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Farmers' costs of environmental regulation: Reducing the consumption of nitrogen in citrus farming

Andrés J. Picazo-Tadeo [a,*], Ernest Reig-Martínez [a,b]

[a] *Universitat de València. Dpto. Economía Aplicada II. Avda dels Tarongers s/n. 46022 Valencia, Spain*
[b] *Instituto Valenciano de Investigaciones Económicas. Guardia Civil, 22. 46020 Valencia, Spain*

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Abstract

Environmental externalities in agriculture, and the choice of suitable instruments to integrate environmental concerns into agricultural policies, are a matter of interest for the Common Agricultural Policy. In this paper, we use *Data Envelopment Analysis* techniques to assess the impact on farms' performance of two environmentally-friendly regulations aimed at abating consumption of inorganic nitrogen in Spanish citrus farming: levies on purchased nitrogen and nitrogen use permits for farms. By comparing farms' short-run maximum profits under both unregulated and regulated scenarios a regulation cost index is computed. Our results show that nitrogen overuse is mostly a matter of management inefficiency and that pollution could be reduced by promoting best farming techniques. Instead, if environmental regulations are implemented, regulating authorities should be aware that quantitative limits exercise a lower impact on farms' profits than taxes.

JEL classification: Q12; Q20; C61

Keywords: Environmental policies; Private regulation costs; Citrus farming; Nitrogen fertilization

1. Introduction

Goods are often jointly produced with negative externalities on the environment, such as water and air contamination, toxic polluting wastes and other undesirable outputs. From the eighties onward, economic literature has paid increasing attention to the measurement of firms' environmental performance and the development of indicators capable of assessing the impact on firms'

* Corresponding author. Tel.: +34 963 828 362; fax: +34 963 828 354.
E-mail address: andres.j.picazo@uv.es (A.J. Picazo-Tadeo).

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performance of public regulations aimed at reducing the negative influence of their productive activity on the environment.

Farming frequently leads to environmental damage through soil and water pollution, because of the increasing usage of inorganic fertilizers. In Spain, consumption of inorganic nutrients (nitrogen, phosphorus and potassium) increased almost fourfold between 1960 and 2000, while the use of nitrogen increased more than fivefold (Reig-Martínez and Picazo-Tadeo, 2002). In some cultivation areas of Eastern Spain specialized in fruit and vegetable production, the problem of underground water contamination due to excessive application of inorganic nitrogen is becoming a serious environmental concern. These areas of intensive farming with a high pollution potential amount to 3.5 million hectares of irrigated land, 1.2 million of them located along the Mediterranean coastline (Varela-Ortega, 1998). In spite of the magnitude of soil and ground water contamination by nitrates in certain areas of Spain, no legislation currently exists that regulates farming fertilization practices. Instead, some regional governments have established *good practice codes* aimed at achieving predetermined standards of environmental quality by recommending acceptable levels of consumption of inorganic nutrients. This is the case in the Eastern Spanish region of Valencia, where regional authorities have set up a code of good practice in citrus farming that suggests *adequate* nitrogen fertilization rates. Nevertheless, a notable feature of this code is that its implementation remains optional.

In this setting, this paper aims to assess the impact on both consumption of nitrogen and farms' performance of two environmental policy regulations aimed at providing incentives for Spanish citrus farmers to reduce their use of inorganic nitrogen fertilizer. The policy instruments analyzed are: (i) levies on nitrogen consumption, and (ii) quantitative limits to the use of this polluting input. Making use of *Data Envelopment Analysis* and goal programming techniques, our research contributes to the existing literature modelling environmental policies into the framework of neoclassical production theory and profit efficiency analysis. Our main results show that excess consumption of nitrogen is mostly a matter of profit inefficiency that could be eliminated by spreading good agricultural practices among citrus farmers. However, if governments decide to enact public regulations aimed at reducing the use of inorganic nitrogen, then from the point of view of their impact on farms' performance, quantitative restrictions are to be preferred to levies because of the formers' low impact on farms' profits.

Our view is that these results could provide the policy makers with meaningful information to improve the design of environmental policies aimed at reducing the consumption of inorganic nitrogen in Spanish citrus farming. Furthermore, provided adequate empirical data are available, this approach can be extended to the analysis of environmental externalities in other agricultural activities. The extent of environmental externalities in European agriculture, and the impact on farms' performance of public policies aiming to bring under control farms' emissions of harmful wastes are a long-standing matter of interest of the *Common Agricultural Policy* (*CAP*). The European policy on rural development, referred to in the *Agenda 2000* as the second pillar of the *CAP* alongside the markets policy, includes important environmental measures, known as *agri-environmental measures*. *Council Regulation* (EC) 1257/99, devised to support rural development, promotes agricultural production methods designed to protect the environment, providing for payments to farmers willing to adopt *agri-environmental commitments* beyond ordinary good agricultural practices.[1] Furthermore, *Commission*

[1] Subsequently, several regulations have amended or laid down particular rules for the application of *Council Regulation (EC) 1257/99*, e.g. *Commission Regulations (EC)* 2603/99, 445/02, 1783/03 and 817/04.