ASSESSMENT OF MICROECONOMIC IMPACTS OF INVESTMENTS ON
AGRICULTURAL BIOGAS PLANTS

Jindrich Spicka¹, PhD
University of Economics, Prague, Czech Republic

Abstract. As the consumption of renewable energy sources increases, the relatively high public support of bioenergy projects supplements the goals of energetic self-sufficiency of the countryside. This paper answers two main questions. Firstly, how the effects of the investment support from the Rural Development Programme (RDP) can be quantified considering the EU evaluation guidelines. Secondly, which economic effects of the support of the agricultural biogas plants are significant. The objective of the paper is to assess the economic effects of the investment support of the agricultural biogas plants from the RDP in the Czech Republic. The counterfactual approach is adopted and investigates what would have happened if the supported producers did not participate in the programme. It then compares the result indicators. Propensity score matching (PSM) with Mahalanobis distance is used to create treatment-control matches based on propensity scores and/or observed covariate variables. Mann-Whitney U test calculates statistical significance of the selected indicators between supported and non-supported agricultural enterprises. In regards to the economic performance of agricultural enterprises, the analysis reveals that investments and investment subsidies targeted at biogas plants have a positive effect on EBIT, cash flow, and value added per hectare of agricultural enterprises as well as on labour productivity. Investments in biogas plants also significantly alter capital structure because of the commercial credit indispensable for financing investment expenditures.

Key words: agricultural biogas plants, counterfactual analysis, investment support, propensity score matching, Rural Development Programme.

JEL code: Q10, O13, Q18

Introduction

This paper assesses economic effects of the investment support of agricultural biogas plants from the Rural Development Programme (RDP) in the Czech Republic, specifically, Measures 311 and 312. According to the EU evaluation guidelines, the impact assessment of the RDP public support requires processing by all EU Member States. However, little attention has been paid to the quantitative evaluation of actual effects of the corresponding support programmes. Medonos et al. (2012) highlight two serious problems of the Common Evaluation Monitoring Framework (CEMF). These include the EU evaluation guidelines which eventually might lead to incorrect conclusions on the success of the programme: i) it is impossible to associate the result and impact indicators (as GVA/GDP) only with policy intervention. In addition, there is a number of other circumstantial factors affecting the results; ii) usually, policy measures either target or are exploited by only some groups of producers/regions etc., which makes simple comparisons between supported and non-supported groups methodologically problematic (Michalek, 2007). The counterfactual approach is used to deal with these shortcomings. According to the EC Guidelines, questions and indicators have to be answered that compare the supported with non-supported farms (counterfactual situation), and the previous situation with the resulting situation after the support (Cueto, 2006).

The Ministry of Agriculture (MoA) provided the data on the investment projects in biogas plants. The MoA database comprises information on the 142 individual applications approved between 2007 and 2011. The data-warehouse is equally connected with the Soliditet – Albertina database. The latter contains data from financial statements of Czech companies as well as an overview of the corporate headquarters, industry sector, number of employees, and total turnover. The Land Parcel Identification System (LPIS) database specifies the area of agricultural land; hence, gathering the basic information on the 119 companies whose applications were approved for investment between 2007 and 2011.

For the counterfactual analysis, it is necessary to have one sample of the supported agricultural enterprises and a sample of agricultural enterprises with similar structural characteristics not supported by the Rural Development Programme (2007 – 2013). As accounting data are available with a lag of t-2, it is possible to use data only for the period 2007 - 2010. A total of 56 out of 119 supported applicants received payments between 2007 and 2010. These are considered as supported enterprises and that the investment was operative until 2010. Nevertheless, complete accounting data in 2007 and 2010 are available only for 38 enterprises. This is because the basic set of supported subjects for counterfactual analysis labelled as “participants”.

In addition, the analysis included the identification of 551 agricultural enterprises without RDP investment support between 2007 and 2010, with complete accounting data in both years. From this group of nonparticipants, it is necessary to select enterprises with similar structural characteristics as supported enterprises. The following available structural indicators for matching participants and nonparticipants are selected:

---
¹ Corresponding author. Tel.: + 420 224 09 8650, E-mail address: jindrich.spicka@vse.cz
Assessment of Microeconomic Impacts of Investments on Agricultural Biogas Plants

J. Spicka

ISSN 1691-3078

The data matching procedure is used to create treatment-control matches based on propensity scores and/or observed covariate variables. The Propensity score matching (PSM) constructs a statistical comparison group based on a model of the probability of participation in the treatment, using the observed characteristics (Khandker et al, 2010). The propensity score was introduced by Rosenbaum and Rubin (1983, 1985). Various approaches can be used to match participants and nonparticipants on the basis of the propensity score. Greedy data matching is used for propensity score data matching procedure in this paper (Bozik, 2011, 2012). Mahalanobis distance within propensity score calipers (no matches outside calipers) is used in this paper as the distance calculation method (Gu, Rosenbaum, 1993).

