Free trade and the environment – evidence from Chinese cities

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ONLINE APPENDIX

Table A1. Correlation matrix

	$EmissionDen_{it}$	$(industry/GDP)_{it}$	$(K/L)_{it}$	$ln(FDI)_{it}$	$Openness_{it}$	$Exporter_{it}$	$MinExporter_{it}$	$PoExporter_{it}$	$NonpExporter_{it}$	$EleExporter_{it}$	$ln(EleComsumption_{it})$	$ln(Wage_{it})$	$ln(Wage_{it}^2)$	$Avmining_{it}$	$AvMapo_{it}$	$AvManonpo_{it}$	$AvElec_{it}$
$EmissionDen_{it}$	1																
$(industry/GDP)_{it}$	0.1339	1															
$(K/L)_{it}$	0.1573	0.2771	1														
$ln(FDI)_{it}$	0.0961	0.0951	0.347	1													
$Openness_{it}$	-0.1097	0.076	0.3739	0.5908	1												
$Exporter_{it}$	-0.0418	0.0377	-0.0847	-0.2974	-0.1327	1											
$MinExporter_{it}$	-0.0201	0.0067	-0.0885	0.0853	0.0299	-0.1706	1										
$PoExporter_{it}$	0.1831	-0.0734	0.0935	0.2326	0.1958	-0.3752	0.0269	1									
$NonpExporter_{it}$	0.157	-0.2173	0.1005	0.2621	0.1546	-0.36	0.1101	0.2862	1								
$EleExporter_{it}$	0.0914	0.0197	-0.034	-0.0569	0.0284	-0.0471	0.0245	0.0947	0.0743	1							
$ln(EleComsumption_{it})$	0.2581	0.3297	0.3394	0.6767	0.4821	-0.0508	0.0873	0.1897	0.0879	0.0434	1						
$ln(Wage_{it})$	0.1591	0.2572	0.5845	0.6036	0.468	-0.1132	-0.0382	0.1119	0.04	-0.0799	0.6116	1					
$ln(Wage_{it}^2)$	0.1565	0.2527	0.5874	0.6056	0.4742	-0.1139	-0.0381	0.1124	0.0428	-0.0754	0.6153	0.9995	1				
$Avmining_{it}$	0.1002	0.4221	-0.0889	-0.3219	-0.224	0.413	-0.054	-0.3948	-0.5045	0.0358	-0.0251	-0.0576	-0.0586	1			
$AvMapo_{it}$	0.1892	-0.0132	-0.0492	-0.2023	-0.2474	-0.057	-0.0447	0.095	0.0971	0.0078	-0.0089	-0.0959	-0.1008	-0.2593	1		
$AvManonpo_{it}$	-0.1035	-0.2455	0.2089	0.4981	0.4372	-0.4778	0.0733	0.3392	0.4129	-0.0611	0.0885	0.184	0.1885	-0.6659	-0.3683	1	
$AvElec_{it}$	-0.3011	-0.2529	-0.0928	-0.0631	0.017	0.1443	0.0047	-0.0971	-0.052	-0.0499	-0.131	-0.0374	-0.0359	-0.1134	-0.2024	-0.1095	1

