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ALTA SCUOLA DI MANAGEMENT ED ECONOMIA AGRO-ALIMENTARE

The EU agricultural and agro-environmental policies: economic methods for impact assessment

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3rd AIEAA Conference, Alghero, 25-27 June 2014

UNIVERSITÀ CATTOLICA del Sacro Cuore

Outline of the presentation

- Background and motivation
  - The “greening” of EU policies for agriculture
  - The increasing specificity of policies
- Impact assessment tools (*not exhaustive list…*)
  - Structural econometric models
  - Math programming models
  - Interlinked bio-economic models
  - Counterfactual techniques
  - Spatial econometric models
- Data issues
- Empirical results of the available studies
  - “Short” literature review on the impact of “green” policies
- Conclusions: research agenda

Background: the evolution of EU policies (1)

- One of key features of the evolution of the CAP is its "greening" (i.e. increasing attention to the environmental impact of agriculture)
- This "greening" of the CAP goes back to the 1992 MacSharry reform, in which several "environmental" objectives were made explicit:
  - Promote more extensive agricultural techniques (i.e prevent negative impact on environment)
  - Recognise the multifunctionality of agriculture (i.e recognise the positive impact on environment)
- The objectives were refined and expanded in the following reforms:
  - Food safety and animal welfare (Agenda 2000)
  - Sustainable agriculture and food production (Fischler Reform)

Background: the evolution of the EU policies (2)

- The development of environmental objectives in the CAP led to the development of new policy tools:
- MacSharry reform (1992):
  - Agri-environmental programs (AEP)
  - Afforestation programs
- Agenda 2000 reform:
  - Clear separation of first and second pillar
  - New financing rules
- Fischler reform (2003):
  - Cross-compliance (link direct payments to agronomic, ecological, animal welfare requirements)
- CAP 2020 reform
  - Green payment (stronger linkage to environmental requirements)

Background: the evolution of the EU policies (3)

- Several EU environmental policies (not part of the CAP) also strongly affect agricultural production
- Water pollution policies
  - Nitrates directive (ND)
  - Water framework directive
- Nature preservation policies
  - Natura 2000 sites (with strong land use restrictions)
  - Habitats directive and birds directive
- Animal/plant health policies
  - Animal welfare legislation

Background: the new EU policy framework

- In addiction to the “green” trend, EU policies affecting agriculture have also changed their “nature”:
  - From price support to direct payments
  - Direct payments linked to compulsory individual compliance of some environmental rules
  - Additional payments linked to voluntary individual participation in some specific programmes (agri-environmental programmes)
  - Compulsory rules affecting land use (Natura 2000) or requiring specific farm investments (animal welfare, nitrates directive)
  - Implementation of policies differing among Member States (MS) and among regions inside each MS
  - Policies becoming territorial specific and farm specific

Implications for impact assessment

- Impact assessment methods should analyse policy impact at the farm level. Typical research questions:
  - Impact of environmental standards/restrictions on farm costs/farm profits/land use
  - impact of agri-environmental schemes on farm profitability
  - impact of agri-environmental schemes on the use of chemicals, on crop diversification, on landscape...
- When addressing environmental issues, the scale of impact assessment should be the territorial level (provinces/regions). Typical research questions:
  - Environmental impact of agricultural activities in a given region, measured by specific indicators
- The difference between voluntary and compulsory programs (i.e. AEP vs. Nitrates directive) should be properly considered

Methods: structural econometric models (1)

- Farm level econometric models for policy evaluation are based on different assumptions:
  - A primal approach (functional form representing technology)
  - A dual approach (functional form representing farm behaviour: cost function, profit function)
  - Both approaches can be extended to account for risk preferences (i.e. stochastic technology; expected utility function)
- The procedure:
  - Start from farm behavioural relationships, including policy variables among determinants (but we need a past history)
  - Derive estimable forms of fundamental economic relationships (i.e. output supplies, input demands, profit)
  - Use estimated parameters/elasticities to simulate policy changes

