

The impact of export tax rebate reform on industrial exporters' soot emissions: Evidence from China

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In this paper, we systematically explore the environmental effects of the export tax rebate rate reduction policy using the China Industrial Enterprise Database, the China Industrial Enterprise Pollution Database, and the China Customs Import and Export Database from 2005 to 2013. Our difference-in-difference (DID) estimates show that the reduction in the export tax rebate rate significantly reduces the intensity of corporate soot emissions, and this finding holds after a series of robustness tests. For every 1-unit reduction in export tax rebate rate, industrial exporters' soot emission intensity decreases by 2.63%. The mechanism analysis shows that the decrease in soot generation, the decrease in coal use intensity, the increase in total amount and efficiency of soot treatment are important channels. Heterogeneity analysis shows that the reduction of export tax rebate rate has a more significant impact on the intensity of soot emissions of high pollution, high energy consumption and resource-based enterprises. This study may provide a reference for other developing countries that also rely on export tax rebates to adjust their policies to combine economic growth with pollution control.

KEYWORDS

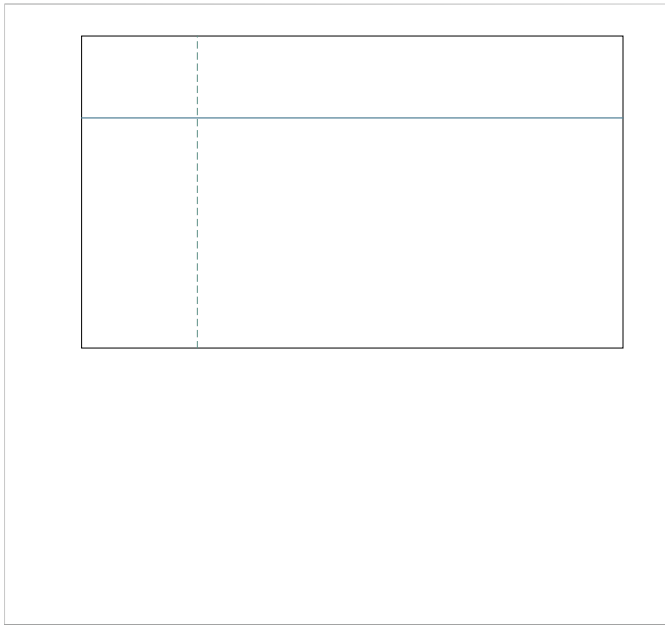
export tax rebate, China, soot emissions, industrial exporters, DID method

1 Introduction

Since 1978, China has experienced rapid economic growth, which has led to a significant increase in industrial production and export. However, the rapid growth of industrial production and export has also led to a significant increase in industrial pollution, particularly soot emissions. In 2001, the Chinese government implemented a policy of export tax rebate rate reduction, which aimed to reduce the intensity of corporate soot emissions. This policy has been widely studied in the literature. For example, Hu et al. (2016) and Li et al. (2018) found that the reduction in the export tax rebate rate significantly reduces the intensity of corporate soot emissions. Similarly, Tian et al. (2021) and Meng et al. (2022) found that the reduction in the export tax rebate rate significantly reduces the intensity of corporate soot emissions. Moreover, Li et al. (2013) and Li et al. (2021) found that the reduction in the export tax rebate rate significantly reduces the intensity of corporate soot emissions. In addition, Tian et al. (2021) found that the reduction in the export tax rebate rate significantly reduces the intensity of corporate soot emissions. Furthermore, Tian et al. (2021) found that the reduction in the export tax rebate rate significantly reduces the intensity of corporate soot emissions. Finally, Tian et al. (2021) found that the reduction in the export tax rebate rate significantly reduces the intensity of corporate soot emissions.

