The Impact of the 2005 CAP-First Pillar Reform (FPR) as a Multivalued Treatment Effect

Alternative Estimation Approaches

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Objective: Is the increasingly complex TE econometrics toolkit suitable for “complex” policy treatments like the FPR? By the way: about 40 bil €/year (30% of EU budget)

1. The FPR case: methodological challenges
2. MT-ATE alternative estimation approaches
3. Results
4. Concluding remarks
1. FPR: methodological challenges (1/5)

What is needed to recreate such a quasi-experimental situation and identify/estimate the Avg. TE (ATE):

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<td>- Multiple treatments</td>
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<td>A clear objective ((Y))</td>
<td>- Unclear (undecided) outcome/target variable</td>
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<td>Observable confounding variables ((X))</td>
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1. FPR: methodological challenges (2/5)

Objective – Estimate the TE of FPR

→ The treatment: the 2003/2005 Reform of the First Pillar of the CAP (FPR)

• Decoupling of support: the key of the reform
  – Reorientation to market:
    ➢ Let farmers choose what (and if) to produce
    ➢ Let farmers achieve an higher allocative efficiency

Objective/Expected outcome: change in the production mix of farmers receiving the treatment
1. FPR: methodological challenges (3/5)

Why don’t use powerful TE econometrics to assess the impact of the FPR?

– We have micro-data!

➢ The sample: a balanced panel (constant sample) of 6542 farms obs. over years 2003-2007 (pre and post-reform).

– But:

1. CAP is a multioutcome policy
2. CAP is a multitreatment policy
3. CAP is a multivalued treatment
4. No suitable counterfactuals for the FPR
1. FPR: methodological challenges (4/5)

FPR as a multioutcome policy: How do we measure if and to what extent farms changed their output vector?

- Two different types of outcome (\(i\)-th farm):
  - **In a short-run perspective**: change in the composition of output (\(K\) is the of possible production activities; \(s_k\) the respective share on GPV). Measures of distance between pre (A) and post (B)

\[
y^1_i = \sqrt{\sum_{k=1}^{K} (S_{ik,B} - S_{ik,A})^2}
\]

Alternative: \(y^2\) simply counts the changes in the output vector

- **In a long-run perspective**: investment decisions (\(I = \text{investments}; \ VA = \text{Value Added}\))

\[
y^4_i = \left( \frac{I_{i,B}}{VA_{i,B}} - \frac{I_{i,A}}{VA_{i,A}} \right)
\]

Alternative: \(y^3\) investments in absolute values

Note: the outcome/target variable is **ALREADY a difference**. The TE is a difference in the difference
1. FPR: methodological challenges (5/5)

2. FPR as a Multivalued Treatment (MT)

→ Treatment Intensity (TI) = FPs/GPV

Distribution of the continuous treatment (TI), First Pillar support on farm’s GPV (in %): Kernel density (K) and frequency histogram (avg. over 2003-2007 period)

5430 treated farms
1112 non-treated farms

Can’t they be suitable counterfactuals for the FPR?

Eligibility to FPR depends on production choices made in the 2000-2002 period. If they made very peculiar choices they must be peculiar

But with MT we do not need counterfactuals
2. MT-ATE estimation approaches (1/4)

3 POSSIBLE EMPIRICAL STRATEGIES:

❖ 1st strategy – PSM-ATT: binary treatment; counterfactuals found through matching conditional on a set of covariates
   ▪ Selection-on-unobservables bias still a problem

❖ 2nd strategy – DID-ATT: binary treatment, counterfactuals are the treated observations themselves before the treatment, still non-treated are needed to get rid of the effects of time
   ▪ Selecting the baseline and the follow-up obs. (years) is critical → CIIA and placebo testing

❖ 3rd strategy – MT-ATE: the treatment is a continuous/discrete variable, a relationship between the treatment level and the outcome variable can be estimated (the DRF); non-treated units (counterfactuals) are not needed → which is the effect for a treated unit of receiving an higher (lower) treatment level?
2. MT-ATE estimation approaches (2/4)

Hirano-Imbens approach - Start with the Rubin (1974) intuition:

- Define a set of potential outcomes \( \{Y_i(T)\}_{T \in \Xi} \) where \( \Xi \) is the set of potential treatment levels and \( Y_i(T) \) is a random variable that maps, for the i-th unit, a particular potential treatment, \( T \), to the potential outcome \( Y \)
- However, for any i-th only one \( Y_i \) is observed corresponding to the actual treatment level \( T_i \)
- The approach estimates the function linking \( Y=f(T) \) on average: the average Dose-Response Function (aDRF)

