European Evaluation Helpdesk for Rural Development

ASSESSING SECONDARY EFFECTS OF MEASURE 13 ON AGRICULTURAL FARMS SUPPORTED UNDER THE FA 2A IN SLOVAKIA USING PSM-DID AND GPSM

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EVALUATING SECONDARY EFFECTS TO ENSURE PROPER BUDGET ALLOCATION

The Slovak RDP 2014-2020 contributes to FA 2A primarily through six measures: M1, M2, M4.1, M4.3, M6.3 and M16.2. However, according to the intervention logic of the Slovak RDP, other measures such as M10, M11 and M13 (programmed under Priority 4) are also expected to contribute secondarily to FA 2A. M13 is a particularly important RDP measure, with a budgetary allocation of 459.4 Mill EUR, which is equivalent to 52% of the total budget planned for Priority 4 and roughly 22% of the total public support under the Slovak RDP 2014-2020.

APPLYING A COUNTERFACTUAL THROUGH PSM-DID AND GPSM

Given the budgetary importance of M13, the Slovak evaluators decided (on the request of the Programme MA) to evaluate separately secondary effects of this individual measure on agricultural farms supported under FA 2A.[1] This separate evaluation was carried out by applying a counterfactual analysis based on statistical matching techniques, i.e. binary PSM-DID and the Generalized Propensity Score Matching (GPSM) implemented in two steps:

STEP 1 - Application of the PSM-DID methodology

In order to answer CEQ 4 and specifically to evaluate the secondary contributions of M13 on farms supported under FA 2A in the years 2014-2016 (i.e. under AIR2017), the judgement criteria, additional result indicators, methodology and data used were as follows:

A) Judgment criterion: due to support obtained from M13, economic performance of farms (beneficiaries of this measure) has improved

B) Result indicators (additional):

- GVA per farm (in EUR)
- Agricultural output per farm (in EUR)
- Farm labour productivity (measured by: agricultural output per AWU and GVA per AWU in EUR/AWU)
- Employment per farm (in AWU)
- Farm assets (in EUR)
- Farm profits (in EUR)

C) Method: binary PSM-DID

D) Data: Slovak farm bookkeeping individual data (2013-2016) (anonymously)

E) Data on individual farm support from M13: Slovak Paying Agency (anonymously)

Under the PSM-DID methodology the following farm specific control variables (16) were considered:

1. GVA/farm in 2013
2. Employment (AWU/farm) in 2013
3. Agricultural output/farm in 2013
4. Total subsidies/farm received in 2013
5. Total assets/farm in 2013
6. Fixed assets per farm in 2013
7. Liabilities per farm in 2013
8. Turnover per farm in 2013
9. Sales from own products per farm in 2013
10. Total inputs per farm in 2013
11. Cost of labour (salaries) per farm in 2013
12. Gross value added per farm in 2013
13. Agricultural land area in ha per farm in 2013
14. Arable land area in ha in 2013
15. Pastures and meadows area in ha in 2013
16. Yields of cereals t/ha in 2013

Furthermore, the following steps were undertaken in order to eliminate various data related inconsistencies in the analysed farm sample and ensure that influence of other non-M13 RDP measures is

FURTHER INFORMATION

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Evaluation: Slovakia AIR 2017

Further information on the use of the GPSM methodology: Hirano and Imbens, 2004; Bia and Mattei, 2008; Michalek, et.al. 2012, 2014, 2020; Bakucs, et. al. 2019; Becker, et. al. 2012; Cerulli, 2012; Esposti, 2014; Kluve, et. al. 2007

reduced to the largest extent possible:

- Farms which showed a positive value of land under less favoured areas (LFA) but at the same time did not receive any support from M13 were dropped from the analysed sample.
- Farms which showed a zero value of land under LFA but at the same time received support from M13 were dropped from the analysed sample.
- All farms which in years 2013-2016 received support from the RDP measures: M121/4.1, M123/4.2, M10, M11, M12, and M14 were dropped from the analysed sample.

The sample used in the PSM-DID analysis included farms which received in years 2014-2016 support from M13 and those which did NOT receive support from M13 (=268 farms in total).

