Did Green Payments' Crop Diversification Induce Change in Environmental, Economic and Land Use Conditions in France?

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1 Introduction

2 Context and Literature

3 Methodology and Data

4 Results

5 Conclusion

2013 CAP Reform

Departure :

- Direct payments ⇒ 1st Pillar CAP;
- Criticism : environment and efficiency (EU Commission, 2012);
- Proposed solution : Green payments with 2013 CAP Reform.

Objectives :

- Improvement of environmental performances;
- Economic support to farmers.

Existing studies

Three dimensions of interest :

- Environment ⇒ (Cortignani et al., 2017 ; Solazzo et al., 2016) ;
- Land-Use ⇒ (Gocht et al., 2017 ; Solazzo et al., 2016) ;
- Economic ⇒ (Cortignani et al., 2017 ; Gocht et al., 2017).

Contribution of the study :

Value Added :

- Effect on technical and environmental efficiency (TE, EE) ;
- Causal impact with quasi-experimental technique ;
- Comprehensive study on the three dimensions ;
- Additionnality estimations.

1 Introduction

2 Context and Literature
- Crop diversification requirements
- Literature review

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Conditions to meet for CDC :

Crop Diversity

- Less than 10 ha of arable land ⇒ Exempted;
- More than 10 ha of arable land ⇒ at least 2 crops & main crop share ≤ 75%;
- More than 30 ha of arable land ⇒ at least 3 crops, main crop share ≤ 75% & two main crop share ≤ 95%.
- **Stated objective :** soil quality

Overview of existing studies on green payments

- **Land-use and land prices :**
  - ↘ Main crop share, but reduced when only green payments is considered (Cortignani et al., 2017) ;
  - 4.5% of the total area is relocated with effect driven mainly by EFA (Louhichi et al., 2018) ;
  - ↗ Land rental values in North Ireland (Olagunju et al., 2022).
- **Environmental effect :**
  - ↗ Ammonia emissions, ↘ GHG and ∅ Nitrogen surplus (Gocht et al., 2017) ;
  - ↗ Crop diversity index , ↘ Nitrogen (Cortignani et al., 2017).
- **Economic consequences :**
  - ↘ Total production and ↘ Farms revenue (Louhichi et al., 2017 ; Cortignani et al., 2017 ; Solazzo and Pierangeli, 2016 ; Cimino et al., 2015)
  - ↘ Total production, but ↗ Farms revenue due to price effects (Gocht et al., 2017)

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Crop diversity, Production and Productivity

- ↗ **Production and Income :**
  - Efficiency use of inputs and complementary (Bommarco et al., 2013 ; Di Falco et al., 2010)
  - Buffer against weeds, pests, and diseases (Lechenet et al., 2014).
  - Hedge against price and production risk (Di Falco and Chavas, 2009) or low rainfall (Donfouet et al., 2017).
- **But mainly negative for green CDC** (Louhichi et al., 2017 ; Cortignani et al., 2017 ; Solazzo and Pierangeli, 2016).
- **Potential impact on TE and EE via :**
  - Input quantity and requirement that depend on each crop ;
  - Different level of production following new crop's introduction.

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3 Methodology and Data
- Econometric Strategy
- Outcome Variables
- Data description

4 Results

5 Conclusion

Difference-in-Discontinuity

Setting :

- Assignment to the treatment or control group is determined according to the known cut-off point randomly;
- Any other evolution around cut-offs is constant over time.
- Exploiting the before/after and policy discontinuity variation.

Application to green payments

- 2013 CAP Reform as natural experiment.
- Comparison :
  - Just below 10 ha vs Just above 10 ha
  - Just below 30 ha vs Just above 30 ha
- Cut-off manipulation test (McCrary, 2008)

Technical and Environmental Efficiency (TE & EE)

The stochastic production frontier can be written as follows (Reinhard et al, 1999) :

$$Y_{it} = f(X_{it}; Z_{it}; \beta) \cdot \exp\{V_{it} - U_i\}, \tag{1}$$

Where

- Y_{it} is the output for farm i at the t time period;
- X_{it} is a vector of inputs.
- Z_{it} is a environmental detrimental input (crop protection, fertiliser, energy).
- β is a vector of technology parameters,
- V_{it} measures the effects of statistical noise,
- U_i, measures the inefficiency.

