A methodological approach for measuring net-impacts of Basic- and Complementary Redistributive- Income Support for Sustainability (BISS-CRISS) interventions (CAP 2023-2027) using FADN data

JERZY MICHALEK

EXPERT OF THE EUROPEAN EVALUATION FOR RURAL DEVELOPMENT

Outline

- Methodological requirements for impact evaluation
- Evaluation experience
- Why is it difficult to evaluate BISS-CRISS?
- Consequences for evaluation
- Proposed methodology (DRF/GPSM)
- Strengths and weaknesses of the approach
- Lessons learnt and applicability

Methodological requirements for impact evaluation

1. Reliance on causal analysis! (rigorousness & credibility)

   - Ensuring that a causal model is explicitly incorporated
   - Causality vs. correlation! (high correlation does NOT imply causality => naïve approaches?)

2. High stability of obtained results (Reliability & Robustness)
   - Ideally: sensitivity is low and reduced to random factors
   - But, robustness dependents on the specific limitations of the applied method!

3. Applied methodology => should allow to isolate effects of a specific intervention from other (e.g. exogenously determined) factors

Example of rigorous evaluation techniques => e.g. quasi-experimental approaches

Evaluation practice

- Recently, impact evaluations of CAP interventions have strengthened considerably (methodology applied)

- Yet, despite availability of advanced quasi-experimental methods only a few evaluation studies investigated effects of Basic Income Support (or Pillar 1 interventions) through rigorous impact evaluations methods. Why?

Why is it difficult to evaluate BISS-CRISS?

- In contrast to other CAP interventions (e.g. Pillar 2) BISS-CRISS support is provided to almost all farms (eligibility criteria > 1 ha) with a different intensity per farm
- Almost no existence of BISS-CRISS **not-**supported farms
- Problems with finding a suitable counterfactual, i.e. farm which did **not** receive BISS-CRISS support
- Additionally to BISS-CRISS => other 1st Pillar interventions (e.g. young farmers, sectoral, etc.) => separation of policy effects is necessary!
- Additionally to CAP 1st Pillar measures => 2nd Pillar measures and national measures => separation of policy effects is necessary!

Why is it difficult to evaluate BISS-CRISS?

Consequences:

- Binary quasi-experimental methods relying on “BISS-CRISS supported” vs. “BISS-CRISS non-supported” (e.g. binary PSM-DID, exact matching, etc.) are not applicable
- Evaluation of 1st Pillar is more difficult than evaluation of 2nd Pillar (for latter a binary PSM-DID can be applied)
- Most evaluators of Pillar 1 prefer to utilize sectoral- or CGE models (policy scenarios: “base-run scenario” vs. “policy-scenario”, e.g. CAPRI, CGE modelling, etc. or spatial econometric analysis. However, these approaches are good for ex-ante evaluations but problematic for ex-post

Possible evaluation question

Evaluation Question: To what extent has BISS-CRISS support affected income and competitiveness of supported agricultural farms?

Possible outcome variables/Impact Indicators:

- Gross Farm Income (SE410) (output – interm. Consump + balance subs/taxes)
- Farm Net Value Added
- Farm economic size
- Farm employment
- Farm investments, etc.

=> application of naïve methods would be problematic!

Proposed methodology => DRF/GPSM

Dose Response Function (DRF) based on the **Generalized Propensity Score Matching** (GPSM)

(see: Hirano, K. and G. W. Imbens. 2004; Imai, K. and Van Dyk, D. A., 2004)

- Several examples of recent applications of the DRF/GPSM method to evaluations of EU programmes/policies

What is DRF/GPSM?

- A quasi-experimental method enabling estimation of policy/subsidization effects conditional on observable determinants of subsidization intensity (i.e. received BISS-CRISS payments per farm)

- Here 3 different estimation approaches are possible:
  - Parametric (e.g. Hirano and Imbens, 2004)
  - Non-parametric, e.g. splin estimators, inverse weighting kernel estimator, etc. (Bia, et al., 2012)
  - Semi-parametric (e.g. Cattaneo, 2010; Flores, et al., 2012)

Advantages of the DRF/GPSM methodology

- GPS (as a balancing score) is **similar to Propensity Score** (PS) in a binary PSM (i.e. farms within the same strata of the GPS should look identical in terms of their observable characteristics X, independent of their level of BISS-CRISS subsidies)
- GPS is extension of PS for multiple/continuous treatments
- **Causality** model is explicitly incorporated
- Non-subsidized units/farms are **NOT** needed (however, they may be included if such data exists)
- **GPSM is built on counterfactuals.** Comparable **control groups** are constructed on the base of pre-subsidisation variables (covariates X) and the estimated GPS