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Variables	Measurement	Observations	Mean	S.D.	Min	Max
L \bar{y}	L ($\frac{1}{n} \sum_{i=1}^n y_i$)	61,904	-7.498	4.267	-18.65	13.73
L \bar{y}_1	L ($\frac{1}{n} \sum_{i=1}^n y_{i1}$)	61,946	-4.587	4.323	-15.90	14.86
P	I $\frac{1}{n} \sum_{i=1}^n y_{i0}$ 2007 $\frac{1}{n} \sum_{i=1}^n y_{i1}$	93,420	.826	.379	0	1
$\frac{1}{n} \sum_{i=1}^n x_i$	$\frac{1}{n} \sum_{i=1}^n x_i$ \bar{y}' $\frac{1}{n} \sum_{i=1}^n y_i$ (%)	93,420	2.955	3.912	0	13
$\frac{1}{n} \sum_{i=1}^n x_i^2$	$\frac{1}{n} \sum_{i=1}^n x_i^2$ \bar{y}' $\frac{1}{n} \sum_{i=1}^n y_i$ (%)	93,406	2.972	3.741	0	13
$\frac{1}{n} \sum_{i=1}^n y_i$	$\frac{1}{n} \sum_{i=1}^n y_i$ $\frac{1}{n} \sum_{i=1}^n y_i$ 1 - $\frac{1}{n} \sum_{i=1}^n y_i$ 0 - $\frac{1}{n} \sum_{i=1}^n y_i$	93,420	.108	.311	0	1
F	L ($\frac{1}{n} \sum_{i=1}^n y_i$)	93,415	11.88	1.586	0	19.44
L KL	L ($\frac{1}{n} \sum_{i=1}^n y_i$ / $\frac{1}{n} \sum_{i=1}^n y_i$ fix)	92,496	4.500	1.468	-10.20	14.72
L	L (fi $\frac{1}{n} \sum_{i=1}^n y_i$)	93,410	2.286	.710	0	5.081
LED	$\frac{1}{n} \sum_{i=1}^n y_i$ / $\frac{1}{n} \sum_{i=1}^n y_i$	93,367	.551	.287	-.891	18.38
P \bar{y} \bar{y}	$\frac{1}{n} \sum_{i=1}^n y_i$ 1 $\frac{1}{n} \sum_{i=1}^n y_i$ $\frac{1}{n} \sum_{i=1}^n y_i$ $\frac{1}{n} \sum_{i=1}^n y_i$ 0	93,420	.187	.390	0	1
L \bar{y}	L ($\frac{1}{n} \sum_{i=1}^n y_i$)	62,103	4.6162	3.9584	0	17.0483
L	L ($\frac{1}{n} \sum_{i=1}^n y_i$)	36,317	5.8577	3.6716	0	16.4175
L	L ($\frac{1}{n} \sum_{i=1}^n y_i$)	17,170	2.2109	4.6439	0	21.6664
L fi \bar{y}	L ($\frac{1}{n} \sum_{i=1}^n y_i$)	40,132	7.6499	4.0107	0	21.6025



本文主要研究的是，在2007年之前，企业是否进行了研发活动，以及研发活动对企业创新的影响。本文的研究假设是：企业研发活动越多，企业创新水平越高。本文的研究方法采用了双重差分模型（DID），通过比较企业在2007年之前和之后的研发活动水平，来评估研发活动对企业创新的影响。本文的研究数据来源于企业研发活动数据库，数据涵盖了2007年之前和之后的企业研发活动水平。本文的研究结果表明，企业研发活动越多，企业创新水平越高。本文的研究结论是：企业研发活动是企业创新的重要驱动力，企业应该加大研发活动的投入，以提高企业创新水平。

