Estimating Sequential Multi-Choice Demand: An Application to Pesticides Utilization in France.

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Introduction

France is the third largest consumer of pesticides in the world. This country has developed systems of production based on the use of these products. So, it appears very dependent on them. The use of pesticides is often the only way for farmers to maintain their yields. In this context, we will focus on practices farmers consider firms’ supply through the estimation of their demand function. To introduce differentiated choices of products, i.e. introduction or the removal of a product influence farmer choices, we consider discrete modeling for demand function and precisely discrete choice models when multiple treatments are applied.

Our goal is to estimate an aggregate demand in the pesticide market for farmers considering different products and heterogeneous farmers in order to explain their choice of products.

Model specifications

Considering the number of treatment and the probability that a farmer reach the last treatment, we estimate a sequential logit demand. Treatment are censored on the basis of the growth stage of the crop at the date of application. Individual farmers characteristics are introduced to explain the probability that a farmer reach the last treatment when we suppose that farmer maximize their utility function by the products and treatments to apply. The estimation is provided on each sample for which farmer applied at least 5 treatments.

Now, we consider the type of treatment, and we estimate the probability that a farmer apply one type of treatment knowing its own characteristics. We set different assumption for the distribution of errors which led us to estimate different class of models. First estimates are provided considering a multinomial logit (Model 1), setting independence between two types. The introduction of farmer individual characteristics is provided through the estimation of a mixed logit (Model 2 and 3) specification.

Finally, we want to test correlation between two types of treatment. Indeed, intensive treatment in one category should be correlated with the other one. The previous model is estimated through a multivariate probit specification (Model 4).

Data and Descriptive Statistics

We use 3 different datasets. Our main data source is the "enquêtes enquêtes cultures", a French survey on farmers agricultural practices. This dataset provides informations on farmers and their individual characteristics. Moreover, it gives informations on pesticides use providing details on each product applied date or growth stage application, doses and name. This data on farming practices are merged with regulation dataset on products authorisation to consider its characteristics, like doses, firm holder, or age. Finally, we introduce prices of products by merging the previous data with PCIA’s survey.

![Figure 1: Area covered by plots, type of treatments, and crops for 2001 and 2006. In million of hectares.](image)

Results

The first results of our estimates on treatment choices highlights that the effect of the doses is more important on the first applications, and smaller when the number of treatments increase. Besides, whatever the rank of treatments, products’ age is negatively related to the probability of application on some categories, like herbicides, but positively for others, like fungicides. Our estimates on farmers’ yields follow approximately an inverse u-shaped curve, and it could exist an optimal number of treatments that leads to the final yield objective, but this optimum is not known by farmers at the moment of the treatment.

Our final sample has 9355 plots for 6 crops, and we focus on the largest type of treatment herbicides, insecticides and fungicides. Because farmers apply more than one product we get 15,583 observations. Finally, we define the market size as sum area of all products applied, and we consider 18 market segments illustrated in Figure 1. This Figure also illustrates the fact that more than one treatment is applied by plots, because the total area is often smaller than the applied product area.

Conclusion and Perspectives

More generally, estimating the demand is the preliminary step to analyse market power. This could lead to measure variation of welfare for farmers after a modification of competition structure, such as mergers or acquisition of firms, or measure the existence of tying sales in the market. In term of public policy, this allows us to measure the effects of products taxation or suppression by measuring the substitution between different characteristics of products or welfare variation.

References