and subsequent years =1

$$ESG_{i,t} = \beta_0 + cpost_ver_{i,t} + \beta \sum Controls + \sum Year + \sum Industry + \varepsilon_{i,t} \tag{1}$$

$$EGP_{i,t} = \rho_0 + apost_ver_{i,t} + \rho \sum Controls + \sum Year + \sum Industry + \varepsilon_{i,t} \tag{2}$$

$$ESG_{i,t} = \lambda_0 + c'post_ver_{i,t} + bEGP_{i,t} + \lambda \sum Controls + \sum Year + \sum Industry + \varepsilon_{i,t} \tag{3}$$

4 EMPIRICAL RESULTS AND ANALYSIS

4.1 Mechanism test

In this paper, a stepwise regression method is used to test whether there is an intermediary effect on the green cognition of administrative staff. As shown in Table 1. At the 1% level, there is a significant positive correlation between voluntary participatory environmental regulation and ESG performance. There is a significant positive correlation between voluntary environmental regulation and green cognition of senior executives at 1% level. There is a significant positive correlation between executive green cognition and ESG performance at 1% level.

Column (1) shows that the significance level of the regression coefficient (c=0.3812) is the total impact of voluntary participatory environmental regulation on ESG performance; in column (3), the regression coefficient of voluntary participatory environmental regulation (c '=0.3760) becomes smaller, because after the inclusion of senior executives' green cognition, The impact of voluntary participatory environmental regulation on ESG performance is partially replaced by executive green cognition. These results suggest that executive green cognition plays a partial mediating role in the influencing

mechanism between voluntary environmental regulation and corporate ESG performance.

Table 1. Mechanism test

	(1) ESG	(2) EGP	(3) ESG
post_ver	0.3812*** (23.2069)	0.5968*** (9.2919)	0.3760*** (22.8389)
EGP			0.0088*** (4.2961)
Controls	Yes	Yes	Yes
Year	Yes	Yes	Yes
Ind	Yes	Yes	Yes
N	14566	14566	14566
adj. R ²	0.154	0.159	0.157

4.2 Robustness test

4.2.1 Parallel trend test

Considering that the prerequisite for the application of multi-phase DID is to satisfy the parallel trend hypothesis, a dynamic effect model is constructed in order to test the parallel trend.

$$ESG_{i,t} = \beta_0 + \sum_{T=-5}^{T=6} \beta_T V_{i,t_0+T} + \sum Controls + \sum Year + \sum Industry + \varepsilon_{i,t} \quad (4)$$

$V_{i,0+T}$ is the policy dummy variable; The time span of the research samples is respectively 5 years before certification and 6 years after certification, and the year before enterprises participate in certification (-1) is selected as the base year. When $T < 0$, the estimated β_T coefficient is not significant, and the parallel trend test passes.

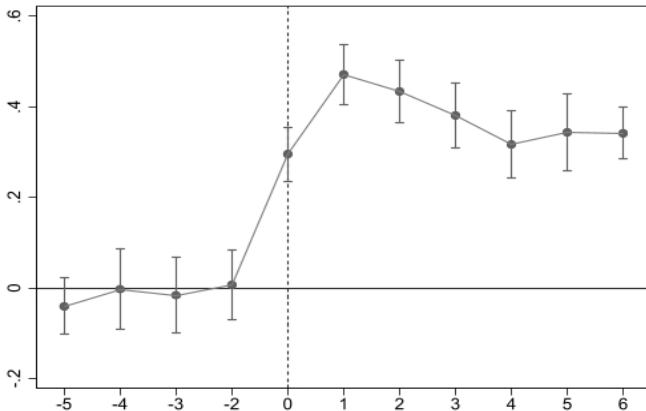


Fig. 1. Parallel trend test

As can be seen from Figure 1, when $T < 0$, βT is not significant, indicating that there is no significant trend difference between the ESG performance of the experimental group and the control group before the event. The results show that the model construction in this paper conforms to the hypothesis of parallel trend, and the use conditions of multi-stage DID are effective.

4.2.2 Placebo test

The effect of non-policy factors on the study results was excluded by setting up pseudo policy dummy variables and conducting placebo test⁹. This paper randomly selected listed companies as the experimental group, repeated 1000 times of regression simulation, and extracted the estimated coefficients and standard errors of pseudo-policy dummy variables. As shown in Figure 2, the estimated coefficients of pseudo-policy dummy variables are concentrated around 0, and most of them are not significant at the 10% level, passing the placebo test.

