Upscaling environmental incentives in the Common Agricultural Policy: an ex ante evaluation method applied with the Farm Accountancy Data Network

Fanny Le Gloux, Pierre P. Dupraz

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Introduction

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Underprovision of agri-environment-climate public goods in the EU

Ambitions	Policies for the agricultural sector	Current trend
Surface water and groundwater bodies must achieve good chemical and ecological status by 2027 (2000/60/EC). Zero pollution for water for 2050 (COM/2019/640).	Nitrates Directive (91/676/EEC). Sustainable Use of Pesticides Directive (2009/128/EC). Incentives for the voluntary uptake of sustainable nutrient/chemical inputs management practices (CAP EEC/2078/92).	Good ecological status: 44% (surface water) (EAA,2021). Good chemical status: 31% (surface water), 75% (groundwater) (EAA,2021).
Put biodiversity on a path to recovery by 2030 (COM(2020)380). All ecosystems are restored, resilient, and adequately protected by 2050 (COM(2020)380).	Birds Directive (79/409/EEC). Habitats Directive (92/43/EEC). Incentives for the voluntary uptake of low-intensity management practices and maintenance of areas for nature and habitats (CAP EEC/2078/92).	Farmland bird taxa with high rates of deteriorating trends : 54% (EAA, 2020). Farmland species with good conservation status: 30% (EAA, 2020). Agricultural habitats with good conservation status: 12% (EAA, 2020).
Keep the global temperature increase well below 2°C above pre-industrial levels by 2100 (UN, 2015). Reduce net GHG emissions by at least 55%|1990 by 2030 (COM(2020)562). Net zero emissions) by 2050 (COM/2019/640).	Incentives for the voluntary uptake of carbon storage, sustainable fertiliser and manure management practices and agroforestry systems (CAP EU regulation N°1305/2013).	Agricultural GHG: -20% 2020|1990, stagnation since 2010 (EAA,2022). Emissions from livestock did not decrease (ECA, 2021). Emissions from manure and fertilisation management increased (ECA, 2021).

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Introduction

Instruments with environmental conditionality in the CAP

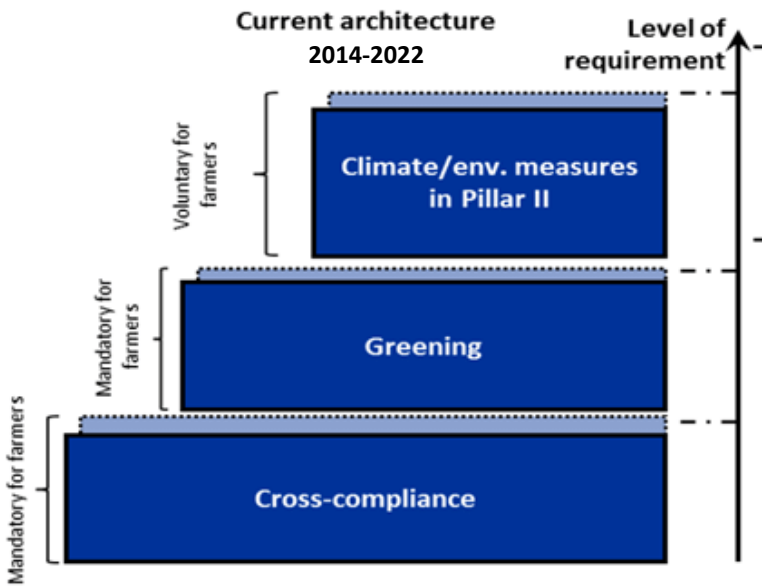
Pillar I

Market intervention
Storage, export subsidies…
€3 billion (2019)

Income support to farmers
Decoupled per ha, coupled to production…
€42 billion each year

Pillar II

Rural development policies
*Physical investment, **agri-environment-climate measures, organic farming**, Natura2000, less favoured areas, risk management…*
€14 billion from EU + €9 billion from Member States each year



5 years contractual commitments:
Area-based agri-environment-climate payments conditioned to specific practices with beneficial effect on the environment (all or part of farmland).
Area-based payments conditioned to convert to or maintain organic farming (usually all farmland).

Requirements of crop diversification, maintenance of permanent grasslands and ecological focus areas conditioning part of decoupled payments.

Penalties on the reception of CAP payments if no compliance to Directives, regulations (EU law) and a set of additional standards.

Literature review

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Environmental effectiveness of instruments until today

Cross-compliance: 85% EU UAA (EC, 2020)

- Environmental « baseline » (Matthews, 2013).
- Reduces environmental dumping but penalties are low and not correlated to damages (Dupraz and Guyomard, 2019).