The main sub-steps undertaken under PSM-DID were as follows: a) Estimation of the "propensity score" for each supported and non-supported farm, by using a parametric method (e.g. probit model, i.e. zero-one dependent variable and 16 specific control variables) ; b) Matching of beneficiaries with non-beneficiaries with the similar propensity score, by applying the minimum standardized bias as a relevant criterion for selection of the appropriate matching algorithm; c) Computation of the average values of result indicators for the matched groups of supported and non-supported farms before and after the RDP support; d) application of DiD on the estimated ATT (Average Treatment Effects on Treated) parameters e) Conducting a Sensitivity Analysis to test the stability of the obtained findings.

STEP 2 - Application of the GPSM methodology

An important programme-specific evaluation question relating to the assessment of the effect of M13 on the economic performance of supported farms was: whether the support intensity under M13 matters, i.e. 'to what extent a higher M13 support intensity yields stronger effects than a lower support intensity?' And 'what would be the optimal (from a micro-economic point of view) support intensity under M13?' Answers to these questions were provided on the basis of the Generalized Propensity Score Matching (GPSM) and the Dose-Response Function (DRF) methodology. GPSM method not only allows to estimate the average effect of public investment support on the selected result/impact indicator but also to assess the marginal effects of analysed RDP measures (or group of measures) , in dependence on the support intensity level obtained.

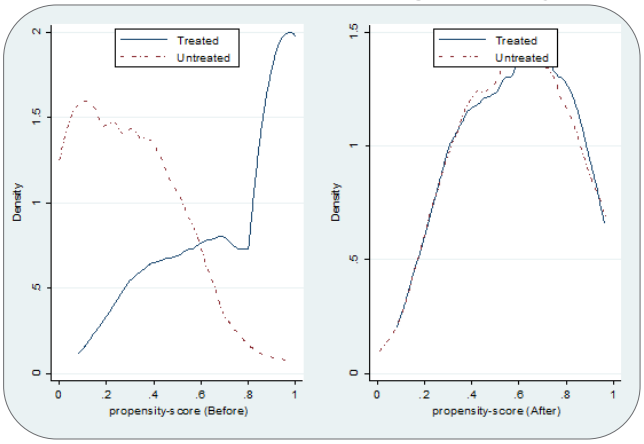
Given the sample of farms supported by M13, for each farm (i) we observe the vector of covariates X (i.e. control variables), the support intensity T, and the outcome corresponding to the level of support received (i.e. result indicators) Y, where Y = f(T). In the binary case, the support from M13 would be restricted to T = {0, 1}. However, agricultural farms differ in their characteristics X (size, location, etc.) such that some farms are more or less likely to receive a higher support intensity than others, so T is an empirical continuous variable. The support intensity T (for each farm i), is the total amount of M13 per supported farm received between the first and the last available observation/year (e.g. 2013 and 2016) in the respective programming period 2014-2020. Information on the individual farm support level is available from the monitoring tables of the RDP (Measures: M13)[2].

By employing the GPSM, the evaluators aimed at estimating the average dose-response function across all farms supported from M13. The key challenge was to compare performance of farms with sufficiently similar characteristics (X) but different support intensity (T) in order to construct a quasi-experimental setting.

The GPSM analysis was only applied for farms which in the years 2014-2016 received support from M13 (=354 farms in total).

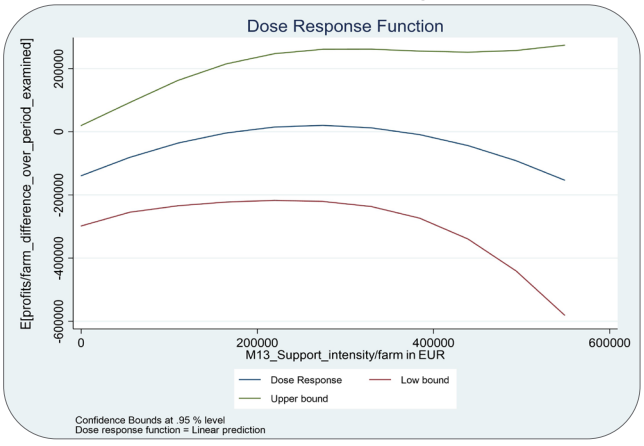
The main sub-steps were: 1) Estimation of the Generalized Propensity Score (GPS) as a conditional density of support from M13 given the covariates (X), incl. checking the validity of the assumed normal distribution using Kolmogorov-Smirnov tests; 2) Testing the balancing property of the estimated GPS function; 3) The estimation of the M13 impact on the selected result indicators describing the economic performance of supported farms using a flexible function (polynomial approximation) of T and GPS; and 4) Estimation of the average potential outcome for each potential level of support T and the entire dose-response function. In order to obtain estimates of the entire dose-response function, the estimation of the average potential outcome was repeated for each level of M13. Bootstrapping was used to find standard errors and confidence intervals.

