Spillover effect of on-farm diversification

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Overview

- Introduction & objective
- Study area & data
- Modeling approach
- Results and conclusions

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Introduction : transition in European rural areas

- New societal demand for rural area
  - Multifunctional agriculture
  - Farm diversification

- CAP beyond 2013
  - Fully decoupled payments
  - More focused on rural development & land management

=> Better understanding of dynamics of rural service supply

Objective

Test if spill-over effect in farm diversification exist

Hypothesis : diversified farms cluster

- Cost of diversification reduces in a diversified neighborhood (external returns to scale)
- Easy knowledge transfer (reducing transaction cost)

=> Probability to diversify is higher in a diversified neighborhood

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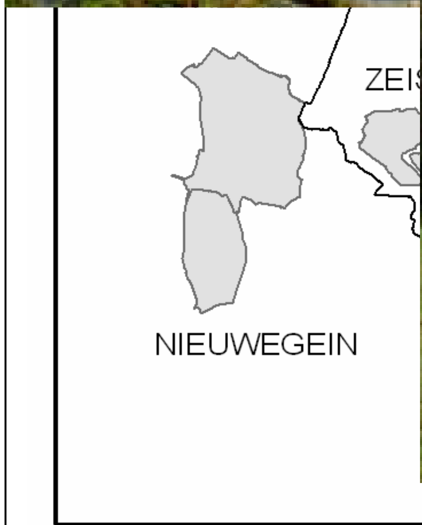

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Data available

- Geographical Information System for Agricultural Businesses (GIAB)
- Full coverage data set for 2005
  - Farm production and household characteristics
  - Diversification (binary variable)
    - Agri-enviromental schemes
    - Recreational activities
    - Short supply chains
    - Care farms
    - …
  - Coordinates at the farmstead

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Theoretical result from a farm household utility maximization problem

$$q_d = g_d(p_f, p_d, R_{d,} R_o, w_o, h, t, v, Z_F, Z_H, S)$$

$$\frac{\partial q_d}{\partial p_d} > 0 \quad \frac{\partial q_d}{\partial R_d} < 0 \quad \frac{\partial q_d}{\partial h} > 0$$

f=food, d=diversification, o=others (non allocable)

p=output price, R=input price, w_o=off-farm wage, h=neighborhood, t=time, v=transfers, Zf=farm-, Zh=household-, S=location- characteristics

But data available = binary for diversification

Econometric model : a spatial probit

- Binary variable

$$y_i \begin{cases} 1 \text{ if } y_i^* \geq 0 \\ 0 \text{ if } y_i^* < 0 \end{cases}$$

Latent model

$$y^* = \rho W y^* + X\beta + \varepsilon$$

$$W = \begin{array}{c} a \\ b \\ c \\ d \end{array} \begin{bmatrix} 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \\ 0 & 1 & 1 & 0 \end{bmatrix}$$
$$\quad\quad a \quad b \quad c \quad d$$

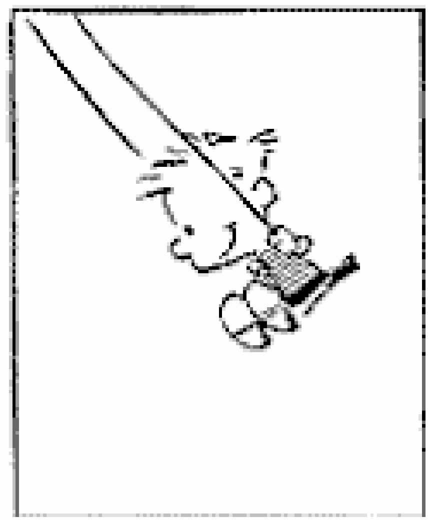
- The reduced form $y^* = [I - \rho W]^{-1} X\beta + u$