Translog Form of the production function

$$
\begin{aligned}
lnY_{it} = \beta_0 & \\
& + \sum_{j=1}^{4} \beta_j lnX_{kit} + \beta_z lnZ_{it} \\
& + \frac{1}{2} \sum_{j=1}^{4} \sum_{k=1}^{4} \beta_{jk} lnX_{ijt} * lnX_{ijk} \\
& + \sum_{j=1}^{4} \beta_{jz} lnX_{ijt} * lnZ_{it} \\
& + \frac{1}{2} \sum_{k=1}^{4} \beta_{zz} (lnZ_{it})^2 + V_{it} - U_i
\end{aligned}
\tag{2}
$$

Technical Efficiency Formula (TE)

TE = observed output / maximum attainable output according to inputs (conventional and pollution-generating) is calculated :

$$\begin{aligned} TE_{it} &= Y_{it} / Y_{it}^{*} \\ &= \frac{f(X_{it}; Z_{it}; \beta) \cdot \exp\{V_{it} - U_i\}}{f(X_{it}; Z_{it}; \beta) \cdot \exp\{V_{it}\}} \\ &= \exp\{-U_i\} \end{aligned} \tag{3}$$

Environmental efficient farm SPF

EE farm is already TE $\Rightarrow U_i = 0$ and $Z_{it} = Z_{it}^F$ with Z_{it}^F the minimal feasible environmentally detrimental input.

$$
\begin{aligned}
lnY_{it} = \beta_0 & \\
& + \sum_{j=1}^{4} \beta_j lnX_{kit} + \beta_z lnZ_{it}^F \\
& + \frac{1}{2} \sum_{j=1}^{4} \sum_{k=1}^{4} \beta_{jk} lnX_{ijt} * lnX_{ijk} \\
& + \sum_{j=1}^{4} \beta_{jz} lnX_{ijt} * lnZ_{it}^F \\
& + \frac{1}{2} \sum_{k=1}^{4} \beta_{zz} (lnZ_{it}^F)^2 + V_{it}
\end{aligned}
\tag{4}
$$

Environmental Efficiency Formula (EE)

The EE is deduced by equalling equation (2) to (3) and replacing $lnEE = lnZ^{F}_{it} - lnZ_{it}$:

$$lnEE_{i,t} = \left[-\left(\overbrace{\beta_z + \sum_{j=1}^{m} \beta_{jz} lnX_{ij,t} + \beta_{zz} lnZ_{i,t}}^{A} \right) \pm \left\{ \left(\overbrace{\beta_z + \sum_{j=1}^{m} \beta_{jz} lnX_{ij,t} + \beta_{zz} lnZ_{i,t}}^{B} \right) - 2\beta_{zz} U_{i,t} \right\}^{0.5} \right] \beta_{zz}$$

Variables (cont'd)

Table – Outcomes of interest

Dimension	Name	Description
Environment	eveness	Shannon Index
	raten	Fertilizer use ratio
	ratph	Crop protection use ratio
	EE	Environmental Efficiency
Economic	TE	Technical Efficiency
	ebe_uta	Operating Surplus per unpaid workers
	rcai_uta	Income before tax per unpaid workers
Land Use	part_dom	Main crop share
	part_dom2	Two main crop share
	nb	Number of crop

Variables

- Unbalanced panel Data from RICA for 2012-2016 period. Final sample = + 15000 Farms ;
- Running Variable = Arable land ⇒ Authors calculations
- Variable for TE and EE :
  - Outputs : Gross agricultural production
  - Inputs :
    - Fixed assets ;
    - Utilised Agricultural Area ;
    - Labour in Annual Working Unit (AWU) ;
    - Intermediary Consumption ;
    - Environmental Input (Fertiliser + Crop protection + Energy).

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4 Results
- Main findings
- Design to fail?

5 Conclusion

Crop Diversity effect around 10ha and 30 ha

Results around 10ha

- ↗ Crop diversity index;
- ↘ Main crop share and two main crop share;
- No effect on TE and EE.

Results around 30ha

- ↗ Number of crop on farm;
- No effect on TE and EE.

Windfall Effects?

Conception or targeting problem?

- Most of farms already respected the diversity criterion (EU, 2017; Louhichi, 2018);
- Problem of targeting or design?

Design to fail?

- Focus on farms that did not respect the diversity criterion before 2013;
- Is there any additionnality?.