Graph 1: Slovakia (M13) - Distribution of propensity scores before and after matching (PSM analysis)



Conclusion: Application of PSM methodology resulted in reduction of a selection bias by approx. 90% and a very good matching.

Graph 2: Effect of M13 intensity change on farm profits (GPSM analysis)



Results from the analysis

This analysis found that M13 had some positive effects on farms' profits (the latter dropped in both groups, but the rate of decrease was lower in farms which were M13 beneficiaries in comparison to non-beneficiaries). In general, despite receiving support from M13, farms located in LFA + ANC areas, in comparison with similar farms

located in productive areas were still subject to numerous negative trends. For example, GVA/farm, agricultural output per farm, labour productivity measured as GVA/AWU, employment per farm and farm assets in the group of farms which received subsidies from M13 increased in years 2013-2016 at a much lower rate than in similar farms located in productive areas. Also, the applied GPSM analysis shows that only with much higher M13 intensity level the effect on selected result indicators would be positive. Therefore, the received level of M13 subsidies (generally understood as a compensation for additional costs incurring for farms located in areas with various constraints) was in Slovakia not sufficient to neutralize those costs. An alternative explanation could be that expected effects of M13 had not yet materialized in this short period of time (2013-2016).

[1] This analysis was carried out independently of the evaluation of impacts of all measures programmed to contribute secondarily to FA 2A (i.e. M10, M11 and M13).

[2] Monitoring tables are prepared for each programming period by the Programme Paying Agency

THE CHALLENGES ENCOUNTERED IN USING THE METHODS SELECTED TO MEET THE OBJECTIVES OF THE EVALUATION

- As a large proportion of farms were supported from various measures (investment and area-based measures) it is generally difficult to distinguish all sources of subsidies, as well as to disentangle primary from secondary contributions.
- Effective application of propensity score analysis requires making choices about (a) how to fit the propensity score model (what covariates should be used?), (b) what type of matching/weighting algorithm will be applied, (c) which balance diagnostics to use, (d) how to determine when balance is sufficient, and (e) what analytical model should be selected. As application of specific quasi-experimental methods and techniques can be statistically complex, solving of these issues required incorporation of experts with profound quantitative skills and significant modelling experience into the evaluation team.
- Application of the GPSM method requires abundant data, the knowledge of econometrics and familiarity with statistical analytical tools (e.g. STATA).
- A special challenge in evaluating secondary effects of a given measure (or bundle of RDP measures) within a given focus area, e.g. FA 2A, was to separate effects of those measures from effects of support obtained by a given group of farms from other RDP measures, e.g. from previous programming period, those not included under a specific programme focus area, and/or non-RDP subsidies. These are clearly confounding factors which (if uncontrolled) may introduce a significant bias to results obtained. Fortunately, the use of selected methods was facilitated by an availability of a robust empirical data base, which included roughly 1600 observations of agricultural farms per year. The database included roughly 500 variables per farm, collected during the period 2013-2016 through the farm bookkeeping database.
- The pre-requisite for applying the GPSM method is the availability of the information on the support intensity per farm from a given measure (e.g. M13). For this it was necessary to link the available bookkeeping farm level database with the PA's monitoring tables on received subsidies from the RDP. This activity was done anonymously in the Paying Agency and results were delivered timely to evaluators.
- The selection of an appropriate time period (after beginning of a given programme) may be crucial for estimating the programme results. Generally, the period which is chosen should not be too short (unfolding outcomes) nor too long, as other confounding factors or policies (specifically targeting either programme beneficiaries or programme nonbeneficiaries) may systematically influence the effects. As evaluation methodologies described above are quite flexible regarding the selection of an 'end period', it is advisable to undertake re-estimations of outcomes by including the successive years, in order to verify the stability of the estimated effects.
- As no single evaluation method is perfect (due to. problems caused by a low uptake, or matching in high dimensional space, etc.) verification of quantitative findings was carried out by combining quantitative and qualitative approaches (a mixed approach was applied). In this case, quantitative evaluation analysis was supplemented by qualitative methods (focus groups, interviews, etc.).

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