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# Going green or going away: Environmental regulation, economic geography and firms' strategies in China's pollution-intensive industries

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ABSTRACT

The high-growth, resource- and pollution-intensive industrialization model that China has pursued has caused severe environmental pollution and deterioration, particularly in a number of clusters in the coastal regions of East and Southeast China, where the Reform and Opening-up policies first started. The lack of uptake of environmental norms/values, deficit of regulatory enforcement of environmental policies, and insufficient institutional capacity have been compounding factors. As environmental standards were raised by China's central government, the enforcement of environmental regulation has been compromised more in inland China than in coastal regions, due to China's "decentralized governance structure" and regional disparity in terms of both economic development and environmental pollution. This paper therefore argues that rising environmental regulations, as well as firm characteristics, regional hub effect and political environment, have all been particularly important in forcing China's pollution-intensive enterprises to restructure their production, through innovation, upgrading, geographical relocation, outsourcing and plant closure, especially in China's coastal regions. It contributes to recent studies by developing a heuristic analytical framework that aims to be sensitive to the impacts of environmental regulation, political environment and regional hub effect over firm restructuring, but which does so by stressing these impacts are simultaneously inflected by the nature and attributes of firms. The empirical analysis suggests a roughly inverted "U"-shaped relationship between firm relocation tendency and firm size (or firm capability), resulting from complex interactions between political environment, regional hub effect and environmental regulation.



## Introduction

The real effects of environmental regulations over firm (re)location behavior, and competitive performance of industry and region have been the subject of heated debates since the outset of the environmental movement in the early 1970s (Jeppesen et al., 2002; Testa et al., 2011). One argument is that firms intend to locate their business activities in countries or regions where environmental regulations are relatively lax (Costantini and Crespi, 2008; Mulatu et al., 2010; Testa et al., 2011). Opponents of stringent environmental regulation claim that higher environmental standards impose additional economic costs by distorting the spatial pattern of economic development—inducing some regions or countries to be at a competitive disadvantage when competing for new investments and jobs (Jeppesen et al., 2002). This statement purports that change in environmental regulation leads to a relocation of dirty goods production from countries with stringent environmental regulation to those with lax environmental regulation, resulting in the so-called "pollution havens" (Copeland and Taylor, 2004; Dean et al., 2009). This is the commonly studied "pollution haven hypothesis (PHH)".

On the contrary, Porter and van der Linde (1995) have argued that costs for compliance with environmental regulations will be offset by cost reductions resulting from technological innovation stimulated by the regulations. This argument is also known as "Porter hypothesis (PH)". The origins of the PH can be traced back to the seminal work of Schumpeter (1947), who has underscored the importance of creative response of economies in adapting to changes in external conditions, and to the induced-innovation hypothesis formulated by Hicks (1932), who pointed out that changes in the relative price of production factors act as a stimulus to technological change and efficiency improvement. In this respect, an industry's competitiveness can be enhanced by properly designed environmental regulations to encourage the

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**Table 1**
Pollution intensity coefficient* of China's industries. *Source:* compiled by authors.

| Industry | Pollution intensity | Industry | Pollution intensity |
|---|---|---|---|
| Non-ferrous metal mining & dressing | **0.466** | Leather, furs, down and related products | 0.032 |
| Electricity and heating production and supply | **0.417** | Rubber products | 0.019 |
| Papermaking and paper products | **0.416** | Fuel gas production and supply | 0.019 |
| Smelting & pressing of ferrous metals | **0.263** | Metal products | 0.014 |
| Water production and supply | **0.245** | Petroleum and natural gas extraction | 0.014 |
| Chemical fiber | **0.110** | Clothes, shoes and hat manufacture | 0.008 |
| Coal mining & dressing | **0.104** | Instruments, meters, cultural and office machinery manufacture | 0.005 |
| Ferrous metal mining & dressing | **0.100** | Special equipment manufacturing | 0.005 |
| Raw chemical material & chemical products | **0.100** | Tobacco products processing | 0.004 |
| Plastic products | **0.094** | Beverage production | 0.004 |
| Nonmetal mineral products | **0.092** | Ordinary machinery manufacturing | 0.004 |
| Textile industry | **0.088** | Communications equipment, computer and other electronic equipment manufacturing | 0.004 |
| Non-metal ores mining & dressing | 0.064 | Transport equipment manufacturing | 0.003 |
| Smelting & pressing of non-ferrous metals | 0.064 | Printing and record medium reproduction | 0.003 |
| Food production | 0.058 | Furniture manufacturing | 0.003 |
| Petroleum processing, coking and nuclear fuel processing | 0.057 | Cultural, educational and sports articles production | 0.001 |
| Medical and pharmaceutical products | 0.049 | Electric machines and apparatuses manufacturing | 0.000 |
| Agricultural and sideline foods processing | 0.044 | **Average pollution intensity** | **0.085** |

