Towards launching Randomized Controlled Trials in Europe

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Introduction

Fundamental difficulties in ex-post evaluation (of CAP) [1]:

- lack of appropriate control group (unbiased expected value)
- heterogenous effects (variance)
- Nonlinear effects
- temporal and spatial lags & general equilibrium effects
- CAP programs that comprise multiple interventions

My focus on **first point**, with some discussion of **second**.

[1] based on Ferraro (2009)

Expected value of treatment effect

Average effects of CAP program on the treated:

$$E(\widehat{ATT}) = \underbrace{E(y_1|D=1) - E(y_0|D=1)}_{\text{Average treatment effect on treated}} =$$

$$\underbrace{E(y|D=1) - E(y|D=0)}_{\text{Observed difference in average}} - \underbrace{E(y_0|D=1) - E(y_0|D=0)}_{\text{Selection bias}}$$

where $y = y_0 + (y_1 - y_0)D$.

- y measure outcome (e.g. fertilizer utilization)
- $D = 1$ if farm is treated: compliance with agri-environment program mandatory

Solutions to selection bias

Observational data:

- **Difference in Difference** combined with **Propensity Score Matching** i.e. Chabé-Ferret&Suberview (2013), Kirchweger et al. (2015)
- **Regression Discontinuity Design** . i.e Objective 1 Funds: eligible if income<0.75 of EU average (Becker et al, 2013)
- **Instrument variables** from the USA (Roberts and Bucholtz, 2005)

Experimental approaches:

- **Randomized controlled trials (RCT):** On-farm-scale ecological models (Firbank et al., 2003). Raineau&Giraud-Héraud(2017)

Example "Refrain from using silage"

- E.g.: Austrian agri-environment program **"Refrain from using silage"**
  - Hey produced instead of silage
  - Grass is cut later, more biodiversity
  - Farms eligible [2]:
    - if $>$ 0.5 livestock/ha: compensation 150 Euro/ha
  - 10.000 participants, 140.000 ha, 18 Mio Euro in 2009

[2] simplified eligibility rule

Observational Data

Evaluation with observational data:

$$\text{Outcome} = \frac{\text{hay}}{\text{hay+silage}}$$

- **Difference in Difference with PSM**: if pre-treatment observations and comparable non-participants are available .
- **Regression Discontinuity Design**: given the eligbility threshold at 0.5 livestock units/ha, we can apply.
- **Instrument Variable Regression:** no instrument available.

Experimental approach

- RCT with random farms excluded from participation: acceptance in CAP still untested.

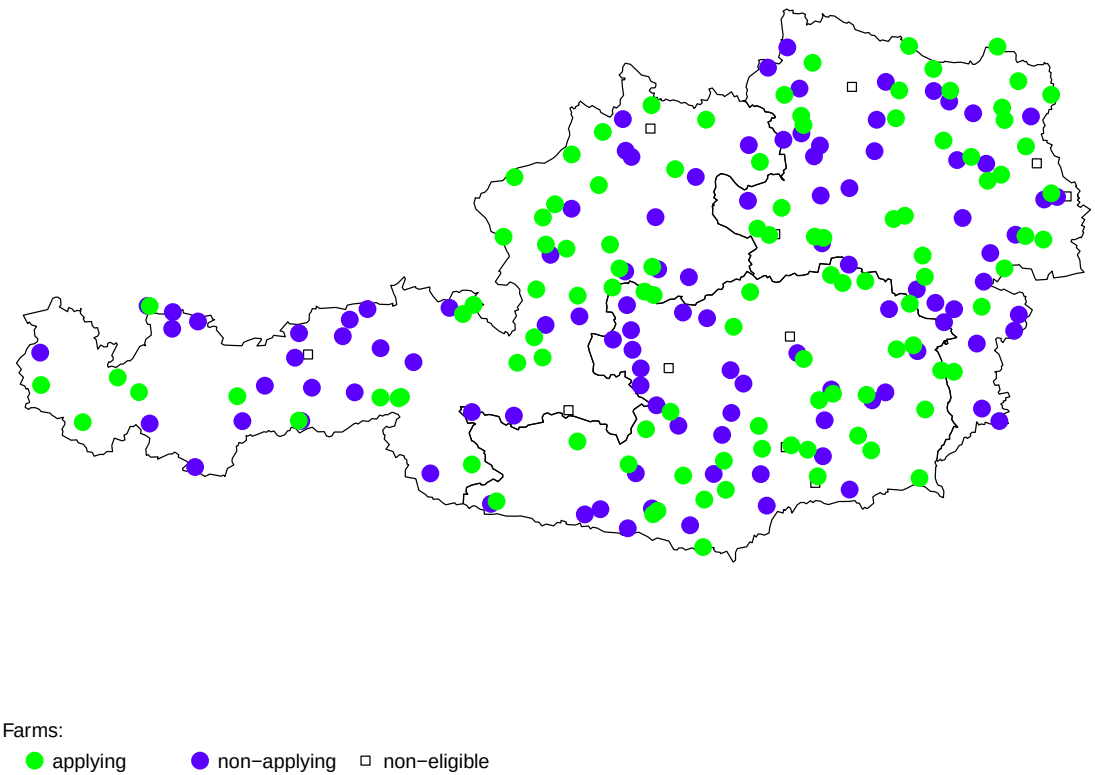
To increase acceptance of RCTs, "**Close to Random RCTs**" (Duflo et al., 2007; Shadish et al. 2002)