Greening: 79% EU UAA (EC, 2020)

- Broad exemptions allowing a majority of farms to comply with only minor changes in agricultural practices (Matthews, 2013; Dupraz and Guyomard, 2019).
- "Greening: a more complex income support scheme, not yet environmentally effective" (ECA, 2017).

Agri-environment-climate measures (AECM): 13% EU UAA (EC, 2020)

- Support targeted towards public good provision, but mixed success (Matthews, 2013).
- Poorly designed instruments led to low and scattered participation, and insufficient effort to reach environmental thresholds (Dupraz et al., 2009; Zavalloni et al., 2019)
- Self-selection of farms with low compliance costs and environmental additionality (Uthes and Matzdorf, 2013; Duval et al., 2016; Zimmermann and Britz, 2016; Cullen et al., 2018).

Organic farming support (OFS) : 6% EU UAA (EC, 2020)

- Mixed dynamics depending on Member Sate flexible implementation (Darnhofer et al., 2019; Stolze et al., 2016).
- Public support is effective at maintaining relative competiveness, major driver of the sector development (Sanders et al., 2011; Casolani et al., 2021).

Literature review

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Levers to improve environmental effectiveness

More environmental ambition on Pillar I income support?

- Requires improving current instruments: little restrictions on practices, no environmental additionality (Grethe et al., 2018).
- Preferred option of the Commission, to cover a more significant part of EU farmland (Matthews, 2013).
- CAP 2023-2027: new « eco-schemes », voluntary for farmers (COM/2018/392; Runge et al., 2022).

More environmental ambition for Pillar II AECM and OFS?

- Flexibility to target payments towards areas where they are most effective (Dupraz and Guyomard, 2019).
- Best environmental effectiveness if well designed and targeted, better attractiveness if well funded (Batary et al. 2015; ECA, 2020).

More public good targeted support, and less "untargeted" support.

- Rather than increasing CAP budget, rebalancing Pillar I and II to reach higher environmental efficiency (Dupraz and Guyomard, 2019; Matthews, 2013).
- Monetary aspects from different sources, including income support payments, are important drivers of the decision to participate in AECM and adopt organic farming practices (Darnhofer et al., 2019; Jaime et al., 2016; Sanders et al., 2011; Van Herzele et al., 2013).

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Research question and contributions

Enhancing the CAP greening by shifting more budget to the environmental measures?

Since the 2014-2020 CAP programming period, Member States have the flexibility to transfer up to 15% of their income support budget to increase funding of Pillar 2 measures (EU, 2013).

- France: 7.5% has been redirected since 2017 (MAA, 2021).
- We aim at simulating the effect of a further reorientation of the remaining 7.5% towards voluntary environmental contracts.

  → *One option for the new CAP 2023-2027 discussed in the Working Paper SMART-LERECO n°21-03 (Chatellier et al., 2021).*

Contributions:

1. Development of an **ex-ante evaluation method** of the mechanism.
2. Modelling French farmers' environmental schemes uptake, resulting from the confrontation of **supply of environmental commitments by farmers**, and **demand from public authorities** (AECM and OFS eligibility criteria), by taking into account the effect of income support.

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Ex-ante evaluation of CAP budget reorientation

Partial equilibrium modelling (CAPRI model):

- Using income support budget to finance a non-CO_2 GHG emission-saving subsidy would reduce non-CO2 emissions by 21% by 2030 in comparison with business-as-usual (Himics et al., 2020).
- 15% of income support budget towards AECM, Natura2000 and less favoured areas has marginal impacts on land use and the environment at EU level and in Germany (Schroeder et al., 2015; Schroeder, 2021).

Linear programming:

- 50% of income support budget towards Pillar II would favour extensification of farming practices and the improvement of water quality and biodiversity in Greece (Giannakis et al., 2014).

→ Results at regional and farm type level.

→ Mechanism not assessed at the microeconomic level and for a specific transfer towards environmental schemes.

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Modelling farmers' uptake of environmental incentives

Micro-economic modelling of farmers environmental schemes uptake :

- Large literature on the uptake of AECM (Damianos and Giannakopoulos, 2002; Vanslembrouck et al., 2002; Defrancesco et al., 2008, 2018; Ducos et al., 2009; Ruto and Garrod, 2009; Giovanopoulou et al., 2011; Espinosa-Goded et al., 2013; Uthes and Matzdorf, 2013; Van Herzele et al., 2013; Unay Gailhard and Bojnec, 2015; Pavlis et al., 2016; Zimmermann and Britz, 2016; Mack et al., 2020; McGurk et al., 2020; Allaire et al., 2011; Pufahl and Weiss, 2009).
- Also on the adoption of organic farming (Koesling et al., 2008; Kallas et al., 2010; Läpple et al., 2011; Chatzimichael et al., 2014; Jaime et al., 2016).

