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Environmental policy and exports: Evidence from Chinese cities

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ABSTRACT

We study environmental regulation and its role for trade in China. Specifically, we assess the effectiveness of an environmental policy in China that introduced stricter regulations on sulfur dioxide (SO_2) emissions in targeted cities. To identify the causal effect of this policy on exports, we use sectoral export data for a panel of Chinese cities and exploit variations in exports between cities and sectors, over time, and, in a second step, between firm types. We find a relative fall in sectoral exports in targeted cities after the implementation of the policy, which is sharper the more polluting the industry. Further, we find that the observed effect is mainly driven by privately owned firms, whereas exports of state-owned firms seem to be unaffected by the new policy. This finding is consistent with the preferential political treatment of state-owned firms in China.

Introduction

In recent years, air pollution has become a major concern in China, with wide-reaching negative effects on not only health and the environment, but also the economy. Air pollution in Beijing achieved international notoriety in January 2013, spiking at unprecedented levels with conventional measures being "beyond index" (The Economist, 2013). The recent negative focus on urban air quality has harmed China, which has long been criticized internationally for its half-hearted commitment to environmental protection.

However, China has introduced a series of regulatory policies over recent decades, despite its image as a bad student. Concerns that environmental problems may act as a brake on economic growth[1] have produced an ambitious array of environmental-protection laws to reduce firm emissions. There is surprisingly little consensus on the impact of these environmental policies on economic activity, or even the environment. Some now question the effective implementation and enforcement of Chinese environmental laws, which have been argued to largely exist only on paper (OECD, 2006). There are also recurrent doubts over the accuracy of official pollution data (The Economist, 2012). The open question is thus whether Chinese environmental regulations are only green-washing on an epic scale, or whether there have been economic repercussions.

This paper investigates the effectiveness of the so-called Two Control Zones (TCZ) policy in reallocating activity away from polluting sectors. This policy was implemented in 1998 by the Chinese central government with the aim to reduce

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[1] Estimates put the cost of air pollution damage in China between 1.2 and 3.8% of China's annual GDP (World Bank, 2007).

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sulfur dioxide (SO_2) emissions, which are considered to be one of the most important sources of air pollution in China.[2] The TCZ policy targeted locations exceeding the national standards on air pollution. Based on previous years' records, a total of 175 cities across 27 provinces were designated as TCZ and therefore faced the new rules.[3]

The empirical analysis in this paper appeals to a panel data set from 265 Chinese cities for 1997–2003, including 158 TCZ cities. We focus on sectoral exports at the city level to measure the economic effect of the TCZ policy and ask whether the implementation of this policy led to any bias against polluting sectors in TCZ as compared to non-TCZ cities. The TCZ policy effect is identified by comparing the exports of TCZ and non-TCZ cities according to each sector's intrinsic exposure to the regulation, which is proxied by its pollution intensity. In a second step, we further filter the effect via the firm's ownership structure.

The advantage of using export data to assess the effectiveness of environmental regulations in China in reallocating activity away from polluting sectors is three-fold. First, export data, contrary to production data, are disaggregated by sector and city level, and are available both before and after the TCZ policy, which is key to our identification strategy. Second, export data, compared to production data which exclude private firms with revenues below five million yuan, cover the whole universe of exporting firms in China. Moreover, export data allow a much finer sectoral decomposition of activity than the production data where firms only report their main sector of activity. Third, export data, compared to production data or emission data, are less likely to suffer from measurement or misreporting problems, which could severely bias the estimates. In the robustness checks we consider the domestic value-added in exports instead of the value of exports to ensure that the relative fall in exports in more polluting industries signals production shifts.

Our paper contributes to the literature in two ways. We first shed light on the claim that new environmental standards may be at odds with China's export-oriented growth strategy, and hence jeopardize its growth prospects. Proponents of the Porter hypothesis – that regulation brings cost-reducing innovation – have challenged this traditional activity-deterring view and argue that there could be a positive link between regulatory stringency and exports (Porter, 1991; Porter and Van der Linde, 1995).

Second, we add to the abundant literature on what Taylor (2004) calls the “pollution haven effect,” whereby tighter environmental rules at the margin affect plant location decisions and activities (Levinson, 1996; Becker and Henderson, 2002; Copeland and Taylor, 2004; Hanna, 2010; Greenstone et al., 2012). Some of this work has looked at Chinese environmental regulations (Dean et al., 2009; Lu et al., 2012) but focuses on the attraction of foreign direct investment.

We further build on recent efforts to address the problem of omitted variables which traditionally hinders the evaluation of environmental policies' impact on trade (Levinson and Taylor, 2008; Millimet and Roy, 2011).[4] It is indeed likely that the way in which environmental policy is designed and enforced in an area is correlated with various broader economic variables, such as GDP per capita or foreign direct investment, where the latter have also been identified in the literature as drivers of export performance.

Our main strategy to counter endogeneity exploits variations in the expected impact of the TCZ policy by sector to isolate the direct regulation-related causal effect. The policy specifically targeted emissions in plants that burn coal, the main source of China's SO_2 emissions. In TCZs, the enforcement of emission standards and the collection of sulfur-emission charges encouraged coal users to adapt their coal-burning processes or use cleaner fuels (State Council, 1998). This increases their production costs, since the adaptation costs (such as that of installing scrubbers or filters) are quite high and the use of cleaner fuel is pricy (Hao et al., 2001). The most cost-effective alternative involves the use of low-sulfur coal or sulfur-fixed briquettes, which is still about 50% more expensive than traditional high-sulfur coal (World Bank, 2003).

As industries vary in terms of their intrinsic dependence on coal, we expect TCZ regulations to have a greater effect on coal-intensive activities and induce a reallocation of resources from higher to lower energy-intensive sectors. This particularity allows us to determine the causal effect of the TCZ policy on exports, even if the selection of TCZs was not exogenous to economic activity. We thus filter the impact of environmental stringency using a sector-level index of energy consumption, which captures its exposure to the new regulations. This strategy is conceptually similar to a triple difference estimate. We compare (i) cities before and after the introduction of the TCZ policy (first difference), (ii) targeted vs. non-targeted cities (second difference), and (iii) sectors with higher vs. lower coal use (third difference).

We appeal to sectoral export data to evaluate the effect of the policy by sector, according to their energy consumption. Our identification strategy partly mitigates the endogeneity issue: by measuring the differential impact of the TCZ policy across sectors, depending on their degree of energy consumption, we reduce the possibility that an omitted variable be driving our results. For an omitted variable to bias our estimates it should also have a differential impact across sectors ordered by energy consumption. The validity of our estimation hinges on the condition that the treated cities would have followed in all sectors the export trend of the control cities if they had not implemented the new environmental policy.

In a second step, our work also addresses concerns about the inadequate enforcement and unsanctioned non-compliance of Chinese environmental regulations (Liu and Diamond, 2005). One common issue is that it is hard for some governmental

[2] Other major air pollutants in China include particulate matter (PM), ozone (O_3) and nitrogen dioxide (NO_2). These were however not specifically targeted by the TCZ policy.

[3] China is divided into 4 municipalities (Beijing, Tianjin, Shanghai and Chongqing) and 27 provinces which are further divided into prefectures. As is common in the literature, we use the terms city and prefecture interchangeably, even though prefectures include both an urban and a rural part.

[4] For a survey of the literature on pollution havens, see Levinson (2008). See Brunel and Levinson (2013) for a recent review of the challenges associated with measuring the repercussions of environmental regulations.