

Dear Reviewers

Many thanks for your careful reading and valuable comments on our manuscript. The comments helped us further revise and improve the paper. We have studied your comments carefully and made corrections accordingly. And in the process, we believe the paper has been significantly improved. The revised parts of the manuscript have been highlighted in yellow font. Our detailed responses to the reviewer's comments are outlined as follows ("Q" denotes question and "A" denotes answer).

Response to Referee 3.

Q1.Again, please combine lines 27-80 as 1 paragraph.

A1.Thank you for your valuable comments. We have merged lines 32-77. The specific changes are highlighted in yellow in the text.

Q2.Please remove the dot after the title “Environmental Regulation, Information Disclosure, and Clean 2 Production in Heavy-Polluting Enterprises: Evidence from 3 China”

A2.We thank the reviewer for this careful observation. The dot after the article title has been removed as suggested. The title now reads: *“Environmental Regulation, Information Disclosure, and Clean Production in Heavy-Polluting Enterprises: Evidence from China”*.

Q3.Again, please write the text books references for the equations.

A3. We are grateful to the reviewers for reminding us to provide textbook references for the econometric equations used in this study. In response, we added appropriate citations in the article. Specific modifications will be highlighted in the text.

Q4.Again, please look to the fogures captions and use “Figure number.” Or “Fig. number.”

A4. We are grateful for the valuable comments from the reviewers, which aim to enhance the consistency of our manuscript. According to the suggestions, we have thoroughly checked and revised all the image titles to ensure consistency. For example, Figure 1. Etc. We believe this change has enhanced the uniformity and

professionalism of the manuscript. And the modified content has been highlighted in yellow in the text.

Q5.Line 218, there is a space here “Note 1:Heavily pollu”

A5. Thank you, reviewers, for your careful observation. The missing space after the colon was added in line 218. The correct way to write this passage now is: "Note 1: Severe pollution..." In addition, we took this opportunity to carefully review the entire manuscript to ensure the consistency of punctuation spacing. For your convenience in reviewing, we have marked the modified content in yellow in the text.

Q6.In the tables captions please put a dot after the number. For example : “Table 5.”

A6. We thank the reviewers for their accurate feedback on the title format. We carefully reviewed and revised all the table titles in the entire manuscript to ensure that a dot was placed after the table numbers as suggested. For your convenience in reviewing, we have highlighted the modified content in the text.

Q7.Please inside the table 9, please put the meaning of the numbers between brackets and the numbers which are not between brackets. For example: 0.015 (2.47) Please put the name in a separate row inside the table in front of and in the same line with its number.**

A7. We are extremely grateful to the reviewers for their excellent suggestions on improving the clarity of Table 9. We restructured the table. Strictly following the advice, we restructured the table by explicitly marking numbers for each variable with separate rows. The values outside the parentheses are now clearly identified as "coefficients", while the values within the parentheses are identified as "t-statistics" in their respective dedicated rows. For your convenience in reviewing, we have attached the modified content.

Table 9. Benchmark regression results.

<i>variable</i>	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	<i>Coefficie</i>	<i>Coefficie</i>	<i>Coefficie</i>	<i>Coefficie</i>	<i>Coefficie</i>	<i>Coefficie</i>	<i>Coefficie</i>
	<i>nts</i>	<i>nts</i>	<i>nts</i>	<i>nts</i>	<i>nts</i>	<i>nts</i>	<i>nts</i>
ER	0.015**	0.019***	0.020***	0.018***	0.017***	0.018***	0.017***
	<i>T-statisti</i>	<i>T-statisti</i>	<i>T-statisti</i>	<i>T-statisti</i>	<i>T-statisti</i>	<i>T-statisti</i>	<i>T-statisti</i>

