



The effectiveness of environmental inspections in oligopolistic markets



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ABSTRACT

This study focuses on the consequences of inducing compliance with environmental legislation through inspections in oligopolistic markets. Adherence to the law is associated with environmental gains, but also with losses in surpluses as firms incur abatement costs. By relating the net social benefit of deterring breaches of legislation to inspection costs, the impact of various market characteristics on the effectiveness of inspections can be assessed, thus providing guidance for environmental inspection agencies that have to prioritize among sectors given a fixed budget.

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1. Introduction

Firms in general have strong incentives to try to reduce marginal cost. Often, this benefits society as a whole and consumers in particular. However, sometimes cost reductions are attained by various illegal activities such as e.g. the use of dirty production technologies. To balance firms' incentives to pollute environmental inspection agencies monitor firms and punish breaches of legislation. Following Becker (1968), a firm therefore has to weigh the benefits from saving abatement costs against the risk of non-compliance being detected and punished.

If resources available for inspections and enforcement were sufficiently large, fines for violations of legislation were sufficiently severe and inspection technologies were sufficiently efficient, it should be possible to induce compliant behavior in any industry subject to environmental regulation. In reality this is seldom the case. The starting point of our study is that the incentives for violating the law differ across industries and that the inspection agency does not have enough resources to achieve full compliance in all industrial sectors.

We apply the Häckner (2000) model of oligopolistic Cournot competition where the representative consumer's utility function is quadratic such that demand for differentiated goods is linear. It is assumed that firms have perfect information regarding market conditions and hence, react strategically in case a competitor saves costs by violating the law. Naturally the cost for inducing compliance is related to the gain from unilaterally breaching legislation, which allows us to relate the social benefits of inspections to this cost. More specifically, we account for three potential channels, through which inspection

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activities affect welfare. First, monitoring of firms is obviously associated with *inspection costs*. Second, inspections are carried out to achieve compliance with legislation and hence, there are *environmental gains*. Third, as abatement is likely to increase marginal costs of production, successful inspections will lead to *economic losses*, because welfare is reduced due to lower market surpluses.¹

Naturally the weight attributed to the economic consequences of inspections may vary across agencies, for example due to the institutional conditions under which they operate. On the one hand, an independent agency may focus solely on the environmental impact of inspections. On the other hand, an agency may be under pressure (e.g. through lobbying) to also consider the market effects of inspections. Given the relative weight of surplus losses vis-à-vis environmental gains, the net social benefit in relation to the costs for inducing compliance can be calculated for any market. We thus obtain a measure for the effectiveness of inspections that varies with respect to the following market characteristics:

- (1) The degree of market concentration;
- (2) The degree of product differentiation;
- (3) Shifts in demand;
- (4) Cost savings from breaching legislation, i.e. abatement costs.

Analyzing the effect of market conditions on the social benefit per dollar spent on inspections enables us to rank sectors with regard to the effectiveness of resources allocated to inducing compliant behavior. Since we assume firms in any given industry to be identical, the agency has to decide between carrying out sufficiently many inspections to deter violations and not monitoring that sector (in which case the environment is harmed, but inspection costs are saved). Hence, our framework can be used as guidance for an agency, which has to determine where to allocate inspection resources that are not sufficient to ensure compliance in all industries subject to environmental legislation.

Our main findings are the following. First, as long as the weight put on economic losses is not too large, inspection agencies should target firms operating on markets with low competitive pressure, i.e. concentrated markets and markets where product differentiation is substantial. Second, inspection agencies should focus on sectors with high abatement costs and weak demand, unless competition is fierce and the relative weight of economic losses is sufficiently small. Third, the higher the weight attributed to surplus losses, the more competitive should the markets targeted by the inspection agency be.

The literature on environmental inspections and enforcement, which has been surveyed by e.g. [Cohen \(1998\)](#) and [Heyes \(2000\)](#), addresses a wide range of issues. Models typically include firms subject to environmental legislation interacting with an agency that optimizes its inspection strategy, e.g. to minimize environmental impact or to maximize social welfare. For example, [Malik \(1990\)](#), [Heyes \(1994\)](#) and [Innes \(2001\)](#) focus on firms' efforts to avoid detection of non-compliance, while e.g. [Nowell and Shogren \(1994\)](#) model firms' contesting of fines for violations.

[Bontems and Bourgeon \(2005\)](#), [Cason et al. \(2016\)](#), [Gilpatric et al. \(2011\)](#), [Harford \(1987\)](#), [Helland \(1998\)](#), [Innes \(1999a,b, 2000, 2001\)](#), [Kaplow and Shavell \(1994\)](#), [Livernois and McKenna \(1999\)](#), [Malik \(1993\)](#), [Macho-Stadler and Pérez-Castrillo \(2006\)](#) and [Oestrich \(2015\)](#) analyze how compliance among self-reporting firms can be enhanced by adequate monitoring strategies. [Cohen and Santhakumar \(2007\)](#) demonstrate that the disclosure of information may lower emissions and enhance social welfare. [Langpap \(2008\)](#) presents a model where self-reporting may enhance private enforcement through citizen suits, such that regulatory and social costs of enforcement are reduced. Other contributions account for the possibility that regulatory outcomes may be influenced by lobbying (see e.g. [Cheng and Lai, 2012](#)).

Most inspection models assume that firms are distributed over a continuum regarding one variable (e.g. abatement costs or the detectability of non-compliant behavior). Implicitly it is thus assumed that firms are myopic with respect to market outcomes, i.e. markets are perfectly competitive such that cost savings due to breaches of legislation increase a firm's profit without influencing market prices and market shares. In contrast, our model accounts for the fact that the degree of competition may vary across markets; hence, non-compliance does not only lower a firm's costs, but also affects the strategic interaction with its competitors.²

In recent years the efficiency of inspections and the effective use of available resources have received increasing attention by several international organizations. For example, [OECD \(2014\)](#) provides guidelines for regulatory policy practices, emphasizing the importance both of "responsive regulation" of specific businesses (pp. 33–35) and of "concentrating resources and efforts where they can deliver the most results" (p. 38). These recommendations originate in the insight that resources for monitoring activities are limited and insufficient for achieving full compliance across all industries, which is also the underlying assumption that we make. Moreover, [OECD \(2014\)](#) suggests that "in the absence of comprehensive data and/or fully reliable data, regulatory enforcement agencies should rely on interpreting what data exists (at least to establish which sectors appear to generate the most damage)" (p. 28). Our set-up yields some simple rules of thumbs based on a few industry characteristics, which can be applied to allocate inspection resources effectively.

¹ It is conceivable that clean production processes are associated with increases in both fixed and variable costs, but here we focus entirely on the latter effect. Obviously, adding fixed costs would introduce a strong link between the level of these costs and market structure.

² See also [Häckner and Herzing \(2012\)](#) who analyze how the incentives for unilaterally breaching legislation are influenced by market conditions.

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