A META-ANALYSIS ON THE OWN-PRICE ELASTICITY OF DEMAND FOR PESTICIDES

Abstract

We present a meta-analysis based on all studies that have estimated pesticide demand elasticities in Europe and North-America. Our meta-analysis allows identifying demand elasticity estimates across various categories. We find elasticities over all studies to be, with a median of -0.28, significantly smaller than zero but inelastic. Using regression analysis, we find that the demand for pesticides in special crops is less elastic compared to arable and grassland farming. Moreover, our results indicate that herbicides have a more elastic demand compared to other pesticides. Studies that consider only short-term horizons indicate significantly less elastic pesticide demands. Furthermore, we find that peer-reviewed studies tend to find more inelastic results compared to grey literature.

Keywords

Own-price elasticity of demand, pesticides, pesticide tax, meta-analysis, robust regression

1   Introduction

Countries worldwide seek for instruments to reduce pesticide use in agriculture and/or its associated risks. Especially in Europe, also taxes on pesticides are frequently discussed and are in place in Sweden, Norway, Denmark, and France (e.g. BÖCKER and FINGER, 2016). The effectiveness of such tax solutions depends on the own-price elasticity of demand for pesticides. Many studies provided estimates for the elasticity of demand, but so far none has synthesized these studies to a coherent picture. More specifically, no systematic meta-analysis has been made between short- and long-term elasticities, between different crop systems and pesticide types, between different regions, between different publication channels and years of analysis, and between different methodologies. We aim to fill these gaps and provide a meta-analysis on pesticide demand elasticities. We focus on results from developed countries of the northern hemisphere to include estimates from comparable agricultural systems.

2   Data and Methodology

In total, 31 studies were identified that report 94 observations for price elasticities of demand. The studies are dated between 1981 (BROWN and CHRISTENSEN, 1981) and 2016 (FADHUILE *et al.*, 2016; FEMENIA and LETORT, 2016) and we obtained the following information: the elasticity values (min. and max. if applicable), the publication year, the period of analysis, the country, the crop system (classification into arable and grassland farming, special crops, and an aggregate group), the pesticide type (herbicides, fungicides, insecticides, pesticides in general), the variability of inputs (long-term *vs* short-term), the methodology used (normative *vs* econometric models), and the publication channel (peer-review *vs* grey literature).

To assess the differences between categories, Wilcoxon Mann Whitney tests are used. In order to identify the most important determinants of pesticide demand elasticity estimates and to estimate marginal effects, a multiple linear regression is conducted. Due to the considerable amount of outlying observations, we use MM-regression, a robust regression technique (e.g. FINGER, 2010). The following (dummy) variables are taken into account in the regression model: period of analysis (middle year of the period), special crops, herbicide, long-term de-

mand, Europe, peer-reviewed study, and econometric method. Different regression models were estimated to provide sensitivity analysis in light of multicollinearity and missing observations for some variables. To account for the fact that some studies report more than one observation, cluster adjusted variance-covariance matrixes are used to derive standard errors.

3 Results

The median of the pesticide demand elasticities reported over all studies is -0.28, and is found to be significantly different from zero. If long-term horizons are considered, demand is with a median of -0.39 significantly more elastic compared to short-term demand (median = -0.18). Regarding the agricultural system investigated, we found that demand for pesticides in special crops is significantly less elastic compared to arable farming and aggregate/national pesticide demand. The region and the publication type are not significant according to the Wilcoxon-Mann-Whitney test.

The regression analyses show that herbicides are significantly more elastic in demand compared to other pesticides. Moreover, we find pesticide demand is more elastic in Europe compared to the USA. Studies that consider only short-term horizons and little flexibility for farmers to adjust to price changes indicate significantly less elastic pesticide demands. In addition, we observe that more recent studies (*i.e.* studies that use more recent data) tend to observe more inelastic demand. This higher reliance of farmers on pesticides was already observed qualitatively by SKEVAS *et al.* (2012) and FADHUILE *et al.* (2016), and our results support their hypothesis quantitatively. Furthermore, we find that peer-reviewed studies tend to find more inelastic results compared to grey literature. For pesticide tax discussions, the results indicate that tax solutions will lead to a reduction of pesticide use in the long-term. However, pesticides will be reduced more in arable farming and less in special crops production, although the latter have higher application rates per hectare. Accompanying measures are therefore necessary to reduce pesticide use and risks in the special crop sector.

Literature

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