Table A2. Chinese cities in data

West	Center	East
Zhongwei	Qitaihe	Sanya
Lijiang	Sanmenxia	Sanming
Wulancha	Shangran	Shanghai
Wuhai	Linfen	Dongguan
Wulumuqi	Dandong	Dongying
Leshan	Jiujiang	Zhongshan
Baoshan	Maozhou	Linyi
Kelamayi	Yichun	Lishui
Liupanshui	Jiamusi	Yunfu
Lanzhou	Xinyang	Foshan
Neijiang	Liuan	Baoding
Baotou	Shikan	Beijing
Beihai	Nanchang	Nanjing
Nanchong	Nanyang	Nanping
Nanning	Shuangyashan	Nantong
Wuzhong	Hefei	Xiamen
Hulunbeier	Jian	Taizhou
Huhehaote	Jilin	Tangshan
Xianyang	Lvliang	Jiaxing
Shangluo	Zhoukou	Tianjin
Jiayu	Xianning	Weihai
Guyuan	Haerbin	Ningde
Tianshui	Shangqiu	Ningbo
Ankang	Siping	Suqian
Anshun	Datong	Changzhou
Dingxi	Daqing	Guangzhou
Yibin	Dalian	Langfang
Baoji	Taiyuan	Zhangjiakou
Chongzuo	Loudi	Xuzhou
Bazhong	Xiaogan	Dezhou
Bayannaoer	Anqing	Huizhou
Pingliang	Anyang	Yangzhou
Guangyuan	Yichang	Chengde
Guangan	Yinchun	Jieyang
Qingyang	Xuancheng	Wuxi
Yanan	Suzhou	Rizhao
Zhangye	Yueyang	Hangzhou
Deyang	Chaohu	Zaozhuang
Simao	Changde	Meizhou
Chengdu	Pingdingshan	Shangtou
Lasa	Kaifeng	Shangwei
Panzhihua	Zhangjiajie	Jiangmen
Kunming	Xinzhou	Changzhou
Shaotong	Huaihua	Heyuan
Qujing	Fuzhou	Quanzhou
Laibin	Fushun	Taian
Liuzhou	Xinxiang	Taizhou
Guilin	Xinyu	Jinan
Wuzhou	Jinzhong	Jining
Yulin	Jincheng	Haikou
Wuwei	Jingdezhen	Zibo
Hanzhong	Suzhou	Huaian
Hechi	Chaoyang	Shenzhen
Luzhou	Benxi	Qingyuan
Hailaer	Songyuan	Wenzhou
Weinan	Zhuzhou	Huzhou
Yulin	Wuhan	Zhanjiang
Yuxi	Haozhou	Binzhou
Baiyin	Yongzhou	Zhangzhou

West	Center	East
Baise	Chizhou	Langfang
Meishan	Shenyang	Chaozhou
Shizuishan	Luoyang	Yantai
Mianyang	Huaibei	Zhuhai
Zigong	Huainan	Yancheng
Xining	Xiangtan	Shijiazhuang
Xian	Quzhou	Fuzhou
Guigang	Tahe	Qinhuangdao
Guiyang	Puyang	Shaoxing
Hezhou	Jiaozuo	Liaocheng
Ziyang	Mudanjiang	Zhaoqing
Chifeng	Baicheng	Zhoushan
Dazhou	Yinyang	Suzhou
Tongliao	Panjin	Maoming
Suining	Suihua	Putian
Zunyi	Wuhu	Laiwu
Eerduosi	Jingzhou	Heze
Jiuquan	Jingmen	Hengshui
Chongqing	Pingxiang	Quzhou
Jinchang	Yingkou	Lianyungang
Qinzhou	Hulvdao	Xingtai
Tongchuan	Wengbu	Handan
Yinchuan	Bengbu	Jinhua
Fangchenggang	Hengyang	Zhenjiang
Longnan	Xiangfan	Yangjiang
Yaan	Xuchang	Qingdao
	Ganzhou	Shaoguan
	Liaoyuan	
	Liaoyang	
	Yuncheng	
	Tonghua	
	Shaoyang	
	Zhengzhou	
	Chenzhou	
	Ezhou	
	Tieling	
	Tonglin	
	Jingzhou	
	Changchun	
	Changsha	
	Changzhi	
	Fuxin	
	Fuyang	
	Yangquan	
	Suizhou	
	Anshan	
	Maanshan	
	Zhumadian	
	Jixi	
	Hegang	
	Yingtan	
	Huanggang	
	Huangshan	
	Huangshi	
	Heihe	
	Qiqihaer	

Table A3. Environmental Kuznets curve: openness

	(1) FE	(2) RE	(3) IV
$(industry/GDP)_{it}$	0.353***	0.211*	0.241+
	(0.073)	(0.056)	(0.141)
$(K/L)_{it}$	31.64***	26.12***	77.27*
	(5.638)	(5.044)	(39.04)
$ln(FDI)_{it}$	0.849*	1.531**	2.003+
	(0.345)	(0.290)	(1.187)
$Openness_{it}$	38.09**	0.879	100.5
	(13.7)	(10.·)	(62.8)
$ln(EleComsumption_{it})$	-2.528*	0.581	-3.712+
	(0.999)	(0.638)	(1.999)
$ln(Wage_{it})$	31.72***	44.84***	214.3*
	(7.341)	(6.431)	(103)
$(lnWage_{it-1})^2$	-1.796***	-2.95***	-15.04+
	(0.539)	(0.451)	(8.469)
N	1866	1869	1774
City FE	yes	no	yes
Year FE	yes	yes	yes
RE	no	yes	no
Hausman test	39.93		
Hausman (p-value)	0		
Underidentification test			13.728
Weak identification test			39.584
Hansen j test (p-value)			0.0266

Notes:
Robust standard errors in parentheses.
***, **, *, +denote significance at the 0.1, 1, 5 and 10% level, respectively.
Dependent variable: the concentration of PM2.5 per square kilometer in city i in year t.
The underidentification test is based on an LM version of the Anderson (1951) canonical correlation test and its p-value (Chi-sq(4)) is less than 0.1, indicating that the test rejects the null hypothesis that the equation is underidentified. The weak identification test is based on the Cragg-Donald Wald F statistic. The F-statistic is above 10, which indicates the validity of the instrument. The Sargan-Hansen test is the overidentification test of all instruments. The p-value (Chi-sq(3)) is greater than 0.1, meaning that the instruments are valid; otherwise, the instruments would not be valid.