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Crop Diversity effect around 10ha and 30 ha on non-compliers

Results around 10ha

- ↗ Crop diversity index and number of crop;
- ↘ TE and EE;

Results around 30ha

- ↘ TE.

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Summary of results

- Main results
  - Significant effect on land use condition around 10 ha and 30 ha;
- Additionnality?
  - Real additionility around 10 ha at the expenses of TE and EE.
  - Effects driven by compliers before 2013
- Policy Implications :
  - Possible windfall effects;
  - Green payments are not enough (alone) to change agricultural practices.

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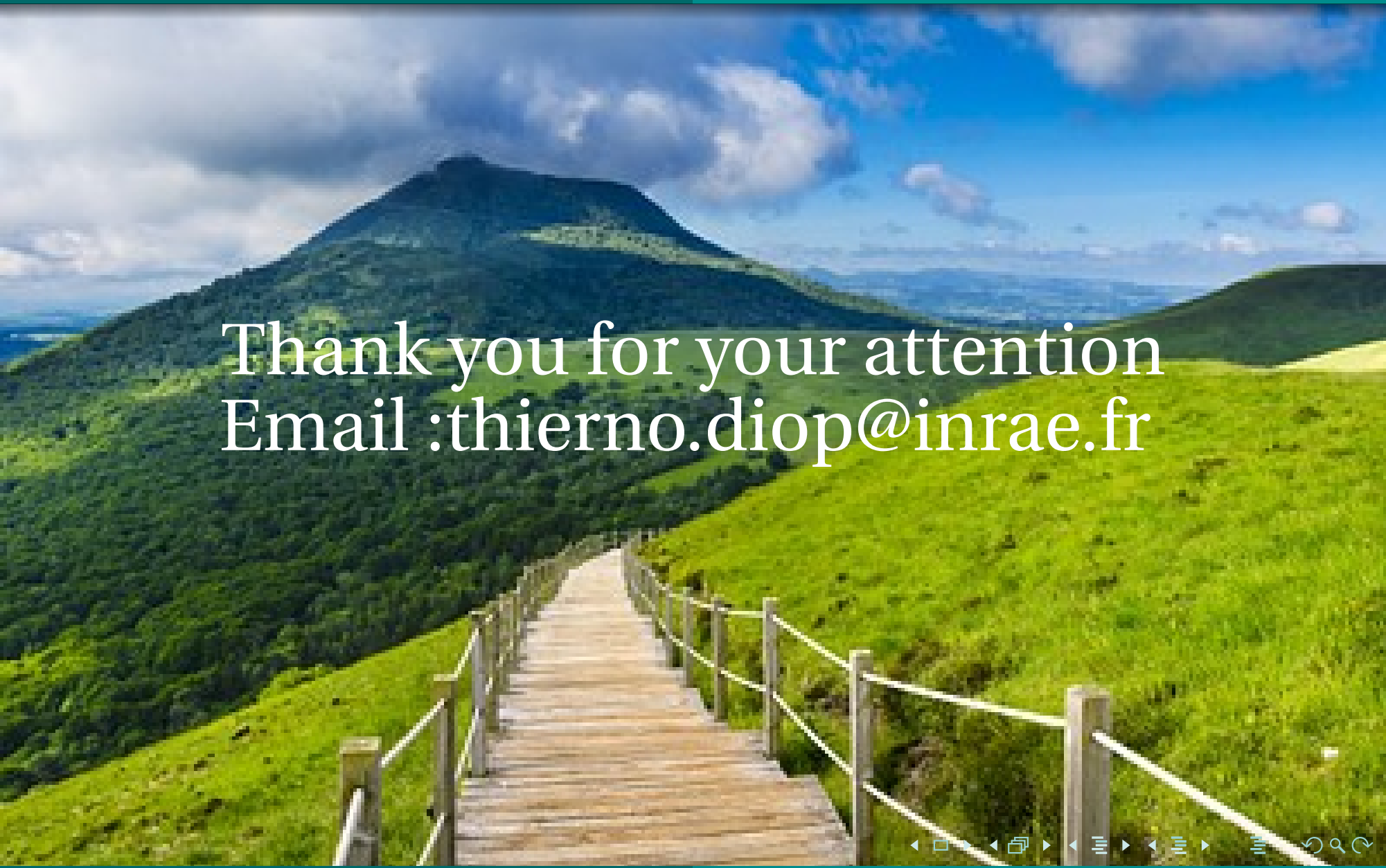
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