- It is a 4-step parametric estimation approach
2. MT-ATE estimation approaches (3/4)

Hirano-Imbens approach - Estimation:

- **1**(st) step: the GPS estimation: \( GPS_i = r(T_i, X_i) = T_i | X_i \sim N(\beta' \bar{X}_i, \sigma^2) \)
  
  ✓ Probability of the i-th unit to receive the treatment level \( T_i \)

- **2**(nd) and **3**(rd) steps: the \( uDRF \) and \( aDRF \) estimation
  
  ✓ Estimation of the conditional expectation of the potential outcome with respect to \( T \) and the estimated \( GPS \): a fully interacted flexible function (\( K,H \)-th order polynomial) then averaged for any given \( T \)

- **4**(th) step: the \( ATE \) estimation
  
  \[
  ATE_j = \partial (a\hat{DRF}_j) / \partial T \quad \text{or} \quad ATE_j = (a\hat{DRF}_j - a\hat{DRF}_{j-1})
  \]
2. MT-ATE estimation approaches (4/4)

The Cattaneo alternative (1):

- Hirano-Imbens approach: computationally complex and too arbitrary parametric assumptions
- Cattaneo (2010) approach: a semiparametric estimation
  - Discrete instead of continuous treatment
- A 3-step approach:
  - The first step is common: GPS estimation (but now is a MLM)
  - The second step is a semiparametric estimation: based on the estimated GPS, the potential outcome means for any treatment level ($\mu_j$) are estimated imposing a set of moment restrictions
  - Two asymptotically equivalent alternatives (the latter is preferable in finite sample):
    - IPW (Inverse Probability Weighting) Estimation
    - EIF (Efficient Influence Function) Estimation
  - The third step consists in estimating the ATE

$$ATE_{IPW/EIF,j} = (\hat{\mu}_{IPW,j} - \hat{\mu}_{IPW,j-1})$$
Covariates - Three (+1) groups of confounding factors:

- **Individual characteristics** of the farmer (AGE) and of the farm (Altitude - ALT).
- Economic (ES, FC) and physical (AWU, HP, UAA and, at least partially, LU) **size** of the farm clearly matters.
- Variables directly expressing the **production specialization** of the farm (TF and, in part, LU).
- A final confounding variable included in the analysis is the dummy expressing **second pillar support** (RDP) (1766 farms; 27%)
3. Results of the application (2/7)

- **MT estimation - Hirano-Imbens: \( aDRF \) and \( TE \)**

![Graph showing Dose Response Function and Treatment Effect Function](image_url)
3. Results of the application (3/7)

- **MT estimation - Hirano-Imbens: \( aDRF \) and \( TE \)**

![Dose Response Function and Treatment Effect Function](image-url)
3. Results of the application (4/7)

- **MT estimation - Hirano-Imbens: $aDRF$ and $TE$**

![Dose Response Function](image1)

![Treatment Effect Function](image2)
3. Results of the application (5/7)

- **MT estimation - Hirano-Imbens: aDRF and TE**

![Graphs showing dose response and treatment effect functions.](image-url)
3. Results of the application (6/7)

MT estimation - Cattaneo (EIF, IPW)

- **TE** ($y^1, y^2$)

![Graphs showing TE estimates for different comparisons (2 vs 1, 3 vs 2, 4 vs 3, 5 vs 4, 6 vs 5, 7 vs 6) for EIF and IPW methods.](image-url)
3. Results of the application (7/7)

MT estimation - Cattaneo (EIF, IPW)

- TE \((y^3, y^4)\)
4. Concluding remarks

- Did the FPR reoriented production decisions? **YES**
- Short-run vs. Long-run production decisions
  - FPR affected SR production decisions
  - SR changes seem conservative: +in number of products, - in GPV shares
  - SR impact is lower (or null) for higher treatment levels: *lock-in effect?*
  - Impact on LR (inv.) decisions is questionable
  - LR impact (if any) is higher for higher treatment levels: *pure financial effect?*
  - LR impact may come from the complementarity of the two pillars
    - *Multitreatment effects?*
- Pros and cons of the MT estimation approaches
  - Advantages on PSM-ATT and DID-ATT estimation:
    - no need of counterfactuals (non-treated units)
    - take the continuous nature of the treatment into account
    - more robust
  - MT-ATT estimation complex and based on arbitrary assumptions
    - Results of good quality with the Hirano-Imbens approach
    - Cattaneo approach: poorer results (especially with IPW estimation)
Thanks for your attention