

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

Mengdi Liu¹, Bing Zhang¹, and Guojun He²

¹ Nanjing University, ² Hong Kong University of Science and Technology

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

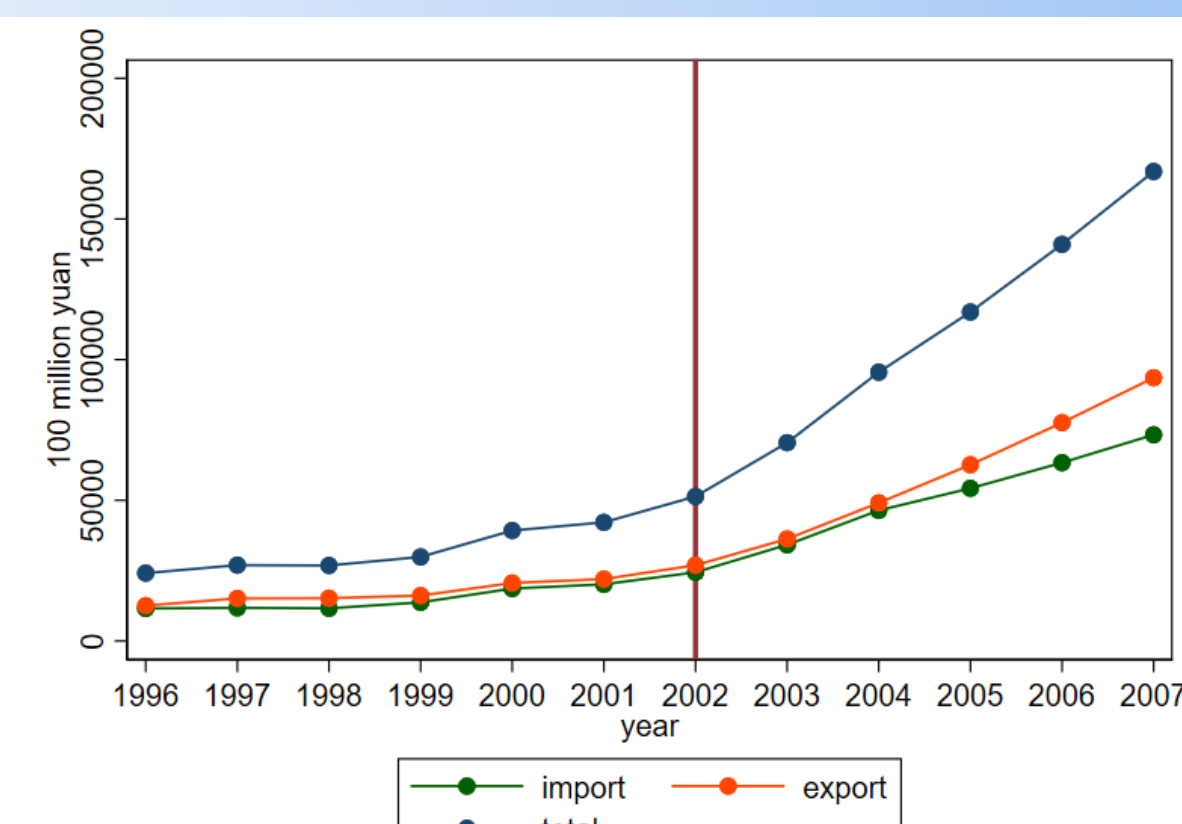


Figure 1: Trade Volumes

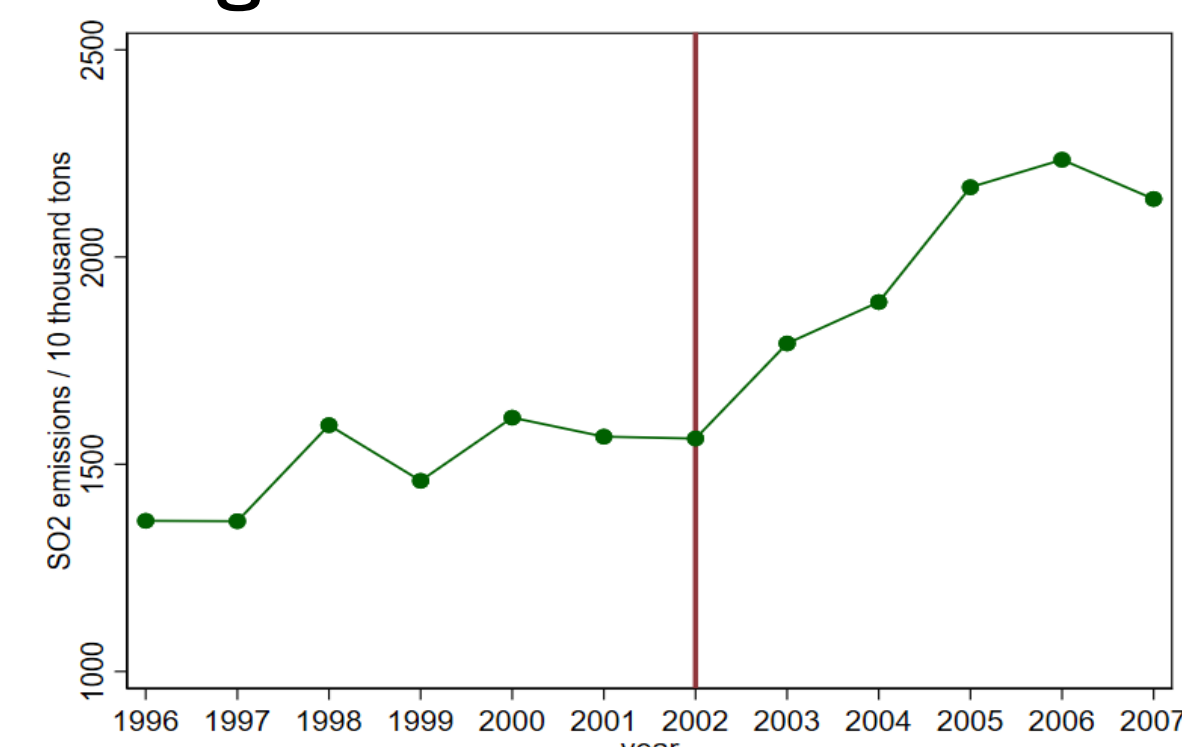


Figure 2: Sulfur Emissions