After the participants group creation (38 agricultural enterprises) and nonparticipants (38 agricultural enterprises), the next step is to perform the counterfactual analysis. This phase comprises an impact evaluation of investment and investment support in biogas energy. First, the relevant indicators are selected. This permits a complex impact evaluation primarily based on financial statements, using well known indicators of profitability, liquidity, activity, capital structure, value added, and productivity suitable for counterfactual analysis.

The Mann-Whitney U test compares the above mentioned indicators between two groups – participants ($Y = 1$) and nonparticipants ($Y = 0$). The null and alternative hypotheses are: $H_0$: Median ($Y = 1$) = Median ($Y = 0$), $H_a$: Median ($Y = 1$) $\neq$ Median ($Y = 0$). A normal approximation method is used for the distribution of the sum of ranks which corrects for ties and does have the correction factor for continuity. The null hypothesis is tested at the significance level of 0.05.

Research results and discussion
The results of the counterfactual analysis present the comparison of indicators between similar groups.

### Table 1

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Units</th>
<th>Year</th>
<th>Median ($Y = 1$)</th>
<th>Median ($Y = 0$)</th>
<th>Mann Whitney Z-value</th>
<th>p-value</th>
<th>Reject $H_0$ at 0.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural area</td>
<td>ha</td>
<td>2007</td>
<td>1 948</td>
<td>1 915</td>
<td>0.4519</td>
<td>0.6513</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2010</td>
<td>1 924</td>
<td>1 968</td>
<td>0.6908</td>
<td>0.4897</td>
<td>No</td>
</tr>
<tr>
<td>Fixed assets per hectare</td>
<td>CZK</td>
<td>2007</td>
<td>45 614</td>
<td>45 080</td>
<td>0.9298</td>
<td>0.3525</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2010</td>
<td>70 011</td>
<td>44 903</td>
<td>4.1607</td>
<td>0.0000</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Source: author’s calculations

Fig. 1. Relative importance of investment expenditures in the supported enterprises

Source: author’s construction

The results of the counterfactual analysis present the comparison of indicators between similar groups.
of participants (n = 38) and nonparticipants (n = 38). The extent of economic effects of investment support depends on the relative importance of investments in the supported enterprises.

As Figure 1 depicts, about 55% of the participants have total investment expenditures between 20 and 60% of total assets. There are also participants with total investment expenditures exceeding 100% of total assets. The mean share is 60%. The question is how economic results of the agricultural enterprises. It may be assumed that investment in new technology/biogas plant significantly increases long-term fixed assets and depreciation. It is also interesting to expose any impact on the utilised agricultural area. Table 1 illustrates the medians of agricultural area and fixed assets in 2007 and 2010.

There is no significant difference in the total agricultural area between participants and nonparticipants. The participants reduce the total agricultural area whereas, nonparticipants extend their acreage. Nevertheless, neither the investment support nor the investment in biogas plant has any impact on the acreage of agricultural enterprises.

Investments in new biogas plants are relatively high and increase the value of fixed assets. This assumption is confirmed through the statistical analysis. Participants have significantly higher fixed assets per hectare in 2010 when biogas is in operation. On the contrary, the value of fixed assets per hectare in nonparticipants is not significantly modified.

It is possible to describe the results thanks to the availability of data on the plan of newly created working positions. Approximately 85% of the applications (approved between 2007 and 2011) suggest that investment will not be associated with the creation of new working positions; 12% planned one new working position. More than one new working position is rare as the specifics of operating biogas plants requires monitoring by at least one worker. It is evident that most agricultural enterprises are able to use the available labour force for biogas plant operation. Therefore, investments in biogas plants do not focus on increasing employment in the country but on maintaining employment and maximising working capacity usage.

Table 2 provides information about the effects of investment support on profitability and cash flow indicators.

Investments in biogas plants do not significantly impact ROA, ROCE and ROE. However, the decline in productivity is observed relating the economic results with the total agricultural area. Investments in biogas plants have a positive effect on EBIT and cash flow per hectare. While the median of EBIT and cash flow per hectare increases in the group of participants, it decreases in the sample of nonparticipants. Hence, there is only positive effect of investments on profitability indicators related with the agricultural area; none with the assets and capital employed. It can be justified by different impact of investments on agricultural area and fixed assets (Table 1).

Table 3 summarises the output of statistical analysis of the differences in value added determinants and depreciation between participants and nonparticipants.

