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Corporate environmentalism and environmental innovation

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ABSTRACT

Several papers have explored the effect of tighter environmental standards on environmental innovation. While mandatory regulation remains the central tenet of US environmental policy, the regulatory landscape has changed since the early 1990s with the increased recourse by federal and state agencies to corporate environmentalism–voluntary pollution prevention (P2) by firms–to achieve environmental improvements. We therefore estimate the effects of voluntary P2 activities on the patenting of environmental technologies by a sample of manufacturing firms. With our panel data of 352 firms over the 1991–2000 period, we adopt an instrumental variable Poisson framework to account for the count nature of patents and the endogeneity of the P2 adoption decision. Our results indicate that the adoption of voluntary P2 activities in the manufacturing sector has led to a statistically and economically significant increase in the number of environmental patents, suggesting that corporate environmentalism can act as a catalyst for investments in cleaner technologies. Our findings are internationally relevant given the increasing ubiquity of corporate environmentalism in both developed and developing economies.

1. Introduction

US firms devote considerable financial resources to the development of cleaner production technologies. For example, statistics in Carrión-Flores and Innes (2010) indicate that on average between 927 and 3150 patents for environmentally friendly technologies were granted every year between 1989 and 2002 to firms in the manufacturing sector.[1] Such figures explain in part the debate in the environmental economics literature regarding the determinants of environmental innovation (see e.g., Jaffe et al., 2002 for a survey). An important facet of this ongoing debate concerns the relationship between environmental regulation and innovation. Porter and van der Linde (1995) contend that, in a dynamically competitive environment, stricter environmental standards may incentivize firms to invest in cleaner technologies that reduce their compliance costs, leading to a "win–win" situation where both pollution levels and firms' operating costs are abated. A number of papers have sought to test the empirical validity of what has become known as the Porter hypothesis (see Horbach, 2008 for a survey). Many of these studies find a causal effect of stricter regulations on environmental innovation, in congruence with the Porter hypothesis (e.g., Brunnermeier and Cohen, 2003; Carrión-Flores and Innes, 2010).

However, a new regulatory paradigm has emerged in recent years with the increasing reliance by federal and state regulatory authorities on corporate environmentalism, that is on firm-initiated or government-sponsored voluntary P2 programs designed to achieve environmental improvements. Firms participating in these programs make a voluntary pledge to exceed emission standards set forth by environmental laws and/or reduce unregulated pollutants.

The 1990 Pollution Prevention Act (PPA) established a federal policy of incentivizing firms to voluntarily adopt source reduction

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[1] Carrión-Flores and Innes (2010) consider a broad measure and a conservative measure of environmental patents. These numbers are obtained by multiplying the reported sample averages for the two measures (24.8 and 7.3) by the number of industries (127) in their sample. The recently released Clean Energy Patent Growth Index which tracks patents granted by the US Patent and Trademark Office (USPTO) for environmentally friendly technologies shows an upward trend between 2002 and 2013; patenting activity reached the highest level in 2013 with 3175 grants made http://cepgi.typepad.com/heslin_rothenberg_farley_/.

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activities, also referred to as pollution prevention (P2) practices.[2] Shortly after the passage of the PPA, the Environmental Protection Agency (EPA) created its first voluntary program, the 33/50, to reduce emissions of 17 highly toxic chemicals; over 1200 firms self-selected into the program. The apparent success of the 33/50 program and a growing awareness among firms and the public of the effects of climate change paved the way for several more voluntary P2 programs such as Energy Star which seeks to decrease carbon dioxide emissions, and the National Environmental Performance Track designed to encourage environmentally proactive firms through rewards and public recognition. From 1996 to 2005, the number of EPA-sponsored P2 programs increased from 24 to 87 (Khanna and Brouhle, 2009).

In addition to government-sponsored voluntary P2 programs, many firms have shifted away from a regulatory driven approach to a more proactive and beyond-compliance strategy towards environmental management.[3] For example, in the wake of a tragic gas leak that killed thousands in Bhopal India, the chemical manufacturing industry responded by creating, on its own volition, the Responsible Care program to enhance environmental performance and occupational safety above and beyond member firms' legal obligations. The apparent success of Responsible Care led the BP Oil Spill Commission to recommend the creation of a like-minded program for the oil and gas industry (Gamper-Rabindran and Finger, 2013) in the aftermath of the Deepwater Horizon oil spill in the Gulf of Mexico in 2010. Other notable examples of firm led initiatives to rein in waste generation include the multinational conglomerate 3M's Pollution Prevention Pays (3P) program and Chevron's Save Money and Reduce Toxins (SMART) program.[4]

In developing and transition economies with lax environmental enforcement agencies, many businesses have embraced corporate environmentalism in order to reassure downstream buyers about their commitment to environmental quality or as a condition of doing business with them. This is more likely to be the case for export-oriented businesses in developing economies who act as suppliers to larger multinational companies that cater to clients in richer economies. Anecdotal evidence indicates that many suppliers in developing economies have faced pressure from their customers in developed countries to seek ISO certification (Prakash and Potoski 2012). China, for example, has the highest number of ISO 14001-certified businesses in the world and empirical evidence in McGuire (2014) indicates that ISO certification has improved environmental compliance for a sample of Chinese manufacturing firms.