Methods: structural econometric models (2)

- For the specific case of the impact of environmental policies we have very few studies:
  - Sauer et al (2012) analysed the impact of both AEP and the ND on technical and allocative efficiency using a Distance Function
  - Lacroix and Alban (2011) used a NQ profit function for analysing land use choices and nitrogen runoff (against the rules of the ND), using advanced panel data techniques
  - Nauges and Laukkanen (2012) used a NQ profit function to analyse the impact of AEP on input use (fertilisers) using a two-stage estimation procedure
- To our knowledge, none of these models has considered the issue of uncertainty
- All models experienced serious data limitations

Methods: Math Programming (1)

- Farm-level math programming models for policy evaluation are mainly based on PMP:
  - Idea: observed activity levels correspond to the optimum choice which maximizes the objective function of the decision maker subject to some constraints
  - Environmental policies are typically represented by one or more constraints or by distinguishing “green” activities
- The procedure:
  - Step 1: set up the farm optimisation problem with resource /environmental constraints and calibration constraints
  - Step 2: derive a multi-output non-linear cost function (using dual values), and estimate the parameters of such function using appropriate techniques (i.e. maximum entropy)
  - Step 3: use this function to recover a calibrated non-linear programming model which reproduces exactly the base period activity levels

Methods: Math Programming (2)

- For the specific case of the impact of environmental policies we have several examples:
  - Psychoudakis et al (2002), Pacini et al (2004) evaluate AEP using LP techniques, simply extending the set of constraints
  - Rohm and Dabbert (2004) are the first to use PMP for evaluating AEP, distinguishing AEP crops from standard crops. A similar approach is used in Buysse et al (2007)
  - More recently Mosnier (2009) used PMP introducing yield risk in a mean variance framework for analysing AEP, while Bamiere et al. (2011) introduced spatial analysis while analysing the birds directive
- MP models carry several limitations, including again the “crude” way of accounting for risk
- Data limitations is still a problem

Methods: Interlinked bio-economic models

- Interlinked bio-economic models for policy evaluation are based on:
  - A PMP model for the economic part, providing the impact of policy changes on economic variables (i.e. land use, output), given exogenous prices
  - Environmental constraints are represented as in any PMP model
  - Results of PMP models are converted in a measure of "environmental pressure" through bio-physical models (involving information on soil conditions, weather, impact of agronomic practices….)
  - Such measures are used to evaluate environmental conditions at the territorial level
  - See Jacquet et al (2011) for an example

Methods: Counterfactual techniques (1)

- Counterfactual econometric techniques are becoming a reference for policy assessment
- They are also strongly supported by the European Commission services (EU Commission, 2012)
- There are several variants of these methods:
  - Propensity Score Matching (PSM): econometric procedure for evaluating the impact of a treatment in a non-experimental setting, i.e. the “treated group” (farms subject to a policy measure) vs. the “control group” (farms not subject); the treatment may be voluntary or compulsory
  - Difference in Difference (DID): used for evaluating the impact of a treatment (ATT) before and after its introduction (combined with PSM it allows to control for selection bias o on both observed and time-invariant unobserved covariates)
  - Regression Discontinuity Design (RDD): suggested when the policy measure is exogenously enforced

Methods: Counterfactual techniques (2)

- Using these techniques, no functional form specification is required, but no specific behavioural assumption is postulated (ad-hoc models)
- Several studies have been published in recent years:
  - Most EU studies have analysed the impact of AEP (Pufhal and Weiss, 2009; Chabé-Ferret and Subervie, 2013) or the impact of cross-compliance measures (Jaraitė and Kažukauskas, 2012), typically combining PSM and DID
  - North-America studies have analysed similar policy measures: agri-environmental advisory activities in Canada (Tamini, 2011), and various land conservation programs (Liu and Lynch, 2011; Lawley and Towe, 2014), again combining PSM and DID
  - To our knowledge, no RDD study is available in the area of farm policy evaluation