	<i>c</i>	<i>c</i>	<i>c</i>	<i>c</i>	<i>c</i>	<i>c</i>	<i>c</i>
	(2.47)	(3.44)	(3.53)	(3.18)	(2.99)	(3.16)	(3.06)
		<i>Coefficie</i>	<i>Coefficie</i>	<i>Coefficie</i>	<i>Coefficie</i>	<i>Coefficie</i>	<i>Coefficie</i>
		<i>nts</i>	<i>nts</i>	<i>nts</i>	<i>nts</i>	<i>nts</i>	<i>nts</i>
<i>b_size</i>		0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
		<i>T-statisti</i>	<i>T-statisti</i>	<i>T-statisti</i>	<i>T-statisti</i>	<i>T-statisti</i>	<i>T-statisti</i>
	<i>c</i>	<i>c</i>	<i>c</i>	<i>c</i>	<i>c</i>	<i>c</i>	<i>c</i>
	(21.75)	(19.81)	(19.22)	(18.26)	(16.80)	(16.55)	
		<i>Coefficie</i>	<i>Coefficie</i>	<i>Coefficie</i>	<i>Coefficie</i>	<i>Coefficie</i>	<i>Coefficie</i>
		<i>nts</i>	<i>nts</i>	<i>nts</i>	<i>nts</i>	<i>nts</i>	<i>nts</i>
<i>g_ratio</i>		0.028***	0.016**	0.011*	0.011*	0.011*	
		<i>T-statisti</i>	<i>T-statisti</i>	<i>T-statisti</i>	<i>T-statisti</i>	<i>T-statisti</i>	<i>T-statisti</i>
	<i>c</i>	<i>c</i>	<i>c</i>	<i>c</i>	<i>c</i>	<i>c</i>	<i>c</i>
	(4.67)	(2.57)	(1.72)	(1.71)	(1.79)		
		<i>Coefficie</i>	<i>Coefficie</i>	<i>Coefficie</i>	<i>Coefficie</i>	<i>Coefficie</i>	<i>Coefficie</i>
		<i>nts</i>	<i>nts</i>	<i>nts</i>	<i>nts</i>	<i>nts</i>	<i>nts</i>
<i>q_value</i>		-0.005**	-0.005**	-0.005**	-0.005**	-0.005**	
		*	*	*	*	*	*
		<i>T-statisti</i>	<i>T-statisti</i>	<i>T-statisti</i>	<i>T-statisti</i>	<i>T-statisti</i>	<i>T-statisti</i>
	<i>c</i>	<i>c</i>	<i>c</i>	<i>c</i>	<i>c</i>	<i>c</i>	<i>c</i>
	(-4.94)	(-5.56)	(-5.50)	(-5.48)			
		<i>Coefficie</i>	<i>Coefficie</i>	<i>Coefficie</i>	<i>Coefficie</i>	<i>Coefficie</i>	<i>Coefficie</i>
		<i>nts</i>	<i>nts</i>	<i>nts</i>	<i>nts</i>	<i>nts</i>	<i>nts</i>
<i>t_asset</i>		0.023***	0.022***	0.022***			
		<i>T-statisti</i>	<i>T-statisti</i>	<i>T-statisti</i>			
	<i>c</i>	<i>c</i>	<i>c</i>	<i>c</i>			
	(8.43)	(8.17)	(7.90)				
		<i>Coefficie</i>	<i>Coefficie</i>	<i>Coefficie</i>	<i>Coefficie</i>	<i>Coefficie</i>	<i>Coefficie</i>
		<i>nts</i>	<i>nts</i>	<i>nts</i>	<i>nts</i>	<i>nts</i>	<i>nts</i>
<i>s_ratio</i>		0.000**	0.000**				
		<i>T-statisti</i>	<i>T-statisti</i>				
	<i>c</i>	<i>c</i>					

					(2.35)	(2.34)
					<i>Coefficients</i>	
					<i>nts</i>	
					-0.005*	
<i>g_rate</i>					<i>T-statistics</i>	
					<i>c</i>	
					(-1.78)	
	<i>Coefficients</i>	<i>Coefficients</i>	<i>Coefficients</i>	<i>Coefficients</i>	<i>Coefficients</i>	<i>Coefficients</i>
	<i>nts</i>	<i>nts</i>	<i>nts</i>	<i>nts</i>	<i>nts</i>	<i>nts</i>
<i>Constant</i>	0.075***	0.060***	0.049***	0.063***	0.051***	0.045***
	<i>T-statistics</i>	<i>T-statistics</i>	<i>T-statistics</i>	<i>T-statistics</i>	<i>T-statistics</i>	<i>T-statistics</i>
	<i>c</i>	<i>c</i>	<i>c</i>	<i>c</i>	<i>c</i>	<i>c</i>
	(20.31)	(16.52)	(11.39)	(12.04)	(9.60)	(7.54)
						(7.69)
<i>R²</i>	0.0164	0.1053	0.1090	0.1135	0.1265	0.1275
<i>Observations</i>	4,860	4,859	4,859	4,793	4,793	4,793
						4,791

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Q8. Inside table 9 its R2 not R-squared

A8. We thank the reviewer for this suggestion regarding the notation clarity. We have revised Table 9 to use the standard statistical symbol " R^2 " instead of the full term "R-squared" for conciseness, and have ensured consistency across all tables and figures in the manuscript.

Q9. Please combine lines 821-838 as 1 paragraph.