Bayesian Markov Chain Monte Carlo (MCMC) methods

- Based on :
  - believes (prior)
  - joint distribution(s) of parameters to estimate
  - random draws from the distributions=> statistics over the sample
- If interdependent joint distribution
  - “frog technique” (Gibbs-sampler)
- For spatial probit
  - Routine by LeSage (Matlab spatial toolbox)
  - “Double Gibbs-sampler”
  - Non-informative prior, normal distribution for β and uniform for ρ

Estimated models

- Weighting matrix
  - M0 no
  - M1 5 nearest neighbors
  - M2 15 nearest neighbors
  - M3 2 km distance ban
  - M4 5 km distance ban



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Results

Model	Without W (M0)	2 km ban (M3)
average age	0.0149	0.0353
age sq	-0.0002	-0.0004
education	0.0341	0.0466
social network	1.6947	2.0964
size	0.0113	0.0131
size squared	-0.00001	-0.00002
organic	0.5104	0.6701
ground water	0.0138	0.0393
dist to road	-0.0618	-0.0878
dist to city	0.0108	0.0082
dist to attractive areas	-0.0392	-0.0210
ρ		**0.4740**
R-squared	0.1561	0.5539

Model comparison

	M 0	M1	M2	M3	**M4**
ρ		0.1508	0.3558	0.4740	**0.5621**
ρ / β_{size}	0	10.69	26.55	36.18	**42.26**
McFadden R-squared	0.1561	0.5410	0.5461	0.5539	**0.5658**
Quadratic probability score		0.1066	0.1061	0.1056	**0.1056**
Logarithmic probability score		0.3573	0.3554	0.3531	**0.3528**

- Bayesian model comparison is not yet possible

Discussion and conclusion

- Diversified farms cluster (hotspot)
  - Near to attractive landscape, further away from cities
  - Wet (low quality) soils
- Extend of spill-over effects is at least 5 km
- No analysis of “nature of the spill-over”
- Addressing the “cold spot” ?
  - Role of local demand

Bayesian specification

- Prior :β = normal, ρ = uniform prior : independent

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$$p(\beta \mid \rho, y^*) \propto N(c^*, T^*)$$

$$c^* = (X'X + T^{-1})(XSy^* + T^{-1}c)$$

$$T^* = (X'X + T^{-1})^{-1} \quad S = (I_n - \rho W)$$

$$p(\rho \mid \beta, y^*) \propto \left|I_n - \rho W\right| \exp\left(\frac{1}{2}[Sy^* - X\beta]'[Sy^* - X\beta]\right)$$

$$y^* \sim TMVN\{(I_n - \rho W)^{-1} X\beta, [(I_n - \rho W)'(I_n - \rho W)]^{-1}\}$$

(LeSage and Pace, 2009)

Gibbs-sampler

1. select initial values for ρ, and y^*, a number of replications and a number of burn-in replications
2. draw β from its conditional distribution given initial values (step 1)
3. draw ρ from given the initial value (step 1) and β computed in step 2
4. draw y^* by :
   - Applying the Geweke procedure for identifying the truncated distribution of y^*
   - Drawing y^* from given β computed in step 1 and ρ computed in step 3 from the distribution identified in step 4a.

Marginal effects for model M3

Marginal effects	direct	indirect	total
average age	0.03472	0.0002	0.0578
average age square	-0.0004	-0.00024	-0.0007
maximum education	0.05066	0.0028	0.0787
social network	2.1658 [0.6798]*	1.1884	3.3542
size	0.0136	0.0075	0.0211
size squared	-0.000016	-0.000009	-0.00002
organic	0.6571 [0.2431]*	0.361	1.1020
ground water level	-	-	0.0491
distance to road	-	-	-0.1457
distance to city	-	-	0.0161
distance to attractive landscapes	-	-	-0.04812

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$$pr\left[y \mid x_i = 0, \overline{X}, \overline{Wy}\right] - pr\left[y \mid x_i = 1, \overline{X}, \overline{Wy}\right]$$