



How do environmental regulations affect industrial dynamics? Evidence from China's pollution-intensive industries



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ABSTRACT

Pollution haven hypothesis (PHH) and porter hypothesis (PH) offer two different perspectives to understand the relationship between industrial dynamics and environmental regulations. This paper seeks to move beyond existing studies that are based on either the PHH or the PH while neglecting the other, towards an analytical framework that not only pays more attention to the ways in which the PHH and the PH co-exist, but also acknowledges the role of firm heterogeneity and local government intervention. Based on a firm-level industrial dataset and a dataset on China's polluting firms, this paper studies the relationship between environmental regulations and industrial dynamics in China's pollution-intensive industries at the firm level. Empirical results confirm the co-existence of the PH and the PHH. Furthermore, firm heterogeneity and government intervention both have the potential to deflect the relationship between environmental regulations and industrial dynamics.

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1. Introduction

One of the key challenges facing pollution-intensive firms is how to respond to environmental regulations (Jeppesen, List, & Folmer, 2002; List, Millimet, Fredriksson, & McHone, 2003; Toledano & Koop, 2010; Yang & He, 2015). The existing literature on environmental regulations and industrial dynamics pay attention to firm behaviors, firm competitiveness and their relationship with environmental regulations, based on either the Pollution Haven Hypothesis (PHH) or the Porter Hypothesis (PH) (Ambec, Cohen, Elgie, & Lanoie, 2013; Bommer, 1999; Kearsley & Riddell, 2010). PHH suggests that uneven environmental regulations between countries/regions cause the relocation of pollution-intensive production to countries/regions where regulations are less strict (Birdsall & Wheeler, 1993; Copeland & Taylor, 2004; Tobey, 1989). It is argued that high environmental standards may cause unemployment and disinvestment due to the additional costs incurred by environmental regulations (Golombek & Raknerud, 1997). In contrast, PH claims that properly designed environmental regulations can catalyze innovations, which to some extent offset

compliance costs (Porter, 1991; Porter & van der Linde, 1995). Such an 'induced innovation' effect may lower the costs of complying with environmental standards on the one hand, and generate new competitive advantages on the other (Kumar & Managi, 2009; Palmer, Oates, & Portney, 1995).

According to the PH and the PHH, environmental regulations force firms to internalize their environmental costs and impact (Murty & Kumar, 2003). This may either result in firms being less competitive in the market because of the additional costs required to comply with regulations, or encourage firms to upgrade their production through innovations, as explained by the PH and its precursor—the "induced innovation" hypothesis (Hicks, 1932). However, existing studies tend to predicate on either the PH or the PHH, and take a "black-or-white" attitude—testifying one hypothesis while implicitly overlooking or negating the other. Furthermore, most of the massive amount of researches done on environmental regulation and industrial restructuring have either used qualitative methods such as case studies and interviews (Zhu, He, & Liu, 2014), or employed quantitative analyses analyzing industrial (re)location and upgrading at the industry level (Toledano & Koop, 2010). Findings based on qualitative methods could be biased and hard to generalize due to the limited sample size; the high level of aggregation in existing quantitative researches makes it hard to understand firm dynamics. This study thus contributes to these debates by stressing the PH and the PHH often co-exist on the

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one hand, and by examining the relationship between environmental regulation and industrial dynamics at the firm level on the other hand. Specifically, we focus on the restructuring of pollution-intensive firms in China, and analyze four dimensions of firm dynamics: firm entry, exit, employment and productivity change. Stringent environmental regulation incurs additional costs and thus may increase entry barriers, frighten off some firms, and lead to employment and productivity decline. However, innovation and upgrading induced by environmental regulations may enable incumbents to grow and attract newcomers.

China has received much attention due to its dramatic economic growth and the subsequent environmental deterioration since its economic reform (He, Pan, & Yan, 2012). China's high-growth, low-cost, resource-intensive development model has given rise to increasingly severe environmental pollution and degradation, particularly in its coastal regions where the Reform first started (He, Dennis Wei, & Xie, 2008). In addition to such a spatial variation of environmental pollution, the stringency of environmental standards as well as the enforcement of environmental laws also differs across geographical regions (Zhang & Fu, 2008). With the deepening of economic reform, decentralization from the central to the local has granted local governments more autonomy, which started to take a primary responsibility for local economic development (He et al., 2008; He, Chen, Mao, & Zhou, 2016), resulting in the so-called "decentralized authoritarianism" in terms of economic development and, more importantly, of the enforcement of environmental laws (Zhu et al., 2014). Specifically, in some wealthy regions with more severe environmental issues and higher environmental awareness amongst stakeholders, local administrations may thus enforce environmental laws more wholeheartedly, whereas local states in less developed regions that face lower level of pollution may favor economic development and implement environmental policies less genuinely (Wang & Wheeler, 2005).