- 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

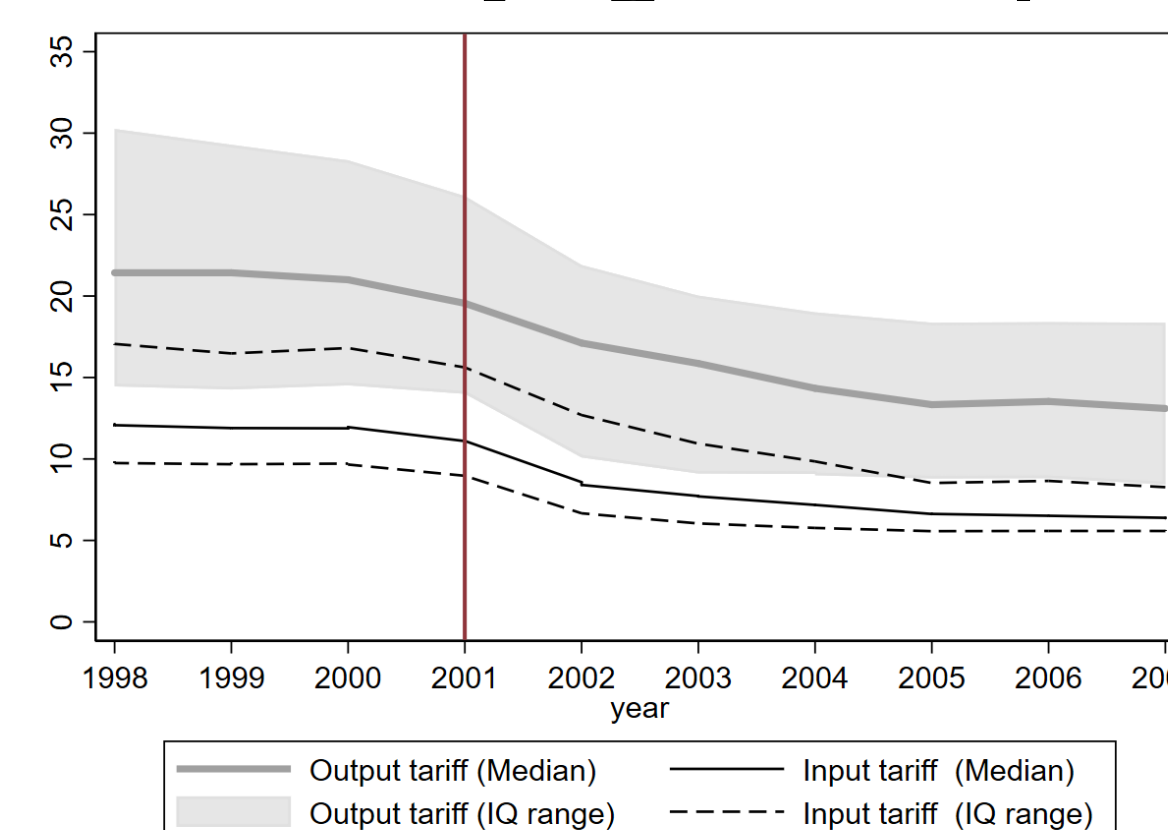


Figure 3: Import Tariff

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

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)	ln(SO ₂)	ln(SO ₂)
	OLS-IV	FE-IV	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)	ln(SO ₂ int)	ln(SO ₂ int)
	OLS-IV	FE-IV	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.