Methods: Counterfactual techniques (3)

- All the above studies have faced several problems and limitations:
  - Data limitations: one of the main problems is that some farm-level environmental performances are typically evaluated in terms of expenditure changes (i.e. expenditure on fertilisers or pesticides)
  - Studies analysing the impact on economic performances of farms (i.e. gross margins) have found several contradictions (i.e. voluntary programs leading to a reduction in gross margins)
  - Uncertainty faced by farmers in the decision of joining the program is not explicitly considered
  - No studies available on compulsory policies like the ND (only cross-compliance is evaluated with these methods)

Methods: Spatial econometric techniques (1)

- Spatial econometric techniques are becoming increasingly popular in several economic research areas (i.e. regional sciences)
- Such methods seem rather promising, since they allow to consider several peculiar aspects of the environmental impact of policies:
  - spatial dimension of some phenomena such as the urbanization and the agglomeration of farms in space
  - possible positive or negative externalities between contiguous territories
  - the geographical variation in the implementation, and the impact, of policy measures
- Farm level data need normally to be integrated with territorial data on environmental indicators

Methods: Spatial econometric techniques (2)

- Available studies are rather scarce in the area of farm policies:
  - On the EU, a few working papers are available
  - One paper presented in this conference last year (Marconi et al, 2013) on the impact of AEP on nitrogen use, and a few others to be presented this year
  - A few articles in the North American literature, focused on environmental issues (climate change, nitrogen use) but not specifically on policy evaluation
- Note however that also these methodologies are basically ad-hoc models (no specific behavioural assumption is postulated)

Data issues (1)

- The problems of the FADN database are well known. The following are especially relevant for the analysis of agro-environmental policies:
  - Quantities of variable inputs, including chemicals (fertilisers, pesticides), are missing; only expenditures are available, with no disaggregation (i.e. Nitrogen fertilisers vs. others)
  - Soil and weather variables are not available
  - Investment data are not very detailed (for policies requiring investments, like ND or animal welfare, more details are needed)
  - Subsidies for AEP (and also for investments) are not disaggregated by type of policy
  - Longer permanence of farms in the sample would be useful for making advantage of panel data techniques and for developing dynamic models

Data issues (2)

- For spatial analysis, we need additional data at the territorial level for environmental indicators
- Possible sources are:
  - Eurostat
  - Institute for Environment and Sustainability-JRC (a lot of work in characterising territories from the point of view of environmental indicators)

Results of available studies

- Broad positive judgement of the impact of AEP from papers applying different methodologies:
  - Positive impact on preservation of habitats/landscapes
  - Positive impact on crop diversity and grassland coverage
  - Reduction of chemical use (that in most cases is chemical expenditure), but this result is controversial
  - Mixed results on the impact on gross margins, including the payments (see the contradictions discussed above)
- Less results available on other issues, especially on compulsory programs:
  - Cross-compliance reduces profitability
  - Very few results on ND or animal welfare

Conclusions: Research Agenda (1)

- In general, studies on the impact of agro-environmental policies are still scarce if compared to those on price polices/direct payments
- On EU policies, most papers have analysed AEP, while much less attention has been devoted to other policies (i.e. ND, animal welfare)
- We expect a lot of interest in simulating/evaluating the impact of the “green” payment
- Results of the available studies cannot be considered conclusive, especially because of their limitations

Conclusions: Research Agenda (2)

- Among the limitations, one should consider:
  - Data limitations (typically linked to the features of the FADN database)
  - Limitations of structural models: they do not properly account for uncertainty (well established in price/payment policy analysis)
  - Limitations of ad-hoc models, since they do not refer to a specific behavioural assumption
- One of the most promising area is that of spatial analysis (spatial econometrics)
  - It is virtually unexplored and seems particularly suitable for environmental policy issues
  - It can take advantage of advanced panel data techniques for econometric analysis
  - But it needs supplementary data at the territorial level

Thanks for your attention

(…..and thanks to Linda Arata for assistance……)

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