Advantages of the DRF/GPSM methodology (2)

- GPSM belongs to a quasi-experimental setting => **enables to compare farms** with sufficiently similar characteristics (X) but different subsidization intensity (BISS-CRISS)

- GPSM **reduces/eliminates the selection bias** and addresses endogeneity

- GPSM is a base for derivation of **entire "dose-response" function (DRF),** i.e. effects for each level of subsidization intensity

Advantages of the DRF/GPSM methodology (3)

- DRF/GPSM is a base for estimation of both **Average Treatment Effects (ATE)** as well as allows to assess the **marginal effects** (i.e. effects of increase by 1 unit, e.g. 100 EUR), in dependence on the support intensity level obtained

- DRF/GPSM can be applied to **answer many Evaluation Questions** regarding 1st Pillar (e.g. regarding effectiveness, efficiency, etc.)

- The analysis of multiple continuous treatments is actually at the **forefront of the current evaluation econometrics literature** (Imbens and Wooldridge, 2009)

Application of DRF/GPSM method

Data:

- Y outcomes, e.g. farm income, farms value added, etc.
- Choice of confounding factors, e.g. variables/covariates X (e.g. farm size, employment, fixed assets, etc.) which determine **both the economic** effects of BISS-CRISS and a **participation/intensity** of the subsidization scheme
- Inclusion of **other** subsidies in the list of covariates (e.g. Pillar 2 and/or national) => Blocking!
- Amount of T (BISS-CRISS subsidies received by a farm in a given period)
- A period should include both pre- and post-subsidisation observations (years)
- The sample should be a balanced panel (optimal: the same farms before 2023 and after, e.g. 2028)

Application of DRF/GPSM method

Data sources (farm data):

- FADN (or farm bookkeeping database)
- Paying Agency data on obtained subsidies (also from other pillars!) for each farm
- Data links done anonymously in PA or national FADN Liaison Agencies

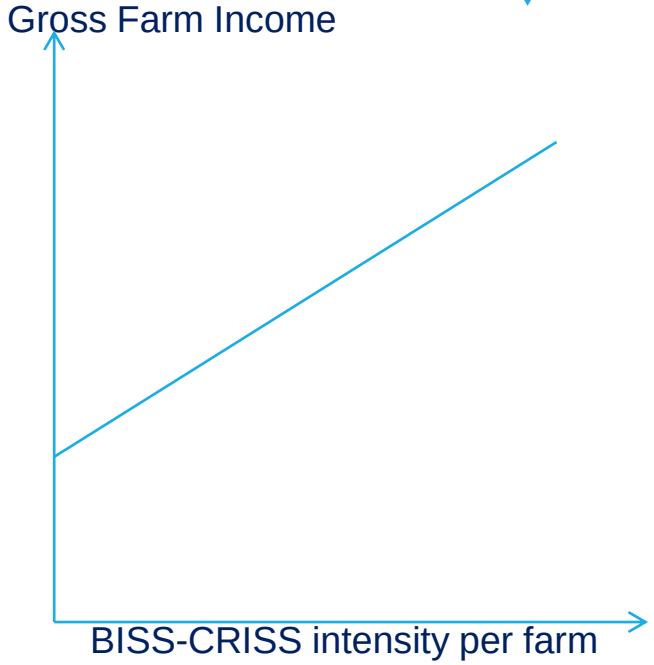
Analytical four steps:

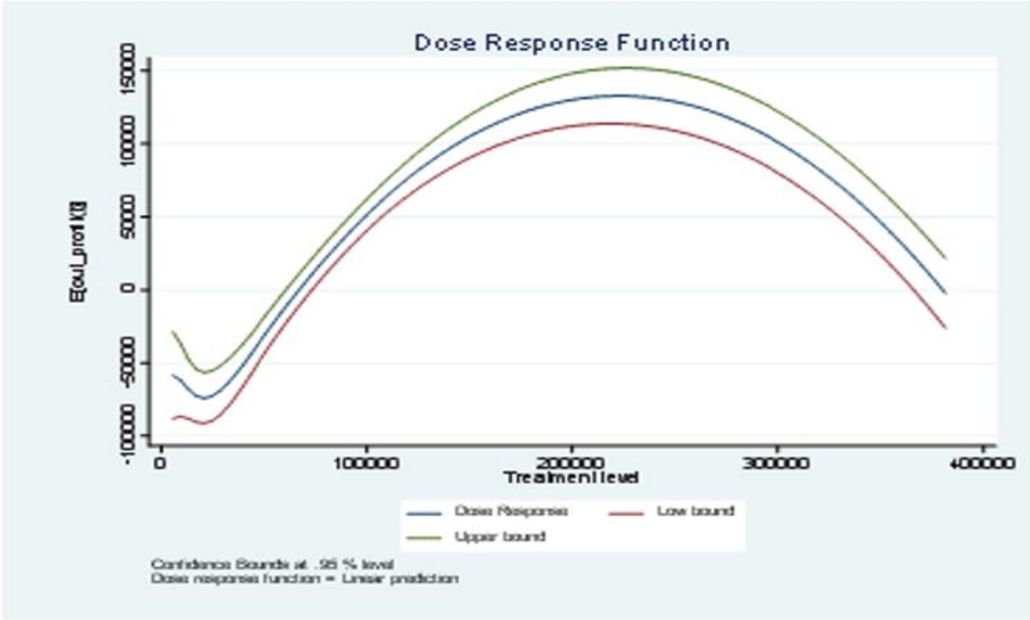
1. **Estimation of the generalized propensity score** (GPS) as a conditional density of the treatment assignment (T), e.g. BISS-CRISS per farm, given the covariates (X)
2. Diagnostics: Validate GPS by **checking for covariate balance** (!)
3. **Response model**: Finding the appropriate functional relationship between the impact indicator (e.g. farm income), the intensity of the BISS-CRISS support, T, and the estimated values of GPS for each farm i.
4. Causal quantities of interest: **Estimation** of the average outcome for each potential level of support T and **the entire dose-response function**

Empirical implementation:

Implementation in STATA (different options, e.g. parametric, semi-parametric, etc.)

Possible Expectations and Outcomes:





Graph 1. Estimated dose response function of AE intensity on farm profits.
Source: own estimation.

Caveats and conclusions

Caveats:

- Evaluation of 1st Pillar is more difficult than evaluation of 2nd Pillar (for latter a binary PSM-DID can be applied)
- Multivalued treatments (DRF/GPSM) increase the number of parameters that must be estimated in comparison to binary PSM-DID
- Abundant data is required
- Econometrics skills

Caveats and conclusions

Conclusion:

- Regarding quantitative evaluation of 1st Pillar BISS-CRISS interventions at farm level => There are NOT too many serious alternatives to DRF/GPSM approach (!)

Thank you

Jerzy Michalek

jmichalek@gmx.de

Naïve approaches

Practical implementation using a “naïve” approach (NOT based on counterfactuals):

$$Y_i = \boldsymbol{\beta}'\mathbf{X}_i + \alpha T_i + \varepsilon_i ,$$

Y = outcome, e.g. farm income

X = structural covariates, e.g. size, employment, etc.

T = obtained subsidization from BISS-CRISS

Problems:

- T is endogeneous (depends on X, e.g. farm size) and correlated with error term
- Relationship between Y and T is unknown (can be linear, non-linear, and vary across supported farms, etc.)
- While above specification is misleading, a strong estimation bias would occur

Solution => a **rigorous quasi-experimental** approach using farm-data (i.e. micro-data, e.g. FADN + Paying Agency data)

Recent applications of the DRF/GPSM method to evaluations of EU programmes/policies

- EU Regional- and structural programmes:
  - **Regional data,** e.g. Becker S.O., et al. (2012); J Kluve, et al. (2012)
  - **Individual firm data,** e.g. Bia M., et al. (2011); Bia, M., and Mattei, A., (2012)
- CAP 1st Pillar => Single Payment Scheme (**farm-level data**), e.g. Michalek, J., et al. (2014); Esposti, R., (2014 a,b)
- CAP 2nd Pillar => Agri-environmental measures (**farm-data + GIS data**), e.g. Michalek, J. et al. (2022)
- CAP 2nd Pillar => Food processing sector (**regional data**), e.g. Michalek, J. et al. (2020)
- CAP 2nd Pillar => General development (**regional data**), e.g. Bakucs, et al., (2019), Michalek, J. (2012)
- Trade policies (**macro-economic data**), e.g. Magrini, et al., 2017

Publications in highly ranked journals: *European Economic Review , Journal of the Royal Statistical Society, Land Economics, Agricultural Economics, Land Use Policy, Regional Studies, etc.*