On Levies to Reduce the Nitrogen Surplus:
The Case of Dutch Pig Farms

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Abstract. Pig farms in the Netherlands pay a zero or low price for using the environment. As a consequence, the environment is overused. The Dutch government wants to reduce the emissions of nitrogen and phosphorus. Possible instruments are regulation and levies. In this study a levy on feed and a levy on the nitrogen surplus are investigated, by incorporating a bad output in the production model. The model is estimated using panel data of Dutch pig farms over the period 1975–1989. Levies on nitrogen turn out to be more cost-effective than levies on feed.

Key words. Pollution control, manure problem, nitrogen surplus, bad output, levies

1. Introduction

Since 1984 the Dutch government has formulated policy measures to reduce the harmful effects of the production and application of manure. For the big farming section the measures that have been taken by the government amount to a prohibition to increase the number of animals, the obligation to remove the manure surplus from the farm, to pay a levy of 0.50 guilders for each kg of surplus of phosphate and to apply the manure in such a way that the ammonia emission is drastically reduced.

Another way of tackling the problem of environmental damage caused by the sector is the imposition of a levy on the nitrogen and phosphate surplus. The farmer can then choose how he will react to the levy. He can pay the levy, he can reduce the number of animals, he can adapt the feed to influence the nutrient content of the manure, he can build pig houses with a low emission of ammonia, he can spread the manure in a low emission way, he can grow crops that take up large amounts of nutrients from the soil, he can apply manure at such a moment that leaching is minimized, etc.

To implement a system with levies on nitrogen and phosphate surpluses, a mineral account has to be kept by the farmer. This asks for a complete registration of all inputs (feed, fertilizer, manure, piglets, etc.) and outputs (meat, manure, crops, eggs, etc.) on which basis the surpluses can be calculated.

Imposition of a levy on inputs (e.g. feed, fertilizer) (or outputs) may be much easier to implement than a levy on the surpluses but has the disadvantage that also parts of the input that are not harmful to the environment are levied. However, by the introduction of threshold values for inputs the ‘polluter pays’ principle can roughly be obtained.

In this paper the effects of a levy on feed or a levy on the nitrogen surplus at farm level are studied using an econometric approach. To this end a bad output is included in the production model of pig farms. Because historical data on the use of different kinds of feed with different mineral contents are not available, the substitution between different kinds of feed as a result of a levy are not taken into account. Also the use of buildings with low levels of ammonia emission are not taken into consideration. The only way a farmer can react is by adaptation of the size of the farm or by substituting feed for other inputs. The production process, however, does not allow for large substitutions between feed and other inputs, so the main response of the farmer to a levy on feed or on nitrogen production will be a reduction in the output.

In Section 2 we review the Dutch manure problem and government policy. In Section 3 we put the behaviour of the pig farmers into a general theoretical framework. The data we use for estimation and simulation purposes are subsequently described in Section 4. With these data and the embedding of the model into a stochastic framework in Section 5.1 we present estimation results in Section 5.2. Simulating the behaviour of the pig farms with the aid of these estimation results is the next step, presented in Section 6. Finally, in Section 7 the main findings of this paper are summarized.

2. The Dutch Pig Sector and the Manure Problem

2.1. MANURE PROBLEMS AND GOVERNMENT POLICY

The Dutch livestock sector is characterised by a large number of animals per hectare of cultivated land. Some 14 million pigs, 100 million layers and broilers and 1.75 million cows are kept on 2 million hectares. With the growth of the livestock sector in the last two or three decades, the production of manure has increased enormously. This has lead to high levels of application of manure to the soil. Furthermore, high levels of fertilizer per hectare have been applied. This excess supply of minerals to the soil has caused big environmental problems in the form of nitrate leaching, phosphate leaching and denitrification. The emission of ammonia (NH$_3$) from stables and from manure spreading also contributes to the environmental problems (acidification).

Growing concern on the quality of the soil and the surface water and on the consequences of acidification, have lead the Dutch government to the formulation and implementation of policies to reduce the unfavourable effects on the environment that are linked to agricultural production (Veenendaal and Brouwer, 1991). For phosphate the objective towards the year 2000 is