Table A4. Environmental Kuznets curve: exporters

	(1) FE	(2) RE	(3) IV
$(industry/GDP)_{it}$	0.246***	0.178***	0.257*
	(0.0623)	(0.0491)	(0.119)
$(K/L)_{it}$	26.41***	26.08***	57.80*
	(4.826)	(4.522)	(28.7)
$ln(FDI)_{it}$	0.582*	1.174***	1.296+
	(0.271)	(0.236)	(0.697)
$Exporter_{it}$	3.443	1.31	15.42
	(3.807)	(3.303)	(10.42)
$ln(EleComsumption_{it})$	-1.339+	0.559	-1.902
	(0.812)	(0.545)	(1.375)
$ln(Wage_{it})$	13.65**	20.12***	160.0+
	(4.224)	(3.962)	(84.5)
$(lnWage_{it-1})^2$	-0.810**	-1.388***	-11.36+
	(0.31)	(0.283)	(6.171)
N	2430	2436	2278
City FE	yes	no	yes
Year FE	yes	yes	yes
RE	no	yes	no
Hausman test	104		
Hausman (p-value)	0		
Underidentification test			21.284
Weak identification test			28.285
Hansen J test (p-value)			0.0105

Notes:
Robust standard errors in parentheses.
***, **, *, +denote significance at the 0.1, 1, 5 and 10% level, respectively.
Dependent variable : the concentration of PM2.5 per square kilometer in city i in year t.
The underidentification test is based on an LM version of the Anderson (1951) canonical correlation test and its p-value (Chi-sq(4)) is less than 0.1, indicating that the test rejects the null hypothesis that the equation is underidentified. The weak identification test is based on the Cragg-Donald Wald F statistic. The F-statistic is above 10, which indicates the validity of the instrument. The Sargan-Hansen test is the overidentification test of all instruments. The p-value (Chi-sq(3)) is greater than 0.1, meaning that the instruments are valid; otherwise, the instruments would not be valid.

Table A5. Additional variables with value-added of different sectors: openness

	(1) FE	(2) RE	(3) IV
$Avmining_{it}$	2.636	5.968	2.228
	(8.874)	(6.409)	(13.58)
$AvMapo_{it}$	10.91	8.383	15.46
	(9.059)	(6.63)	(10.63)
$AvManonpo_{it}$	-21.43**	-1.375	-27.51**
	(7.596)	(5.822)	(10.15)
$AvElec_{it}$	-12.05+	-13.39*	-10.82+
	(6.215)	(5.610)	(5.734)
$(K/L)_{it}$	30.12***	21.66***	31.22
	(6.29)	(5.606)	(20.2)
$ln(FDI)_{it}$	0.957*	1.872***	0.58
	(0.441)	(0.358)	(1.239)
$Openness_{it}$	10.26*	4.937	30.53
	(4.309)	(3.985)	(31.77)
$ln(EleComsumption_{it})$	-2.552*	0.921	-3.309
	(1.244)	(0.697)	(2.453)
$ln(Wage_{it})$	3.18	-9.987***	23.51
	(4.077)	(2.865)	(53.39)
N	1418	1423	1325
City FE	yes	no	yes
Year FE	yes	yes	yes
RE	no	yes	no
Hausman test	326.73		
Hausman (p-value)	0		
Underidentification test			37.496
Weak identification test			17.813
Hansen J test (p-value)			0.0406

Notes:
Robust standard errors in parentheses.
***, **, *, +denote significance at the 0.1, 1, 5 and 10% level, respectively.
Dependent variable : the concentration of PM2.5 per square kilometer in city i in year t.
The underidentification test is based on an LM version of the Anderson (1951) canonical correlation test and its p-value (Chi-sq(4)) is less than 0.1, indicating that the test rejects the null hypothesis that the equation is underidentified. The weak identification test is based on the Cragg-Donald Wald F statistic. The F-statistic is above 10, which indicates the validity of the instrument. The Sargan-Hansen test is the overidentification test of all instruments. The p-value (Chi-sq(3)) is greater than 0.1, meaning that the instruments are valid; otherwise, the instruments would not be valid.