As seen in the table, investments in biogas plants have significant impact on the value added per hectare in addition to labour productivity expressed by the indicator value added per staff cost. The group of supported agricultural enterprises increases the value added and labour productivity after establishing the investment, unlike nonparticipants. This is a very important finding that could impact the economic competitiveness of agricultural enterprises.

Regarding cost and yields, results are not clear as in the case of the value added. Investments have no significant impact on cost of sales per hectare. It is somewhat surprising given that the biogas plant heats some buildings and operations within the farm. This leads to savings of purchased heat. Some more noticeable
savings in sales cost are obvious in the sample of participants. The difference towards nonparticipants is not statistically significant. Higher depreciation per hectare in the group of participants is related with higher value of fixed assets as the consequence of the investment in biogas plant.

In the group of participants, the median of sales of production per hectare in 2010 is at the same level as in 2007; whereas, the nonparticipants have lower sales. Thus, support of biogas plants fulfils its mandate: diversification of farm income and stabilisation of farm income.

Table 4 contains ratio indicators of liquidity, turnover, and capital structure.

Investments in biogas plants have no significant impact on liquidity ratios. The current and cash ratios are lower after investment apparently because participants have to repay investment loans. Nevertheless, no statistically significant differences are found. Questionable are the effects of investments on turnover ratios. Some significant differences are revealed only in the long-term asset turnover as a result of higher fixed assets after setting up biogas plants.
On the contrary, clear effects of investments are observable in the capital structure. Since such financially demanding investments as biogas plants need to be co-financed through commercial credit, the debt ratios significantly increase in the participants group. The median level of debt ratio is still under the recommended level of 50% in 2010 which indicates no severe debt problems of supported agricultural enterprises. It also depends on the future development of the economic situation of agricultural enterprises.

The results conform to the findings by Medonos et al. (2012) and Bozik (2011). Their quantitative assessment shows significant benefits from investment support in terms of business expansion (Gross Value Added, GVA) and productivity (GVA/labour costs) improvements. These results were confirmed by the qualitative survey. Thus, public support enables farms to achieve their strategic objectives.

Conclusions

As mentioned previously, the objective of this discussion was to assess economic effects of the investment support of agricultural biogas plants from the Rural Development Programme (RDP) in the Czech Republic. The analysis of the approved applications suggests that biogas plants are built mainly by large agricultural companies. They are for the most part, located in the production-intensive areas with sufficient own raw material for operation of biogas plants. Furthermore, they are equipped with sufficient capital for a relatively large investment expenditures associated with the construction or improvement of the biogas plants. According to the RDP strategic framework, the production of energy from renewable sources and use of renewable energy sources within diversification of agricultural activities is a promising activity. It contributes to both the alleviation of climate change and support of the rural economy. The analysis of the economic impacts reveals some significant ex-post effects of investments in agricultural biogas plants.

— Investments and investment subsidies targeted at the biogas plants have a positive effect on EBIT, cash flow, and value added per hectare of agricultural enterprises. The launch of biogas plants increases fixed assets, depreciation, and capital employed. It does not lead to a significant change of farm agricultural area. Subsequently, there is no significant impact on ROA, ROE and ROCE even if these indicators have been considered as key indicators of companies’ economic performance.

— Support of the biogas plants significantly increases labour productivity. The creation of biogas plants does not create any new working positions in most cases as the operation of biogas plants is mostly ensured by available workers.

— Biogas plants have rather a revenue stabilisation effect than cost savings effect. Investment support for the construction and modernisation of biogas plants achieves one of the goals of the RDP aimed at the farm income stabilisation.

— Investments in biogas plants significantly change capital structure due to commercial credit, indispensable for financing investment expenditures.

The paper also presents one possible methodical approach to quantitative impact evaluation of the RDP investment support. However, some disadvantages of such counterfactual analysis are identified using PSM. The above processed analysis is based on financial indicators only. For a better understanding of all potential effects of the investment support, case studies are appropriate. Long-term organisational viability and competitiveness should not be evaluated solely in terms of financial measures. The case studies can help evaluate the nonfinancial aspects of rural development. It is a great challenge for future research. Another problem of the PSM is to locate similar groups of nonparticipants as it is not possible to find comparable companies. The results of the counterfactual analysis based on propensity score matching is biased to a certain extent. Nevertheless, the above described propensity score matching is a suitable basis for quantitative impact evaluation.

Bibliography


Acknowledgements

The author gratefully acknowledges the financial support provided by the Ministry of Education, Youth and Sports. The research was financed by long-term institutional support to the conceptual development of research organisation (VSE IP300040). In addition, thanks to the Ministry of Agriculture for investment projects data.