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## Spatial diffusion of Organic Farming

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► **To cite this version:**

Ghislain Geniaux. Spatial diffusion of Organic Farming. Impact of the location of agricultural production on ecosystem services, Nov 2015, Dijon, France. 16 p. hal-01606145

**HAL Id: hal-01606145**

**<https://hal.science/hal-01606145>**

Submitted on 5 Jun 2020

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# Spatial diffusion of OF

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# Statistical model of OF switching : motives and determinants

- Determinant of OF choice at farm level are extensively studied, qualitatively and quantitatively.
- I propose to start the discussion at the conclusion of a recent literature survey on this issue : Geniaux et al. 2010 « *Les déterminants de la conversion à l'agriculture biologique : une revue de la littérature économique* », livrable AgriBio3

# Motives and Determinants

- Motives (Padel 2001)
  - Agronomic, agro-ecologic challenge,
  - Ethical, religious and societal choices,
  - Pollution and environmental issues,
  - Health issues,
  - Profit/rentability (Geniaux, Mzoughi, Napoleone, 2014)
- Classification of observable determinants of choices
  - Farmer characteristics
  - Farm characteristics
  - External (neighbouring, market, policy)

# Modelisation of OF switching

- Qualitative analysis of small sample  
see Bellon et Lamine 2010 for a review
- Econometric models at farm scale :
  - Dependant variable :
    - binary (OF/CF) → logit/probit **Lohr and Salomonson 2000, Pietola and Oude Lansink 2001, Genius et al., 2006, Sauer and Park 2009**
    - multinomial (several levels of engagement in OF, alternatives label, AC) → logit/probit **Anderson et al 2005, Burton et al 2003, Koesling et al 2008**
    - Share of OF → Tobit **Khaledi et al. 2010**
    - Number of Year in CF before switching → duration model **Lapple and Donnellan 2009, Kallas et al. 2010**

# Explanatory Variables

- Farmer characteristics
  - Age –
  - Education +
  - Farming experience +/-
  - Risk aversion --/+
  - Environmental/ethical motives\* +
  - Other sources of earning/work +/-

# Explanatory Variables

- Farms characteristics
  - Size +/-
  - Production type (wine +, green garden +, cereal -, ...)
  - Specialisation level – except wine sector
  - Juridic statute\* (collective forms +)
  - technical efficiency +/-
  - short supply\* chains +

# Explanatory Variables

- Factors external to the farm
  - Neighbouring context (population, agronomic, soil, climat) +/-
  - Transformers and supply chains +
- Policy (local aids,...) :
  - National policy
  - Local policy (promote for ?)

# Some remarks about theses models

- Poor explanatory power without « motives » variables
- Endogeneity problem with ex post « motives » variables, and with some ex post farm characteristics.
- Discrete choice model with spatial dependence are complicated to implement particularly on large sample.
- For internal characteristics, only age and education have universal effect.

# Spatial dependance and OF diffusion

- What for :
  - Accurate estimation of determinants effects  $\beta$
  - Spatial diffusion process
- More developed at aggregated scale (municipality or higher, Bichler et al 2005a, Lewis et al. 2009, Geniaux et al. 2009, **Allaire et al. 2015**)
- How to interpret spatial dependance in SAR model :

$$Y = \lambda WY + X\beta + err$$

# Precaution

- Share of OF are highly heterogeneous between type of production, and share of type of production are highly spatially correlated
  - Global OF analysis can be problematic
  - A ratio between CF and OF has to be preferred → OLS/SAR inappropriate → logit/probit
  - logit/probit with spatial dependence are undeveloped, particularly for large sample.
- Discrete choice model at farm scale would be preferred to take into account soil, farm and farmer characteristics, and to analyse close neighboring effects.

# Precaution

- Where Spatial Autocorrelation come from in SAR model ?
  - Missing covariates spatially autocorrelated
  - Non linearity of spatially autocorrelated covariates.
  - Spatially varying coefficients (spatial heterogeneity)
  - Spatial process of diffusion
- A model with low adjustment fit  $R^2 < 0.4$  imply a correction through WY that constitutes a proxy of unobserved spatially covariates X.
- A high spatial parameter is a diagnostic of model miss-specification when adjustment fit is low and perhaps a spatial process when adjustment fit is high

# Spatial dependence and OF diffusion

- Why observed Spatial Dependence is high ?
  - Poor explanatory power of empirical models.
  - Bad specification of model.
    - Missing explanatory variables that are spatially correlated
    - Non linearity
- Overestimate spatial parameters
  - Biased estimation of spatial effect  $(I - \lambda W)^{-1} \beta$

# A working program for analysing Spatial Diffusion of OF

- Exhaustive database with farm and farmer characteristics for whole France (French Census 2010)
- Take benefit of MSA database in which annual Farm earning are available for 2002-2015 and Agence Bio Data that allow to distinguish between OF installation and CF to OF switch.
- Privilegiate analysis at farm scale
  - To analyse small neighbouring effects
  - To take into account farm and farmer characteristics
- Sector based analysis
  - Is spatial dependance related to the total number of OF neighbors or to the number of OF neighbors in same agricultural sector
- Analysis of OF/AC and OF intention to switch.

# A working program for analysing Spatial Diffusion of OF

- PROBIT MODEL with spatial dependence using « Approximate likelihood estimation of spatial autoregressive binary choice models » D. Martinetti and G. Geniaux 2015
  - Available for SAR, SEM, SARAR and SDM models,
  - Highly accurate estimation using maximum likelihood technics,
  - Usable for large sample size : Up to 1 million observations with sufficiently sparse spatial weight matrices,
  - Soon available as R cran package

# First results

- Municipal scale results (36 000 obs)
  - Share of UAA of OF at municipal
    - SAR model → High spatial parameter (~0.6) with low adjustment R<sup>2</sup> around 0.2
    - Wine and Fruit +, crop -
    - Population municipal + ( Wpop -)
    - Short supply chaines + (Wssc not significant)
  - Share of UAA of intention to OF
    - SAR model → High spatial parameter (~0.5) with low adjustment R<sup>2</sup> less 0.2

# First results

- Sector by sector
  - No spatial autocorrelation for crop/cereal and maraichage (vegetables)
  - High spatial autocorellation for WINE and for FRUIT, more related to the total share of OF in the neighbouring than the share of OF in the same production sector.