3.2 Methods

本文主要研究的是，在2007年之前，企业是否进行了研发活动，以及研发活动对企业创新的影响。本文的研究假设是：企业研发活动越多，企业创新水平越高。本文的研究方法采用了双重差分模型（DID），通过比较企业在2007年之前和之后的研发活动水平，来评估研发活动对企业创新的影响。本文的研究数据来源于企业研发活动数据库，数据涵盖了2007年之前和之后的企业研发活动水平。本文的研究结果表明，企业研发活动越多，企业创新水平越高。本文的研究结论是：企业研发活动是企业创新的重要驱动力，企业应该加大研发活动的投入，以提高企业创新水平。

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TABLE 5 Mediation mechanism of the effect of export tax rebate rate reduction on the firms' soot emission intensity.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Lnsootdischarge	Lncoal	Lnsoottreat	Lngovegasability	Lnsootdensity	Lnsootdensity	Lnsootdensity	Lnsootdensity
<i>Retaxgap_{ijt} Post_t</i>	−.0221***	−.0036***	.0326**	.0133***	−.0051***	−.0103	−.0103	−.0261***
	(.0060)	(.0014)	(.0162)	(.0045)	(.0015)	(.0075)	(.0149)	(.0094)
<i>Δ</i>	.1971***	.0366	.1715	−.0158	−.0079	.0547	.4375**	.1714*
	(.0650)	(.0616)	(.2145)	(.1101)	(.0165)	(.0720)	(.2015)	(.0953)
L	−.0751***	.1244***	.4642***	.0201	−.5141***	−.5242***	−.3034***	−.6904***
	(.0279)	(.0330)	(.1194)	(.0569)	(.0071)	(.0444)	(.1079)	(.0561)
L	−.0401***	−.0276*	−.1234*	−.0029	.0257***	.0269	.0191	.0046
	(.0121)	(.0162)	(.0708)	(.0278)	(.0031)	(.0257)	(.0632)	(.0268)
L	.1813***	.0915**	.0778	.1116*	−.1044***	−.0337	.3231***	.0958
	(.0368)	(.0373)	(.1216)	(.0649)	(.0094)	(.0459)	(.1101)	(.0597)
LED	−.1355***	−.0659	−.1384	−.1398	.0932***	.1551*	.2495	−.0884
	(.0524)	(.0693)	(.2403)	(.1059)	(.0133)	(.0910)	(.2145)	(.0815)
<i>P Δ Δ</i>	.0986***	−.1474***	.0256	−.0128	.0538***	−.1546***	−.5495***	−.0070
	(.0381)	(.0395)	(.1419)	(.0666)	(.0097)	(.0515)	(.1297)	(.0624)
L <i>h</i>					.9963***			
					(.0015)			
L						.0673***		
						(.0144)		
L							.6752***	
							(.0270)	
L <i>Δ Δ</i>								.2076***
								(.0133)
<i>Δ</i> FE	<i>Δ</i>	<i>Δ</i>	<i>Δ</i>	<i>Δ</i>	<i>Δ</i>	<i>Δ</i>	<i>Δ</i>	<i>Δ</i>
<i>P Δ</i> FE	<i>Δ</i>	<i>Δ</i>	<i>Δ</i>	<i>Δ</i>	<i>Δ</i>	<i>Δ</i>	<i>Δ</i>	<i>Δ</i>
<i>I Δ Δ</i> FE	<i>Δ</i>	<i>Δ</i>	<i>Δ</i>	<i>Δ</i>	<i>Δ</i>	<i>Δ</i>	<i>Δ</i>	<i>Δ</i>
<i>F</i> FE	<i>Δ</i>	<i>Δ</i>	<i>Δ</i>	<i>Δ</i>	<i>Δ</i>	<i>Δ</i>	<i>Δ</i>	<i>Δ</i>

(C *Δ Δ*)

• DID

4.2.2 Placebo test

C

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TABLE 6 Effect of lower export tax rebate rate on the intensity of soot emissions from SOEs and non-SOEs.