Despite the increased recourse to these voluntary environmental programs in developed, transition, and developing economies, surprisingly little has been done to ascertain their effects on environmental innovation. The main objective of our study is to explore whether the voluntary adoption of P2 activities by regulated firms impels or impedes their investments in environmental technologies.[5] To our knowledge, only few papers (e.g., Johnstone et al. (2010), Brouhle et al. (2013), Carrión-Flores et al. (2013)) have studied the link between P2 programs and environmental innovation For example, using country-level data, Johnstone et al. (2010) find no effect of the presence of "voluntary environmental policy"–captured by a dummy variable—on environmental patenting activity. Brouhle et al. (2013) examine the effect of participation in the Climate Wise program on firm-level environmental innovation, finding that Climate Wise participation enhanced the technical capacity of less R&D-intensive firms, which in turn led to a statistically significant increase in the number of environmental patents. Specifically, they find that a participant firm with median R&D intensity had 18% more environmental patents as a result of participation in the Climate Wise program. Carrión-Flores et al. (2013) also evaluate the effect of P2 program participation on environmental innovation at the industry level. They find that participation in the 33/50 program led to increased environmental patenting in the short-run (between 1994 and 1999) but had a negative effect in the long-run (between 2000 and 2004). Per their results, a 10% increase in the industry-level 33/50 adoption rate was estimated to increase environmental patents by 27.5% between 1996 and 1999, and reduce said patents by 46.2% in years 2000–2004.

Both the 33/50 (Carrión-Flores et al., 2013) and Climate Wise (Brouhle et al., 2013) were designed with short-term pollution reduction objectives for a narrow target of emissions. For example, the 33/50 program sought to abate emissions of 17 toxic chemicals by 33% by 1992 and by 50% by 1995 relative to 1988 baseline levels (Khanna and Damon, 1999). Likewise, Climate Wise was in effect from 1993 to 2000 and focused on the nonutility manufacturing sector to achieve reductions in greenhouse gas (GHG) emissions. Unlike these two narrow "short-term" programs, the P2 program–spawned by the PPA and is our focus–is far broader in scope (targets all 683 chemicals and chemical categories in the Toxics Release Inventory (TRI)) and does not have any explicit time-sensitive emission reduction goals. It consists of a diverse set of 43 P2 practices ranging from good operating practices (e.g., improved maintenance scheduling, recordkeeping), to improved procedures, to raw material and process modification (e.g., modified equipment, layout, or piping). Between 1991 and 1995, over half of all TRI facilities had adopted at least one P2 practice (Sam, 2010); in the same period, only 12% of eligible firms had joined the 33/50 program.

Moreover, unlike Carrión-Flores et al. (2013), we use firm-level data instead of aggregate industry-level data. We do so for two main reasons. First, both decisions to invest in patentable environmental research as well as adoption of P2 activities are made by firms. Second, aggregation at the industry level may serve to attenuate the real impact of voluntary P2 activities on

[2] The PPA defines a source reduction practice as "any practice which (i) reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, or disposal; and (ii) reduces the hazards to public health and the environment associated with the release of such substances, pollutants, or contaminants."

[3] Businesses and industries have taken unilateral steps to proactively improve their environmental management by adopting the International Organization for Standardization (ISO)'s 14001 standards and related environmental management systems–such as Total Quality Environmental Management (TQEM)–that enable them to identify the environmental impacts of their products and internalize those impacts in their operational decisions (Sam et al., 2009).

[4] These slogans illustrate that private firms' investments in cleaner technologies are also motivated by shareholder wealth maximization, which manifests itself via a number of channels. Specifically, cleaner technologies have the potential to i) reduce operating expenses and lower the number of costly inspections and enforcement actions (Maxwell and Decker, 2006), ii) help preempt costly boycott campaigns (Innes and Sam, 2008), iii) enhance the appeal of a firm's products among environmentally conscious consumers (Khanna and Damon, 1999); iv) spur tighter standards that raise rivals' costs (Salop and Scheffman, 1983; Innes and Bial, 2002), iv) forestall negative public reaction in media and financial markets (Hamilton, 1995) by reducing the frequency of environmental infractions and the volume of toxic chemicals produced. Eccles et al. (2014) classify firms based on their adoption of sustainability policies by 1993 and track their financial performance over an 18 year period. They find that *high sustainability* firms (those that voluntarily adopted sustainability practices) outperformed otherwise similar *low sustainability* firms in terms of stock market performance and accounting rates of returns (return on equity and return on assets). Sharma and Vredenburg (1998) also find that environmental proactiveness was associated with a number of competitive benefits such as lower operating costs and improved corporate reputation.

[5] By environmental innovation, we are referring to successful patents of environmental technologies.