



# Following the green trail: Identifying FDI environmental spillovers on Chinese firms



Chun Liu<sup>1</sup>; Chenchen Deng<sup>2</sup>; Yi Zhang<sup>2</sup>

<sup>1</sup> School of Economics, Southwestern University of Finance and Economics,

<sup>2</sup> Jinhe Center for Economic Research, Xi'an Jiaotong University

## Abstract

- This study investigates the causal impact of foreign direct investment (FDI) on environmental outcomes of Chinese domestic firms by leveraging the exogenous relaxation of FDI regulations occurred during China's accession to the WTO.
- Our shock-based IV results reveal that the presence of foreign firms has positive intra-industry spillover effects on the environmental performance of domestic firms. Within the same industry, the positive spillovers are attributed to the dominant agglomeration effect over the competition effect of FDI. Our analysis of pollution abatement suggests that domestic firms adopt both production processes and end-of-pipe reduction strategies.
- These findings support the pollution halo hypothesis and provide important policy implications for emerging economies seeking to achieve sustainable development.

## Background

### Competing hypotheses on FDI environmental spillovers

- The pollution haven hypothesis: FDI is attracted to countries with less stringent environmental regulations.
- The pollution halo hypothesis: FDI improves the economic and environmental performance of domestic firms

### Channels for FDI environmental spillovers

- The agglomeration effect occurs when domestic firms observe and imitate the advanced environmental practices of foreign firms, leading to positive spillovers within the industry.
- The competition effect may lead to a race to the bottom in environmental standards as domestic firms are pressured by the need to maintain cost competitiveness against foreign entrants, which may induce increased pollution.

### Identification challenge

- Identifying the FDI spillover effect is challenging because the decision by foreign multinationals to enter specific countries and industries is an endogenous one.
- We employ the plausibly exogenous relaxation of FDI regulations on China's WTO accession and construct a shock-based IV to identify the causal effect of FDI on the environmental performance of local firms.

## Research Design

Our shock-based IV model is as follows:

The second stage:  $Pollutants_{fit} = \beta_0 + \beta_1 FDI_{sector_{it}} + \Theta Controls + \delta_f + \lambda_t + \varepsilon_{fit}$

The first stage:  $FDI_{sector_{it}} = \eta_0 + \eta_1 Treatment_i * Post02_t + \Theta Controls + \delta_f + \lambda_t + \varepsilon_{fit}$

where  $f$ ,  $i$ , and  $t$  denote firm, industry and year, respectively.

- ✓ *Pollutants* includes *COD intensity* and *SO2 intensity*, measured as the logarithm of COD emission and SO2 emission per unit of output value of domestic firms.
- ✓ *FDI sector* captures the extent of FDI in industry  $i$  in year  $t$ .
- ✓ *Treatment* indicates whether industry  $i$  belongs to the treatment group (encouraged industries).
- ✓ *Post02* is a dummy indicating the post-WTO period.
- ✓ *Controls* include a range of time-varying firm and industry characteristics.

## Data

### Firm-level data

- Production data: Annual Survey of Industrial Firms (ASIF) from 1998 to 2007
- Emission data: the Environmental Survey and Reporting (ESR) database

### FDI deregulation data

- The 1997 and 2002 versions of the *Catalogue for the Guidance of Foreign Investment Industries*.

### Backward and Forward industry linkage data

- China's 2002 Input-Output Table

## Baseline Results

Dep. Vars.	COD intensity		SO2 intensity	
The second stage: dependent variable is <i>Pollutants</i>				
<i>FDI sector</i>	-3.247** (1.542)	-3.499*** (1.170)	-1.351** (0.594)	-1.284** (0.586)
The first stage: dependent variable is <i>FDI sector</i>				
<i>Treatment*Post02</i>	0.034*** (0.013)	0.034*** (0.013)	0.034*** (0.013)	0.034*** (0.013)
Firm Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
FDI determinants × year dummies	No	Yes	No	Yes
Tariff reductions × year dummies	No	Yes	No	Yes
SOE privatization × year dummies	No	Yes	No	Yes
Kleibergen-Paap rk Wald F statistic	14.675	17.783	14.675	17.783
Observations	230,856	230,628	230,856	230,628
Adjusted R <sup>2</sup>	0.776	0.855	0.804	0.917

- We find that the presence of FDI has a positive spillover effect on the environmental performance of domestic firms within the same industry.

### Identification assumptions:

- Parallel trend checks
- Alleviate non-random treatment timing concerns
- Alleviate non-random selection of the treatment group concerns

### Robustness checks:

- Exclusion of exports in the construction of the FDI presence variable
- Alternative measurement of firm environment performance
- Composition of foreign multinationals: include the percentage of wholly-owned multinationals in all foreign multinationals
- Controlling for systematic changes
- Controlling for special economic zones effect

## Further Analysis

### Horizontal FDI spillover mechanisms

- Knowledge spillover effect (support):
  - ✓ More significantly positive FDI effect for firms with higher absorptive capacity and those in regions facing more stringent environment regulations.
- Competition effect (limited evidence):
  - ✓ The effect of horizontal FDI is not contingent on different degrees of market competition across industries.
- Comparing these two potential mechanisms:
  - ✓ Supporting knowledge spillovers, with larger positive effects for FDI located in the same city and from developed countries.

### Vertical FDI environmental spillovers

- Insignificant spillovers for domestic firms forward or backward linked to FDI.

### Firms' pollution abatement strategies

- Reduce pollution through production process control and end-of-pipe treatment.

## Contribution

- We contribute to the literature on the impact of FDI on the environment. Our research distinguishes itself from prior studies by employing the plausibly exogenous relaxation of FDI regulations on China's WTO accession to establish the causal effect of FDI on the environmental performance of local firms.
- Our study add to the broader literature on FDI spillovers. Though a large body of literature has examined to what extent FDI contributes to the economic performance of local firms, the environmental implications of FDI itself has garnered less attention. Our findings highlight that FDI has the potential to yield the pollution halo effect in developing countries.
- This paper enhances our understanding of the channels of FDI spillovers. Our research unveils that environmental spillovers mainly takes effect through knowledge and technologies dissemination.

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## Contact

Yi Zhang  
Jinhe Center for Economic Research  
Xi'an Jiaotong University  
Email: [zhangyi.econ@mail.xjtu.edu.cn](mailto:zhangyi.econ@mail.xjtu.edu.cn)