This paper explores the relationship between environmental regulation and industrial dynamics in China—a country characterized by enormous spatial variation of environmental pollution on the one hand, and variegated governance structure with respect to environmental regulations on the other hand. It does so by testifying the PH and the PHH at the firm level and by taking into account two key factors that have been largely overlooked in recent literature—firm heterogeneity and government intervention. The next section proposes an analytical framework. In section three, we introduce data and provide some descriptive analyses. After interpreting the model and variables, section four also analyzes empirical results. The last section summarizes the main findings.

2. Environmental regulation and industrial dynamics: the role of firm heterogeneity and government intervention

Based on either the PHH or the PH, plenty of researches have already explored the articulation between industrial dynamics and environmental regulations, but empirical evidence is at best mixed and inconclusive (Jeppesen & Folmer, 2014; Murty & Kumar, 2003; Zhu et al., 2014). One of the reasons is the role of firm heterogeneity has been largely overlooked. As argued by Zhu et al. (2014), even though the introduction of appropriate environmental policies may trigger industrial innovations and open up new market opportunities, both the PH and its precursor "induced innovation" hypothesis fail to include a discussion with respect to the underlying mechanisms of the introduction of innovations and to the actual availability of additional resources that innovations demand (e.g., investments, technological and technical know-how). In most studies on the PH and the PHH, there is an implicit assumption that firms are homogenous. Martin (2010) has, however, pointed out that regional economic systems are often complex, consisting of

numerous heterogeneous firms with different competences, technologies, business models and resources, though the firms may all belong to the same industry. Given this, it would be problematic to examine the relationship between environmental regulation and industrial dynamics without taking into account firm heterogeneity as well as whether some firms face greater pollution abatement costs or possess more resources to innovate than others.

Firm characteristics may deflect the relationship between environmental regulations and industrial dynamics in many ways (Dean, Brown, & Stango, 2000; Wang & Jin, 2006). Specifically, some empirical studies have stressed firm size as a key explanatory factor in regional industrial dynamics under increasingly stringent environmental regulation (Dean et al., 2000; Heyes, 2009). Dean et al. (2000) have argued that unit pollution abatement costs may be different for small and large firms due to compliance, enforcement, and statutory asymmetries. First, *compliance asymmetries* result from productive and administrative economies of scale in pollution abatement activities, even regulations are equally applied and enforced across small and large firms (Pashigian, 1984). Since compliance is often capital-intensive and demands additional investments such as those on the installation of equipment, the optimal firm size tends to increase. Firms larger than the optimal size are more capable to take pollution reduction measures appropriate to their scales of operations, whereas small firms are not resourceful enough to deal with the technology-forcing aspects of environmental laws (Dean et al., 2000). Furthermore, the cost of interpreting and discovering relevant laws and regulations, coping with regulatory organizations, and performing necessary paperwork could generate another type of fixed costs. Small firms again may be disadvantaged since they are not able to spread such administrative costs over high production volumes.

Second, regulations may be enforced unequally across small and large firms, resulting in *enforcement asymmetries*. Theoretical arguments and empirical studies however generate mixed evidence. On the one hand, large firms, particularly those with brand names, have quickly become the targets not only for national and local governments but also for campaigns by activists and social groups that are intended to improve environmental conditions (Vogel, 2003; Zhang et al., 2008). The rationale behind this is to identify the most profitable and visible branded firms in the market, not because the environmental standards adopted by such firms are the worst (actually, they are often relatively good), but rather because these firms have to protect their brand reputation with consumers (Walker, Di Sisto, & McBain, 2008; Zhang et al., 2008). On the other hand, other studies believe that enforcement asymmetries may occur in the opposite direction, favoring rather than penalizing large establishments (Bartel & Thomas, 1987). Since enforcement agencies seek to maximize net political support, large firms often have an advantage in defending themselves with greater legal and political resources, and are therefore subjected to less stringent enforcement. Third, statutory asymmetries may be due to differences in the stringency of legislation that small firms face compared with large ones. This type of asymmetries may favor small firms since legislators tend to shield small firms from regulations to minimize the potential disproportionate effects of regulations on small businesses. In short, the impact of environmental regulation is complicated and may vary across large and small firms.

Another factor that has not received much attention in the academic literature is how local governments' intervention affects the relationship between environmental regulation and industrial dynamics. Since the initiation of China's Reform and Opening-Up Policies, China has undergone dramatic economic growth and has experienced three fundamental transformations: (1) from a state-owned, collective economy dominated by SOEs to one with growing level of private ownership and market-orientation

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