Table A6. Additional variables with value-added of different sectors: exporters

	(1) FE	(2) RE	(3) IV
$Avmining_{it}$	1.729	5.103	13.08
	(7.414)	(5.582)	(21.63)
$AvMapo_{it}$	4.915	7.678	10.89
	(7.458)	(5.710)	(11.43)
$AvManonpo_{it}$	-18.45**	0.820	-19.13*
	(6.51)	(5.101)	(8.807)
$AvElec_{it}$	-9.051	-10.55*	-8.197
	(5.535)	(4.996)	(6.424)
$(K/L)_{it}$	26.26***	22.05***	43.69
	(5.206)	(4.859)	(28.24)
$ln(FDI)_{it}$	0.684*	1.45***	1.662
	(0.338)	(0.285)	(1.955)
$Exporters_{it}$	2.639	0.348	14.66
	(5.414)	(4.364)	(22.57)
$ln(EleComsumption_{it})$	-1.487	1.188	-3.567
	(0.99)	(0.587)	(3.469)
$ln(Wage_{it})$	-1.166	-7.052***	-43.58
	(2.528)	(2.061)	(84.0)
N	1866	1872	1710
City FE	yes	no	yes
Year FE	yes	yes	yes
RE	no	yes	no
Hausman test	102.69		
Hausman (p-value)	0		
Underidentification test			17.566
Weak identification test			4.883
Hansen J test (p-value)			0.0166

Notes:
Robust standard errors in parentheses.
***, **, *, +denote significance at the 0.1, 1, 5 and 10% level, respectively.
Dependent variable : the concentration of PM2.5 per square kilometer in city i in year t.
The underidentification test is based on an LM version of the Anderson (1951) canonical correlation test and its p-value (Chi-sq(4)) is less than 0.1, indicating that the test rejects the null hypothesis that the equation is underidentified. The weak identification test is based on the Cragg-Donald Wald F statistic. The F-statistic is above 10, which indicates the validity of the instrument. The Sargan-Hansen test is the overidentification test of all instruments. The p-value (Chi-sq(3)) is greater than 0.1, meaning that the instruments are valid; otherwise, the instruments would not be valid.

Table A7. GMM estimation

	(1)	(2)	(3)
$(industry/GDP)_{it}$	-0.0233	0.165+	0.148
	(0.153)	(0.0910)	(0.140)
$(K/L)_{it}$	4.642	7.803	40.20+
	(9.746)	(21.76)	(23.42)
$ln(FDI)_{it}$	0.431	1.081+	2.010***
	(0.694)	(0.584)	(0.505)
$Openness_{it}$	-23.90		
	(21.75)		
$Exporter_{it}$		-7.072	
		(17.41)	
$MinExporter_{it}$			7.016
			(9.627)
$PoExporter_{it}$			-3.333
			(3.970)
$NonpExporter$			17.09*
			(7.879)
$EleExporter$			6.980
			(11.92)
$ln(EleComsumption_{it})$	-5.510	1.334	-0.0417
	(3.464)	(1.756)	(3.525)
$ln(Wage_{it})$	26.40*	-0.695	-22.83*
	(12.60)	(1.488)	(9.415)
N	1869	2435	2462
No. of instruments	49	49	103
AR1 (p-value)	0.114	0.0972	0.0337
AR2 (p-value)	0.219	0.516	0.503
Hansen-J (p-value)	0.0564	0.196	0.162

Notes:
Robuststandarderrorsinparentheses.
***, **, *, + denote significance at the 0.1, 1, 5 and 10% level, respectively.
Dependent variable : the concentration of PM2.5 per square kilometer in city i in year t.