Variables	SOEs			Non-SOEs		
	Lnsootdensity	Lnsootdensity	Lnsootdensity	Lnsootdensity	Lnsootdensity	Lnsootdensity
<i>Retaxgap_{ij}</i> <i>Post_t</i>	−.0463*	−.0473*	−.0474*	−.0350***	−.0274**	−.0281***
	(.0272)	(.0273)	(.0270)	(.0110)	(.0107)	(.0107)
L		−.2761**	−.2823**		−.7040***	−.6296***
		(.1352)	(.1362)		(.0521)	(.0497)
L		.0509	.0458		−.0269	−.0306*
		(.0592)	(.0625)		(.0182)	(.0181)
L			.1659			−.0120
			(.1187)			(.0725)
LED			−.0401			−.0086
			(.0945)			(.0840)
<i>P</i> <i>g</i> <i>g</i>			−.0055			.1516**
			(.1641)			(.0732)
<i>g</i> FE	<i>g</i>	<i>g</i>	<i>g</i>	<i>g</i>	<i>g</i>	<i>g</i>
<i>P</i> <i>g</i> FE	<i>g</i>	<i>g</i>	<i>g</i>	<i>g</i>	<i>g</i>	<i>g</i>
<i>I</i> <i>g</i> FE	<i>g</i>	<i>g</i>	<i>g</i>	<i>g</i>	<i>g</i>	<i>g</i>
<i>F</i> FE	<i>g</i>	<i>g</i>	<i>g</i>	<i>g</i>	<i>g</i>	<i>g</i>
C	−6.3105***	−2.7223	−3.0519	−3.4752***	4.4387***	3.6844***
	(.7712)	(1.9047)	(1.9686)	(.3409)	(.7085)	(.6866)
O <i>g</i>	7301	7242	7237	54,589	54,162	54,147
<i>Δ</i> 2	.7550	.7526	.7529	.7273	.7333	.7327

N = 2,400; F FE, F fix; *, **, *** denote significance at the 10%, 5%, 1% level, respectively. P *g* FE, P *g* fix, I *g* FE, I *g* fix.

the results of the fixed effects model (5), (6), (7), (8) show that the lower export tax rebate rate significantly reduces the intensity of soot emissions from SOEs and non-SOEs. The coefficient of *Retaxgap_{ij}* is negative and significant at the 1% level in all four models. The coefficient of *Post_t* is also negative and significant at the 1% level in all four models. The coefficient of *L* is negative and significant at the 1% level in all four models. The coefficient of *LED* is negative and significant at the 1% level in all four models. The coefficient of *P* *g* *g* is negative and significant at the 1% level in all four models. The coefficient of *g* FE is positive and significant at the 1% level in all four models. The coefficient of *I* *g* FE is positive and significant at the 1% level in all four models. The coefficient of *F* FE is positive and significant at the 1% level in all four models. The coefficient of *C* is negative and significant at the 1% level in all four models. The coefficient of *O* *g* is positive and significant at the 1% level in all four models. The coefficient of *Δ*2 is positive and significant at the 1% level in all four models.

4.3 Mechanism analysis

The results of the fixed effects model (1), (2), (3) show that the lower export tax rebate rate significantly reduces the intensity of soot emissions from SOEs and non-SOEs. The coefficient of *Retaxgap_{ij}* is negative and significant at the 1% level in all three models. The coefficient of *Post_t* is also negative and significant at the 1% level in all three models. The coefficient of *L* is negative and significant at the 1% level in all three models. The coefficient of *LED* is negative and significant at the 1% level in all three models. The coefficient of *P* *g* *g* is negative and significant at the 1% level in all three models. The coefficient of *g* FE is positive and significant at the 1% level in all three models. The coefficient of *I* *g* FE is positive and significant at the 1% level in all three models. The coefficient of *F* FE is positive and significant at the 1% level in all three models. The coefficient of *C* is negative and significant at the 1% level in all three models. The coefficient of *O* *g* is positive and significant at the 1% level in all three models. The coefficient of *Δ*2 is positive and significant at the 1% level in all three models.

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