- **Pilot project, phase-in:** Randomize in which areas program is introduced first.
- **Over-subscription:** If applicants > budget allows: randomize who of applicants can participate.
- **Encouragement design**:
  - promote program among randomly selected farms
  - Use promotion intensity as instrument variable to estimate ATE
- "**Free-Lunch Randomization**" for Agri-Environment measures (Morawetz, 2014)

"Free lunch" randomization

After deadline for application for agri-environment program:

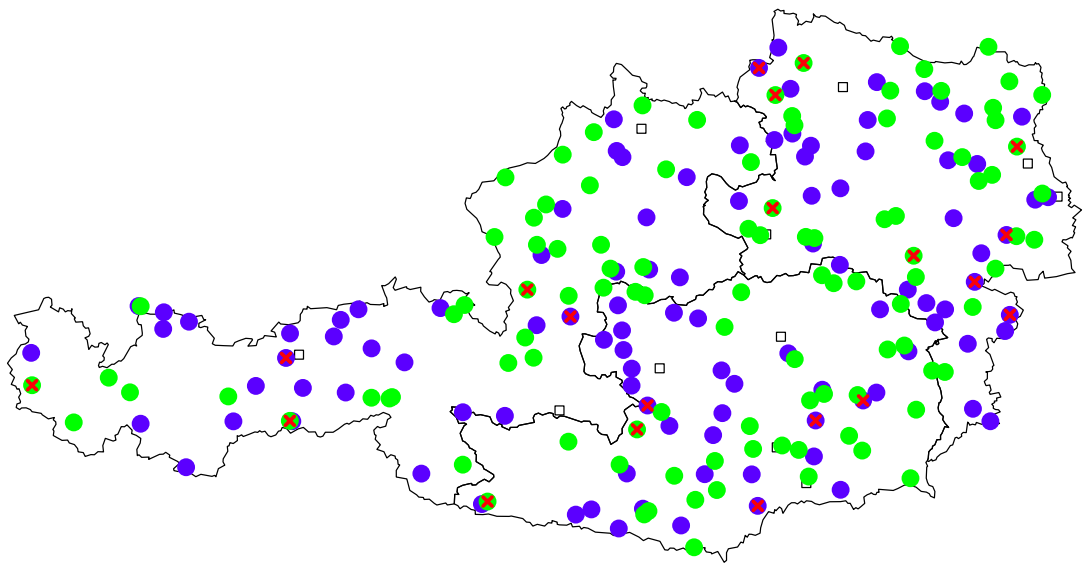
- Eligible farms which applied for silage program
- Eligible farms which did not apply for silage programs
- non-eligible farms



"Free lunch" randomization

Randomly selected farms get a "free lunch" :

- get agri-environment payments (independent whether they applied)
- do not have to comply with the rules



"Free lunch" randomization

At end of period, calculate the **average treatment effect on the treated**

$$\underbrace{E(y_1|D=1)}_{\text{applying, non "free lunch"}} - \underbrace{E(y_0|D=1)}_{\text{applying, "free lunch"}}$$

- $D = 1$: farms willing to participate in agri-environment program
- y_1: outcome of farms that have to comply to the rules
- y_0: outcome of farms which do not need to comply to the rules

Why include non-applying farms in randomization?

- Otherwise biased, because expected payment would depend on application.

Demonstration Free Lunch Randomization

Who is willing to do a contract with me?

- Your part: you **accept the next review request** from a journal
- May part: **I pay you a chocolate ball now**

Demonstration Free Lunch Randomization

Who is born in December?

- All December born are freed from having to accept the next review request
- All December born can keep the a chocolate ball
- If born in December, you get a chocolate ball, independent from a contract

In one year I will evaluate if chocolate balls had an effect:

- % "next review requests accepted" of those with contract **born January to November**
- minus
- % "next review requests accepted" of those with contract **born in December**

Discussion "free lunch" randomization

Advantages:

- Acceptance hopefully higher as nobody is excluded
- Estimate directly ATT
- Only minor change in CAP program necessary
- Applied among FADN participants to reduce survey costs

Disadvantages:

- Effect of being a "free lunch" farm:
  - applying farms: "reciprocal obligation" (Corrigan and Rousu, 2006)
  - income effect
- Negative environmental effects in the short run

Observational data or experiments?

Trade-off bias and variance in RCTs (Deaton and Cartwright, 2016).

Measure precision of $\widehat{ATT}$ with Mean Squared Error (MSE)):

$$MSE = E(\widehat{ATT} - ATT)^2 = Var(\widehat{ATT}) + bias(\widehat{ATT})^2$$

- RCT with small number of observations (e.g. 200):
  - $\widehat{ATT}$ unbiased, but possibly large variance
- Observational study with many observations (e.g. 10.000):
  - $\widehat{ATT}$ possibly biased but smaller variance.

Conclusions

- Suitability of method depends on specific program
  - Pre-treatment and comparable non-treated observations available? DiD-PSM
  - Arbitrary threshold available? RDD
  - Instrument available? IV
  - Pilot, phase-in, over-subscription? Close to random RCT.
  - Ex-post evaluation of Agri-Environment Program? Free lunch randomization.
- Suitability depends on joint effort of program designers and evaluators:
  - collect pre-treatment observations
  - include arbitrary eligibility rules
  - run phase-in
  - apply "free lunch randomization"

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