Estimating a farm group model and input allocations using accounting data

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Introduction
For environmental and economic impact analyses, the knowledge on physical or monetary input use per production activity is often very important. However, input use at production activity level is typically not available from accounting data and other ad hoc approaches or regressions of total input use on output quantities are applied to obtain the desired information. In a second step, the obtained coefficients are then used to specify Mathematical Programming (MP) models for agri-environmental policy assessment calibrated or fitted to observed choice in activity levels.

Here we propose a methodology for specifying a farm group model with a Positive Mathematical Programming (PMP) formulation while simultaneously estimating input allocations to enterprises instead of using a two step approach. As activity specific input costs are relevant for decisions on land allocation, we hypothesize that such an estimation approach will make better use of available information than the previously applied two-step approach.

A further contribution of this research is the real world example of estimating a non-linear cost function using multiple observations from single farm accounting data and prior information on shadow prices. This generally serves a better empirical foundation for PMP type models.

Results
The concept also offers a farm group supply model with a PMP-type objective function based on multiple farm level observations, a relevant contribution, because most models of this type are not based on a statistical estimation approach. The ability to include prior information on resource shadow prices promises more realistic results compared to standard PMP specifications.

More observations over time will probably improve the specification with respect to the price response behavior of the resulting farm group model. Pnud data typically show more price variation and therefore allow results in more robust estimations in this respect. Another direction of further development could be the application of Bayesian approaches as in Janzen (2007), which promises a more straightforward and transparent implementation of prior information without support points related complications.

Data
The developed estimation approach is applied to a set of year 2000 FADN® accounting data from 50 Belgian farms. The Belgian dataset we use has a distinct advantage as input cost per production activity are additionally collected and used to validate the results of the proposed approach.

The data distinguishes the five input categories and a 'value-added' category obtained residually. The inputs are used to engage in seven production activities.

Table 1: Farm group sample

<table>
<thead>
<tr>
<th>Farm</th>
<th>Crop</th>
<th>Land allocation</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 1</td>
<td>100</td>
<td>0.80</td>
<td>0.60</td>
</tr>
<tr>
<td>No. 2</td>
<td>110</td>
<td>0.70</td>
<td>0.50</td>
</tr>
<tr>
<td>No. 3</td>
<td>120</td>
<td>0.60</td>
<td>0.40</td>
</tr>
<tr>
<td>No. 4</td>
<td>130</td>
<td>0.50</td>
<td>0.30</td>
</tr>
</tbody>
</table>

Note: standard deviations of variables are given in parenthesis

* FADN: European Farm Accountancy Data Network

Acknowledgments
The authors kindly acknowledge the help of J. Bross from University of Göttingen, who provided the data for the validation of input coefficients.

Conclusions
Using a sample of 50 Belgium FADN® accounting records, the hypothesis that this simultaneous approach would outperform separate input allocation regressions introduced by Léon et al. (1999) was confirmed. The new approach showed better results for all considered aggregated measures across farms comparing estimated input coefficients with observed ones available for this sample, but not used in the estimation.

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Fit of the behavioral model

Table 4: Pearson’s correlation coefficient for input allocations

<table>
<thead>
<tr>
<th>Crop</th>
<th>Land allocation</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicory</td>
<td>0.40</td>
<td>0.60</td>
</tr>
<tr>
<td>Winter wheat</td>
<td>0.30</td>
<td>0.50</td>
</tr>
<tr>
<td>Winter barley</td>
<td>0.20</td>
<td>0.40</td>
</tr>
<tr>
<td>Potatoes</td>
<td>0.10</td>
<td>0.30</td>
</tr>
<tr>
<td>Green peas for tin</td>
<td>0.00</td>
<td>0.20</td>
</tr>
</tbody>
</table>

For further information

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