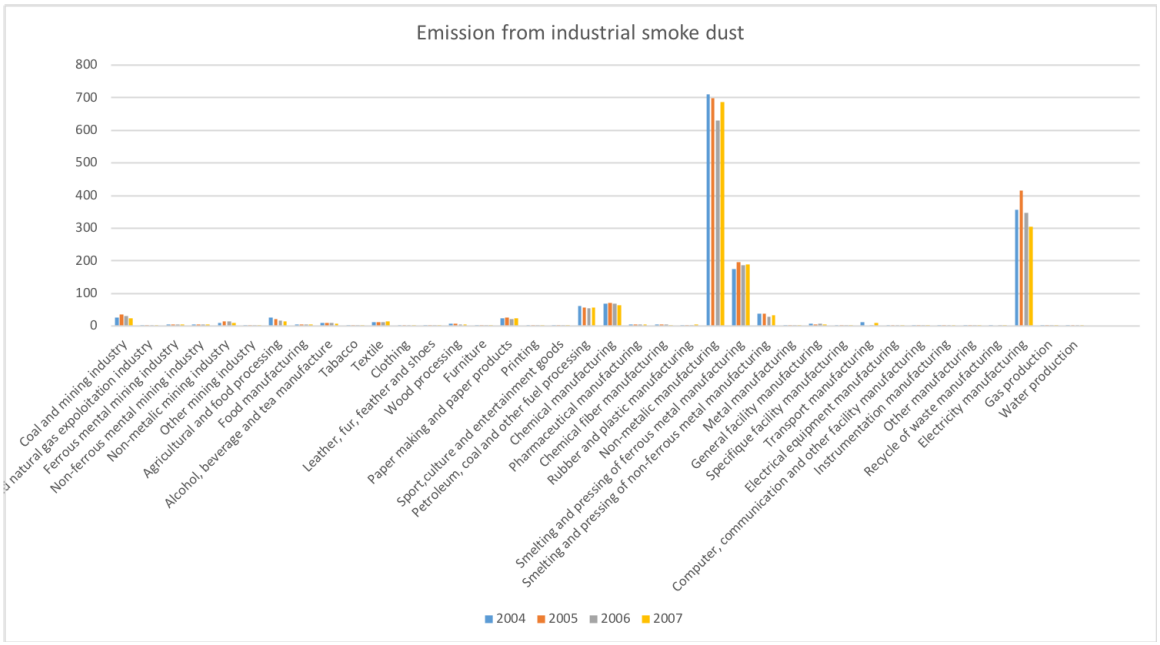

Figure A1. Emissions of industry smoke dust from 2004-2007.
Data source: China Environmental Statistics Yearbook.

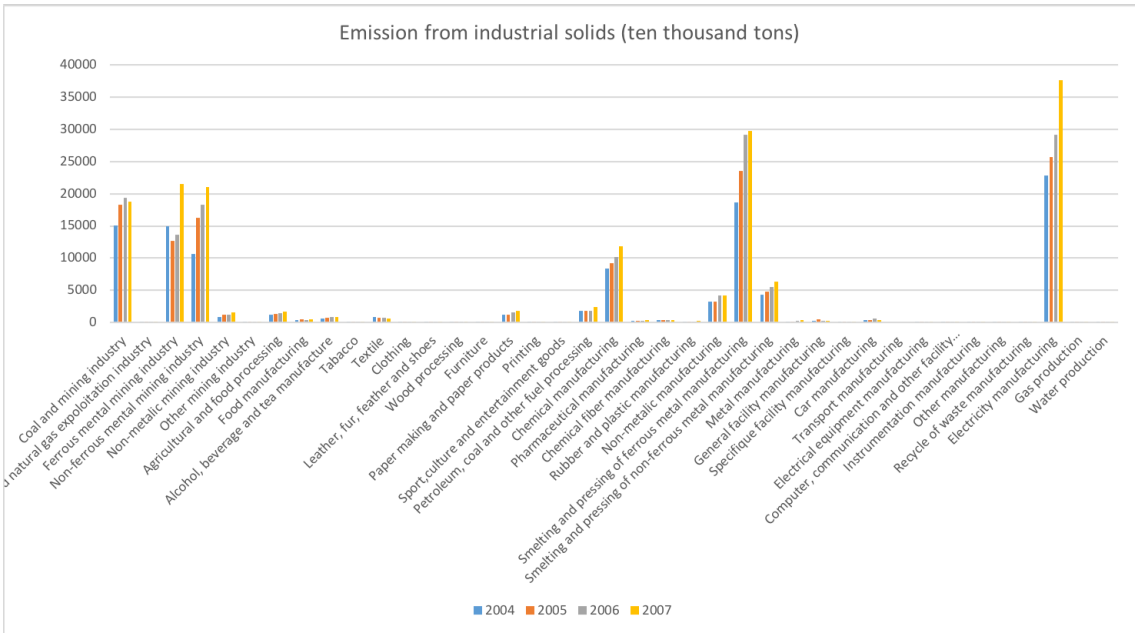

Figure A2. Emissions of industrial solids from 2004-2007.
Data source: China Environ-mental Statistics Yearbook.