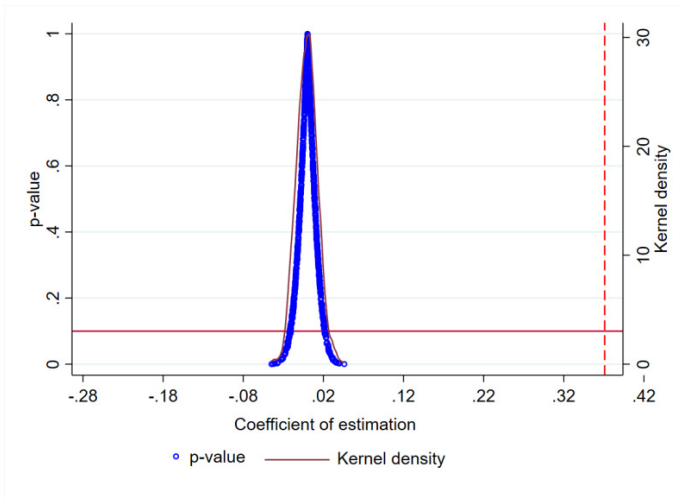


Fig. 2. Placebo test

4.2.3 PSM-DID

The enterprises that have passed ISO14001 certification are used as the treatment group, and the enterprises that have not passed ISO14001 certification are used as the control group¹⁰. Control variables were regressed as covariates to obtain propensity score values to estimate the average treatment effect (ATT).

A balance test should be taken before matching propensity scores. Figure 3 and Figure 4 are the effect drawings before and after matching. The difference of propensity probability distribution between the group before pairing and the control group was significant, and the difference of propensity probability distribution between the group after pairing and the control group was significantly reduced, indicating that the pairing effect was better.

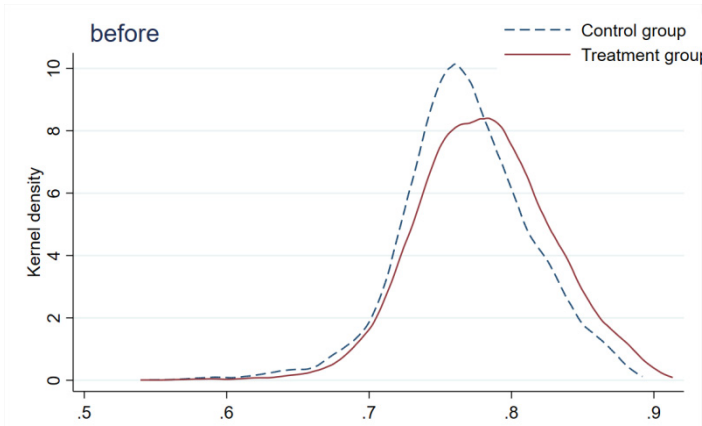


Fig. 3. Before sample matching

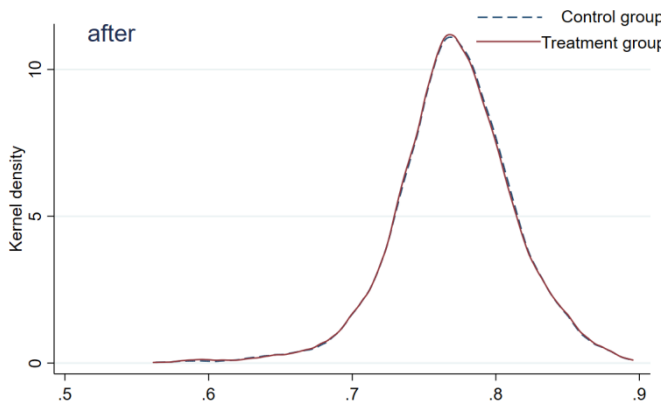


Fig. 4. After sample matching

In this paper, samples obtained after 1:1 nearest neighbor matching are used for DID regression. The results are shown in Table 2. Columns (1) and (2) are regression results for models with uncontrolled and controlled variables, respectively. At the 1% level, there is a substantial positive association, and hypothesis 1 is valid

Table 2. PSM-DID

	(1)	(2)
	ESG	ESG
post_ver	0.4014*** (18.6832)	0.3783*** (18.5309)
Controls		Yes
Year	Yes	Yes
Industry	Yes	Yes
N	10118	10118

5 CONCLUSIONS AND RECOMMENDATIONS

The empirical findings presented in this research demonstrate that: (1) Environmental regulations whose implementation is voluntary can enhance businesses' ESG performance. (2) Voluntary participation in environmental regulation can improve the green cognition of executives. (3) When examining how voluntary, participatory regulations related to the environment affect businesses' ESG performance, the green cognition of executives plays a partial mediating role.

In light of the aforementioned findings, the following recommendations are made: Initially, businesses should be encouraged by the government to exercise their own judgment and actively carry out voluntary, participatory environmental regulations. Second, Strengthen the understanding of green development, and actively respond to the call of the state. According to the research, high-level understanding of green development concept has a positive role in promoting enterprise ESG performance.

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