

Trade Liberalization, Technology Upgrading, and Environmental Outcomes: Evidence from China's Accession to the WTO

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Abstract

Much concern has been raised on whether trade causes environmental damage in developing countries. In this paper, we estimate the impact of trade liberalization on environmental performance using firm-level data. Using the tariff rates from the accession agreement as instruments, we find that lowering input tariff leads to higher average SO₂ emissions (9-11%) which is largely due to scale effects and composition effects while lowering output tariff has a weak negative effect on SO₂ emissions. Given that we have detailed firm-level information, we trace through in detail the mechanisms through which trade liberalization contributes to technology upgrading. We find that the decrease in import tariff has a net negative effect on SO₂ generation intensity which means with the extent of free trade increase, the production becomes cleaner. We also find that compared to firms in non-treated cities, firms in cities with tougher environmental regulation lower pollution intensity when the import tariffs decrease.

Motivations

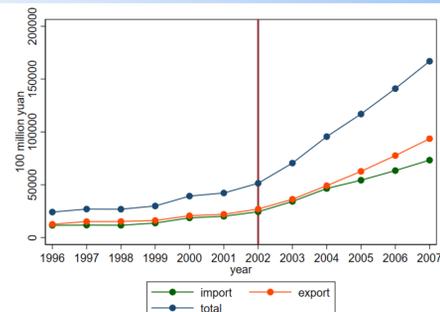


Figure 1: Trade Volumes

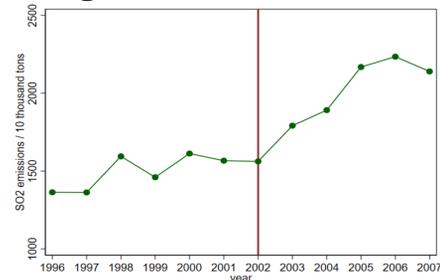


Figure 2: Sulfur Emissions

- Trade volumes and industrial emission increased at a relatively flat rate before 2002.
- Foreign trade (import and export) has begun to grow rapidly since China's accession to the WTO in 2002.
- At the same time, industrial emission also began to increase greatly.
- **How does trade liberalization affect China's industrial pollution emissions?**

Data

- The China's Environmental Statistics Database (CESD) is the most complete nationwide environmental data set in China.
- The CESD covers approximately 85% of the annual emissions of primary pollutants in each county and each year.
- The CESD contains more than 400 data fields, which are updated annually.

Table 1: Summary Statistics

Year	Obs.	Variable	Mean	Std. Dev.
2000	39,877	SO ₂ emission (kg)	118533.40	1109263.00
		SO ₂ generation intensity (kg/10 thousand yuan)	2084.15	170423.60
		output (10 thousand yuan)	675.59	4998.03
2006	42,497	SO ₂ emission (kg)	160890.40	1176314.00
		SO ₂ generation intensity (kg/10 thousand yuan)	3631.60	91481.66
		output (10 thousand yuan)	940.21	8319.41

Empirical Strategy

Quantifying trade openness

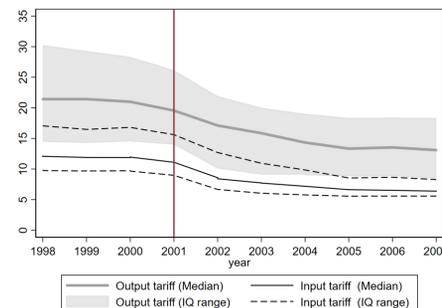


Figure 3: Import Tariff

$$Y_{it} = \beta_1 Output_tariff_{jt-1} + \beta_2 Input_tariff_{jt-1} + X_{jt}\theta + \gamma_t + \alpha_i + \delta_{jt} + \varepsilon_{ijt}$$

where i, j, t represent firm, industry and year, respectively. We use firm-level annual pollution emission as the indicator of environmental performance (Y_{it}).

Endogeneity of tariffs

- Reverse causality: the policymakers lower tariffs selectively only in industries that have competitive advantages (e.g. highly polluting industries).
- Misattribution: industry characteristics that are merely correlated with tariff cuts might be the real reason for the subsequent pollution effects.

Maximum tariffs as instruments

- The rates from the accession agreement were fixed by 1999.
- The low remaining variation in tariff rates by 2007 implies that there was little room for policy discretion in tariff reductions.
- The maximum tariff level is a good predictor of the actual tariff (Brandt et al, 2017).

Results

Table 2: Effects of tariffs on firm-level SO₂ emissions

	(1)	(2)	(3)
	ln(SO ₂) OLS-IV	ln(SO ₂) FE-IV	ln(SO ₂) FE-IV
Input tariff (lagged)	-9.262*** (0.219)	0.474 (0.341)	0.021 (0.539)
Output tariff (lagged)	0.097 (0.074)	0.286*** (0.078)	0.151* (0.085)
Firm fixed effects	NO	YES	YES
Year fixed effects	YES	YES	YES
Industry-year fixed effects	NO	NO	YES
Observations	341686	341686	341686

Table 3: Test on technology effects using SO₂ generation intensity

	(1)	(2)	(3)
	ln(SO ₂ int) OLS-IV	ln(SO ₂ int) FE-IV	ln(SO ₂ int) FE-IV
Input tariff (lagged)	-17.754*** (0.254)	-0.047 (0.383)	-0.691 (0.619)
Output tariff (lagged)	3.576*** (0.090)	0.196** (0.083)	0.223** (0.092)
Firm fixed effects	NO	YES	YES
Year fixed effects	YES	YES	YES
Industry-year fixed effects	NO	NO	YES
Observations	270080	270080	270080

- The results of OLS models show that with the input tariff decrease the average SO₂ emission increase mainly caused by **scale effect** and **composition effect**.

- After controlling firm fixed effects, the freer trade helps reduce pollution emissions possibly by updating production technology (**technique effect**).

Reference:

Brandt, L., Van Biesebroeck, J., Wang, L., & Zhang, Y. (2017). WTO accession and performance of Chinese manufacturing firms. *American Economic Review*, 107(9), 2784-2820.