Does ETS Contribute to China’s Economic Agenda?

Junjie Zhang

Environmental Research Center, Duke Kunshan University
Nicholas School of the Environment, Duke University
junjie.zhang@duke.edu

Shenzhen ETS Conference
December 12, 2017
China’s Economic Aspiration

2020-2035: crossing high-income threshold

- implied economic growth rate: $\geq 3.95\%$

2035-2050: becoming a mid-level high-income economy

- implied economic growth rate: $\geq 5.43\%$

Challenge

- ambitious growth target vs carbon emission peak by 2030
Alignment of ETS with China’s Economic Reform Strategy
ETS as A Growth-Friendly Climate Policy Instrument

Supply-side structural reform

• internalize the external costs of environment, energy, and natural resources

Revenue-neutral carbon pricing

• using revenues from carbon allowances to reduce other pre-existing distortionary taxes

Towards innovation-driven economic growth

• can ETS increase industrial competitiveness by stimulating innovation?
Research Question

Porter hypothesis

- strict environmental regulations can induce efficiency and encourage innovations that help improve commercial competitiveness

Key policy question

- evaluate the causal effects of China carbon ETS pilots on firms’ low-carbon innovation
China’s Seven Carbon Market Pilots

[Map showing China with regions marked as carbon markets.]
## Covered Sectors in Regional ETS Pilots

<table>
<thead>
<tr>
<th>Pilot Region</th>
<th>Covered Sectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beijing</td>
<td>Electricity, heating, cement, petrochemical and other industries, large public buildings including hospitals, schools and governments</td>
</tr>
<tr>
<td>Chongqing</td>
<td>Electricity, metallurgy, chemical industries, cement, iron and steel</td>
</tr>
<tr>
<td>Guangdong</td>
<td>Electricity, cement, iron and steel, petrochemical industries, public services including hotels, restaurants and business</td>
</tr>
<tr>
<td>Hubei</td>
<td>Electricity, heating, metallurgy, iron and steel, automobile and equipment, chemical and petrochemical industries, cement, medicine and pharmacy, food and beverage, papermaking</td>
</tr>
<tr>
<td>Shanghai</td>
<td>Electricity, iron and steel, petrochemical and chemical industries, metallurgy, building materials, papermaking, textile, aviation, airports and ports, public and office buildings, railway stations</td>
</tr>
<tr>
<td>Shenzhen</td>
<td>Electricity, building, manufacturing, water supply</td>
</tr>
<tr>
<td>Tianjin</td>
<td>Electricity, heating, iron and steel, chemical and petrochemical industries, oil and gas exploration</td>
</tr>
</tbody>
</table>
Performance of Regional ETS Pilots by Market Activity

<table>
<thead>
<tr>
<th>Pilot Region</th>
<th>Turnover Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beijing</td>
<td>0.0296</td>
</tr>
<tr>
<td>Shanghai</td>
<td>0.0157</td>
</tr>
<tr>
<td>Tianjin</td>
<td>0.0067</td>
</tr>
<tr>
<td>Chongqing</td>
<td>0.0015</td>
</tr>
<tr>
<td>Hubei</td>
<td>0.0423</td>
</tr>
<tr>
<td>Guangdong</td>
<td>0.0159</td>
</tr>
<tr>
<td>Shenzhen</td>
<td>0.1139</td>
</tr>
<tr>
<td>Nationwide</td>
<td>0.0238</td>
</tr>
</tbody>
</table>

The turnover rate is defined by the ratio of trading volume on the secondary market to the total allowance.
One Explanation: Provincial Attitude Towards Market Mechanism

<table>
<thead>
<tr>
<th>Pilot Region</th>
<th>Liberal-Nontraditional-Market Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shanghai</td>
<td>1</td>
</tr>
<tr>
<td>Guangdong</td>
<td>2</td>
</tr>
<tr>
<td>Beijing</td>
<td>4</td>
</tr>
<tr>
<td>Tianjin</td>
<td>8</td>
</tr>
<tr>
<td>Hubei</td>
<td>10</td>
</tr>
<tr>
<td>Chongqing</td>
<td>13</td>
</tr>
</tbody>
</table>

Empirical Strategy

Empirical challenge

- confounders of low-carbon innovation

Difference-in-Difference-in-Differences (DDD)

- ETS pilot regions vs non-pilot regions
- covered firms vs other firms
- after ETS vs before ETS
Illustration of the Empirical Method

Carbon ETS Regional Pilots

DDD Model
\[ \text{Industry}_j \times \text{ETS}_r \times \text{Post}_t \]

Alternatively
\[ \text{Industry}_j \times \text{Pilot}_{rt} \]

Path-dependence

Firms’ Low-carbon Innovation

Shareholders’ Spillovers
Data

Publicly-listed manufacturing companies

- Shanghai and Shenzhen stock markets (2003-2015)

Firm-level patents data

- State Intellectual Patent Office (SIPO)

Financial and accounting data

- China Stock Market & Accounting Research (CSMAR)
- capital, cash, revenue, debt, net sales and profits
- shareholders’ name, the ratio of shares, and ownership structure
Low-Carbon Innovation

Low-Carbon Patents per Firm

ETS Zones vs. Non-ETS Zones

Graph by ETS Polit Dummy
Major Findings

• Regional Carbon ETS increases firms’ low-carbon innovation

• Higher carbon price stimulates more innovation

• Active ETS has a positive effect on innovation

• These results are consistent and robust
Concluding Remarks

First empirical evidence that ETS incentivizes innovation

- active market leads to intensive low-carbon innovation

Firms’ responses hinge on government’s commitment to ETS

- short-term policy: compliance through transitory but costly behavior
- long-term commitment: engagement in innovation reduces cost of compliance

Limited data and information are available for empirical analysis

- transparency is important for ETS design, operation and assessment
More Information

Website

Duke Kunshan Environment
http://dukekunshan.edu.cn

WeChat