A9. Thank you for your valuable comments. We have merged lines 821-838. The specific changes are highlighted in yellow in the text.

Q10. Please combine the discussions and conclusions under one subtitle called "Conclusion."

A10. We are grateful for the reviewers' suggestions. As suggested, we will merge the discussion section and the conclusion section into a unified section named

"Conclusion". For your convenience in reviewing, we will attach the revised "4.1 Conclusion".

4.1 Conclusions

In the research on the role of environmental regulations in the environmental performance of enterprises, the positive impacts verified by the empirical results are in line with the "Porter Hypothesis", and this conclusion also echoes international experience - for instance, the European Union promotes green innovation in manufacturing through a carbon emissions trading system, and Japan relies on environmental regulations to enhance energy efficiency. All of them reflect the positive promoting effect of environmental regulations on the environmental performance of enterprises. It is worth noting that the "command and control" style of supervision adopted by China can also effectively force enterprises to transform. The realization of this effect is attributed to the continuous strengthening of environmental protection law enforcement in recent years.

In terms of the mechanism of environmental information disclosure, it shows a mediating effect feature of "short-term inhibition - long-term promotion", which is different from the model of "direct positive correlation between regulation and disclosure" under the mandatory disclosure system in Europe and the United States. In China, the environmental information disclosure of heavily polluting enterprises is mainly voluntary. In the short term, affected by compliance pressure, some enterprises will simplify the content of information disclosure. However, in the long term, high-quality environmental information disclosure can contribute to the improvement of enterprises' environmental performance by reducing information asymmetry and strengthening social supervision. This mechanism is also in line with the ecological efficiency framework of the World Business Council for Sustainable Development.

From the perspective of evolutionary game theory, the equilibrium point of this system tends to be "enterprise non-clean production". The core problem lies in that the total cost of clean production is higher than the benefits it brings, which is consistent with the "cost-benefit" logic in international governance. This also highlights the importance of enhancing regulatory efficiency and designing reasonable fine and subsidy mechanisms. This is in sharp contrast to the practical experience of the US Regional Greenhouse Gas Initiative in improving regulatory

efficiency and the EU in stabilizing carbon prices, further confirming the necessity of optimizing regulatory and incentive mechanisms.

Based on the above background, this paper constructs A three-party game model among heavily polluting enterprises, the government and environmental information disclosure regulatory authorities on the basis of evolutionary game theory, and combines the panel data of 570 listed companies in heavily polluting industries in China's A-share market from 2014 to 2022. Systematically explore the decision-making mechanism and influencing factors of enterprise clean production in multi-agent interaction scenarios, and ultimately draw the following core conclusions:

First, at the evolutionary game level, the strategic choices of the three parties are all dominated by the cost-benefit relationship. Among them, the willingness of heavily polluting enterprises to implement clean production depends on the balance among the costs of environmental protection technology upgrades, information disclosure, subsidies and fines - the relative level of cost and benefit directly determines whether the enterprise is inclined to carry out clean production.

Secondly, when the cost of clean production for enterprises is too high and the relevant incentive and restraint mechanisms are insufficient, enterprises will be more inclined to choose non-clean production strategies. From the perspective of regulatory authorities, environmental information disclosure regulatory departments will only choose to strictly supervise in accordance with the law when the regulatory benefits exceed the regulatory costs. The government will only take strict regulatory measures when the verification cost is lower than the fines and confiscation of gains. Overall, the core bottleneck for heavily polluting enterprises in their strategic choices has always been that the total cost of clean production is higher than its comprehensive benefits.

Thirdly, at the empirical level, environmental regulations have a significant positive impact on enterprises' clean environmental performance. This result validates Hypothesis H1, indicating that reasonable environmental regulations can enhance environmental performance by increasing the marginal cost of pollution emissions, compelling enterprises to increase their investment in green innovation. Meanwhile, environmental information disclosure plays a mediating role in the relationship between environmental regulations and corporate environmental performance: although environmental laws and regulations may have an inhibitory

effect on corporate environmental performance due to compliance pressure in the short term, in the long run, high-quality environmental information disclosure can significantly promote the improvement of corporate environmental performance by reducing information asymmetry and strengthening social supervision. Furthermore, the empirical results also show that the scale of enterprises and the total asset turnover rate have a positive impact on environmental performance, while the Tobin Q value has a negative impact. This phenomenon reflects that short-term environmental protection investment will temporarily squeeze the market valuation of enterprises.

Again, we would like to thank you for reviewing our work. We have made a considerable effort to take into account your suggestions and comments. We hope you will be pleased with our response. In any case, we are open to consideration of any further comment on our answers.

Best regards,

19/10/2025