Journal of Cleaner Production 64 (2014) 91–97

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

The effect of Integrated Pollution Prevention and Control regulation on facility performance

Francesco Testa [a,*], Tiberio Daddi [a], Maria Rosa De Giacomo [a], Fabio Iraldo [a,b], Marco Frey [a]

[a] Sant'Anna School of Advanced Studies – Institute of Management, Piazza Martiri della Libertà 33, 56127 Pisa, Italy
[b] IEFE e Institute for Environmental and Energy Policy and Economics, Bocconi University, Milan, Italy

ARTICLE INFO

Article history:
Received 27 April 2013
Received in revised form
1 August 2013
Accepted 1 August 2013
Available online 15 August 2013

Keywords:
IPPC
Environmental regulation
Environmental performance
Technologies

ABSTRACT

Over the past fifteen years there has been considerable debate in the economic literature about what is the proper design of environmental regulation that can be effective. In this article, we provide a contribution to the literature and empirical evidence by focusing on a new form of direct regulation introduced by the European Union: the Integrated Pollution Prevention Control regulation. By using data from different sources, we performed ordered probit regression and found that the design of Integrated Pollution Prevention and Control permit provides a positive impulse for increasing investments and, as a consequence, produces positive effects on performance at the facility level. Our study clearly shows that direct regulation can have a strong and significant effect on performance, but it depends on how it is designed. The main managerial implication stemming from our work is the need to properly design approaches and tools for direct regulations.

1. Introduction

The main factors affecting the sustainable consumption and production path are undoubtedly the production systems which provide products and services to the market and consumers (EC, 2013; Nash, 2009; Partidário et al., 2007).

The significance of the environmental pollution deriving from industrial activities has been emphasized by several studies and survey data (Galán et al., 2002; Kunz et al., 2013; Polizzi et al., 2007; Tseng et al., 2013). For instance, the European Pollutant Release and Transfer Register show that almost 2000 (large and medium) facilities release almost 2 billion tons of CO_2 and 32 billion tons of hazardous waste. In addition, a European study that estimated the environmental impact of SMEs in Europe, using data from Eurostat (Constantinos et al., 2010) found that SMEs are responsible for about the 64% of industrial pollution in the EU. According to this study, the industrial activities with the highest impact on the environment are the following: the manufacturing of chemicals, basic metals, rubber and plastic; the food industry; mining and quarrying; pulp and paper production, coke, energy production, air and water transport, construction.

To protect the environment, governments need to introduce a wide set of tools according to the so-called policy mix instruments, to combine mandatory and voluntary approaches based on market dynamics (Iraldo et al., 2009). To achieve sustainable growth through the promotion of a greener economy is one of the priorities of the Europe Strategy 2020 (European Commission, 2010), for which important and real changes in regulations have been requested (Giner-Santonja et al., 2012).

Over the past fifteen years there has been considerable debate in the economic literature about the proper design of effective environmental regulation. The inspiring study of Porter and van der Linde (1995b) states that "properly designed environmental regulations can trigger innovation that may partially or more than fully offset the costs of complying with them." This finding stimulated an extensive amount of studies on the effect of different forms of environmental regulation on performance (see for instance: Cole and Elliott, 2003; Ederington and Minier, 2003; Gray and Shadbegian, 2003; Lanoie et al., 2011).

Although many studies found that direct regulation is an effective environmental policy instrument, the relationship between command and control regulation, investments and performance of facilities has not yet been sufficiently investigated (Triesbwetter and Hitchens, 2005). Many previous studies focused only on the link between regulation and environmental performance (Daddi et al., 2011a, b; Honkasalo et al., 2005; Mirasgedis et al., 2008; Silvo et al., 2002; Styles et al., 2009) whereas few

* Corresponding author. Tel.: +39 (0)50 883975; fax: +39 (0)50 883936.
E-mail address: f.testa@sssup.it (F. Testa).

0959-6526/$ – see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.jclepro.2013.08.003

studies have compared the efficiency of mandatory regulation (Hitchens et al., 2002; López-Gamero et al., 2009).

In this article, we provide a contribution to the literature and empirical evidence by focusing on a new form of direct regulation introduced by the European Union, which mixes the characteristics of command control with such forms of flexibility and the following technology incentives: the Integrated Pollution Prevention Control (IPPC) regulation (Council Directive 96/61/EC, repealed by the Council Directive, 2008/1/EC). Directive 2008/1/EC will be repealed on January 7, 2014 by Directive 2010/75/UE (European Parliament, 2010) on industrial emissions.

Specifically, our research uses quantitative analysis to determine the effectiveness of the design of the IPPC regulation on a facility's environmental performance and investments. By using a dataset collected within the EC-funded Project MED IPPC NET, we tested the following propositions: i) the design of the IPPC permitting system positively stimulates investments by facilities; ii) IPPC facilities which increase environmental investments are able to achieve more significant improvements in environmental performance. A notable strength of our study is the use of data from different sources in order to reduce one of the most significant biases affecting the survey method known as the "common rater" effect.