*Note 1:* *Pollution intensity coefficient of China's 35 industries is calculated in three steps:
(1) $P_{i,1}$ (waste water pollution intensity), $P_{i,2}$ (waste gas pollution intensity), and $P_{i,3}$ (waste residues pollution intensity) are defined as the amount of waste water (gas or residues) that are discharged to produce one million Yuan of output in industry *i*.
(2) The underlying formula is used to standardize $P_{i,1}$, $P_{i,2}$ and $P_{i,3}$:
$\overline{P}_i^a = \frac{P_i^a - \min(P_1^a, P_2^a, \ldots, P_{35}^a)}{\max(P_1^a, P_2^a, \ldots, P_{35}^a) - \min(P_1^a, P_2^a, \ldots, P_{35}^a)}$, $a$ = 1,2 or 3.
(3) Finally, pollution intensity coefficient of industry *i*, $\overline{P}_i$, is measured as:
$\overline{P}_i = \frac{\overline{P}_i^1 + \overline{P}_i^2 + \overline{P}_i^3}{3}$.
*Note 2:* If the pollution intensity coefficient of one industry is higher than average (0.085), it is considered as pollution-intensive (in bold).

application of new, innovative, and clean technologies (Hamamoto, 2006; Kumar and Managi, 2009; Porter and van der Linde, 1995). Although PH is primarily focusing on the relationship between environmental regulation and innovation/competitiveness, this argument can also be applied to portray the relationship between environmental regulation and firm (re)location as firms' location behavior is highly related to innovation, competitiveness as well as production efficiency (Leiter et al., 2011; Testa et al., 2011).

The gist of PH for our present purposes is that increase in environmental standards can actually improve competitiveness, offset compliance costs and encourage firm upgrading, whereas PHH contends firms intend to relocate their business activities from countries (or regions) with stringent environmental regulation to ones where environmental standards are relatively low, in order to avert compliance costs. At the present time, while efforts to explain the effect of environmental regulation over firm restructuring (or competitiveness) have attracted increasing scholarly attention, a great deal of attention is directed towards analyzing the relationship between environmental regulation and firm restructuring based *either* on PHH (Dean et al., 2009; Spatareanu, 2007; Tole and Koop, 2010) *or* on PH (Costantini and Crespi, 2008; Hamamoto, 2006; Kumar and Managi, 2009; Murty and Kumar, 2003). Most extant studies have taken a "black-or-white" attitude, and sought to verify one hypothesis while implicitly neglecting, if not completely negating, the other. The present paper will contribute to this emerging polemic and argue that PH and PHH—in most instances—co-exist, by focusing specifically on the restructuring of the pollution-intensive firms in Shangyu, Zhejiang province in China. By "pollution-intensive firms", we are referring to firms in industries such as non-ferrous metal mining & dressing, electricity and heating production and supply, papermaking and paper products, smelting & pressing of ferrous metals, water production and supply, chemical fiber, coal mining & dressing, ferrous metal mining & dressing, raw chemical material & chemical products, plastic products, nonmetal mineral products, and textile industry (Table 1), which have also been regarded as pollution-intensive industries in the *First Nationwide Pollution Source Survey* (2007) launched by China's State Council.[1]

China has received constant attention for both its rapidly growing economy and the serious environmental degradation that has occurred since the Reform and Opening-up policies of 1970s (He et al., 2012). The high-growth, resource- and pollution-intensive industrialization model that China pursued has caused severe environmental pollution and deterioration (Chan and Yao, 2008; He et al., 2012), particularly in a number of clusters in the coastal regions of East and Southeast China where the Reform and Opening-up policies first started (He et al., 2008; Wang, 2010; Wei et al., 2007; Wen, 2004). The lack of uptake of environmental norms/values, as well as implementation deficit of environmental regulations and policies, and the lack of institutional capacity have been compounding factors. With an increasing number of pollution incidences, such as the low visibility days in Beijing in 2013 caused by thick fog and haze, reported by the media, much attention has been directed towards reducing pollution and to promoting clean technology as well as industrial upgrading. A series of laws, regulations, and standards such as the *Comprehensive Work Plan of Saving Energy and Diminishing Pollution*, have therefore been issued, resulting in an increasing level of environmental stringency.

Pollution emissions vary across the Chinese regions as the coastal regions have a relatively longer period of unbridled economic development (Tang et al., 2010) (Fig. 1), and the strength of the enforcement of the environmental regulations varies across regions as well (Zhang and Fu, 2008). First, the variation of environmental regulation could be attributed to the intention of

[1] General Office of the State Council, May 25 2007, "Report on the First Nationwide Pollution Source Survey." Retrieved on February 23 2014 from: http://www.gov.cn/zwgk/2007-05/25/content_626141.htm.