2. Different approaches to environmental regulation

Industrial activities contribute extensively to global pollution. Therefore, public intervention through environmental regulation is necessary for reducing pollution, for the benefit of society. Still, the debate on the most effective and efficient approach to environmental regulation is still very much alive (Testa et al., 2012).

The supposed struggle between environment and economy, evidenced by many studies, comes from a non-dynamic view of environmental regulation. In a static scenario, where companies have already taken their cost-minimizing decisions at the design stage, environmental regulation induces a cost increase and tends to reduce the market share of those companies that invest more resources and spend more money for environmental protection. The conventional and traditional economic view based on neoclassical economic theory affirms that the costs of regulation are high, and that they increase costs, and reduce profits (Altman, 2001). This view also holds that costs induced by environmental regulation affect prices and, consequently the demand dynamics are able to affect investment decisions and, as a result, innovation by companies. According to this view, environmental regulation exists only to correct negative externalities, so it inevitably turns out to be counterproductive for efficiency and competitiveness (Cole and Elliott, 2003; Ederington and Minier, 2003; Gray and Shadbegian, 1998).

In contrast with the traditional view, a new vision affirms that improved environmental performance—determined by regulation itself, but through different dynamics—is able to stimulate actions and investments by companies that generate efficiency. This new perspective suggests that environmental regulation is potentially beneficial to firms because it brings about innovations that, in the long run, produce more efficient technologies, higher productivity, lower risks and, therefore, lower costs of compliance in addition to new clients and market opportunities (Porter and Van der Linde, 1995a). This paradigm maintains that properly designed environmental standards can trigger innovation that more than balances the costs of complying with them (Dean and Brown, 1995).

Environmental regulation can be broadly classified into three categories according to how compulsory they are as follows: direct regulation (command and control), market-based instruments (economic instruments) and soft instruments (Del Brio et al., 2002).

Command and control regulation is linked to the "polluter pays principle" and it includes standards such as mandatory limitations and prohibitions. Direct regulation forces companies to adapt to new environmental changes by setting specific standards and limits on performances and/or requirements about the adoption of technologies and processes and, ultimately, by checking their compliance with regulations (Camison, 2010) through inspections and controls.

Economic instruments—especially those that can be defined as "market-based"—imply a number of potential advantages over direct regulation. First of all, they provide a continuous incentive to reduce pollution (e.g. "pigouvian" taxes), secondly they entail lower implementation costs and can be applied through easily calculable parameters (e.g.: energy or carbon taxes) (Zylicz, 2010).

Soft instruments include voluntary industry agreements, green procurement practices and environmental certification schemes, but can be extended to include also incentives for eco-innovation in products, processes and systems in organizations (Camison, 2010). The principle behind soft instruments is that companies set their own objectives and targets for environmental improvement (identifying the most efficient investments to achieve them) and publicly commit themselves to pursue and obtain these results (Anton et al., 2004; Buysse and Verbeke, 2003).

Several studies focused on the analysis of the impact of single policy instruments on environmental performance. For instance, Jaffe et al. (2002) affirm that the economic instruments, such as "piguovian" taxes, determine more positive impacts over time compared to command and control approaches on innovation and diffusion of environmentally desirable technologies and techniques. For instance, the effectiveness of emissions-related taxes is proven by some studies, a relevant case-study being the Swedish refund system for NO_x, which prompted and stimulated eco-innovation by allocating tax revenues to better performing producers (Sterner and Isaksson, 2006). The effectiveness of the "market-based" instruments, such as emissions trading schemes is more debated and uncertain (Burtraw et al., 2005; Ellerman, 2003; Sandoff and Schaad, 2009).

With regard to voluntary instruments, many studies investigated the effects of environmental management systems and agreements on the environmental performance of companies, finding positive links between their adoption and the improvements achieved (Arimura et al., 2008; Daddi et al., 2011a, b; Gusmerotti et al., 2012).

Finally, some studies stated that direct regulation improves environmental performance (Silvo et al., 2002; Testa et al., 2012). However, there are contradictory results about the effectiveness of the mandatory approach to incentivizing environmental adjustments made by companies (e.g. Clemens and Douglas, 2006; Potoski and Prakash, 2004).

As mentioned above, for the purposes of our study we focused on a new form of direct regulation introduced by the European Union that mixes the characteristics of "command and control," with different forms of flexibility and incentives for innovation: the Integrated Pollution Prevention Control (IPPC) Directive. The main purpose of the IPPC Directive is to minimize or prevent pollution arising from the most significant industrial and agricultural sources of environmental impacts, through the establishment of an integrated pollution prevention and control system that puts into practice a cross-media, synergetic and coordinated approach to the protection of the environment as a whole (Lopez-Gamero et al., 2009). The environmental behavior of firms subjected to this Directive is regulated by an integrated IPPC permit that contains standards and requirements to which firms must comply. The permit should include, among others, the sources of emissions, the nature and quantities of foreseeable emissions, and the measures