→ Most do not account for the effect of income support.

- Overall positive effect of coupled payments on AECM adoption in Germany (Pufahl and Weiss, 2009), marginal or negative effect for extensive grassland AECM in France (Allaire et al., 2011).
- Positive effect of the decoupling of income support on the adoption of organic practices in Sweden (Jaime et al., 2016).

Materials and methods

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Methodological approach

For AECM on the one hand, and OFS on the other hand:

1. **Estimation of a model of voluntary adoption** from a sample of participants and non-participants.

Data: French Farm Accountancy Data Network (FADN). Farm-level data, representative of medium and large farms.

2 dependent variables:

Participation decision (selection equation).

Farm-level environmental payment (outcome equation).

Explanatory variables:

Income support received: coupled, decoupled

Farm and farmer characteristics

Eligibility criteria: technical orientation, region, organic certification

2. Using estimated model: prediction of new probabilities to adopt an environmental scheme and new farm-level payment triggering adoption (« acceptable payment ») if **income support is reduced by 7.5%.**
3. **Ranking of farms** according to their decreasing probability of adoption.
4. **Allocation of the additional budget** to (new) farms up to their estimated acceptable payment.

Materials and methods

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Econometric model of voluntary adoption

Generalised Tobit model (Type II) (Amemiya, 1984; Wooldridge, 2010) : simultaneous estimation of a system of 2 equations (maximum likelihood estimator).

1. **Selection equation**: estimated from the sample of participants and non-participants

$$D^* = \alpha z + \varepsilon, \qquad \varepsilon \sim N(0,1), \qquad D = \begin{cases} 1 \; if \; D^* > 0 \\ 0 \; otherwise \end{cases}$$

- $D^*$is the probability to participate (latent)
- $D \in \{0,1\}$: participation (observed)
- z : explanatory variables (observed)

2. **Outcome equation:** estimated from the sample of participants

$$P^* = \beta x + u, \qquad u \sim N(0, \sigma^2), \qquad P = \begin{cases} P^* \; if \; D^* > 0 \\ unobserved \;\; otherwise \end{cases}$$

- $P^*$is the farm-level payment triggering decision to participate (Espinosa-Goded et al., 2013) (latent).
- P is the observed farm-level payment for participating (not observed when $D = 0$)
- x: explanatory variables (observed)

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2019 FADN data

Assumptions for the allocation of 7.5% of income support to AECM and OFS:

- $541\ million\ €$ to be allocated

We keep the current 53%/47% ratio :

- $287\ million\ €$ to AECM
  - Possible recipients: all farms.

  Current participants are assumed eligible for enrolling new measures and/or more hectares.
- $254\ million\ €$ to OFS
  - Possible recipients: all farms except current participants.

  Conventional farms can adopt OFS for conversion to organic farming.

  Organic farms can adopt OFS for maintenance of organic farming.

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Descriptive statistics of the data

FADN - France 2019; N= 7,193

	Weighted mean	Standard deviation
Participation in AECM	0.11	1.99
Participation in OFS	0.07	1.64
AECM payment (€) (D=1)	7,271.39	43,754.32
OFS payment (€) (D=1)	9,978.35	74,337.98
Decoupled income support (€/ha)	184.97	779.16
Income support for suckler cows (€)	2,264.75	29,755.06
Standard gross production (1,000€)	208.40	1,433.00
Depreciation (€)	32,693.77	227,228.16
Utilised agricultural area (UAA) (ha)	90.71	499.26
Permanent grasslands (ha)	23.51	249.38
Grazing livestock density (Livestock Unit/ha)	0.52	6.18
Rented UAA (ha)	76.46	489.77
Land rent (€/ha)	661.21	1,712.28
Labour (Annual Work Unit)	2.01	13.49
Natura2000 area	0.04	1.25
Less favoured area (LFA)	0.30	2.92
LFA payments (€)	3,737.8	46,237.1
Age (years)	51.4	61.7
Certified organic	0.09	1.78

Additional covariates:
agricultural education
general education
farm type (OTEXE)
region

Results

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Model of voluntary environmental scheme uptake (weighted average marginal effects)

***p-value<0.001; **p-value<0.01; *p-value<0.05; +p-value<0.1

	AECM		OFS	
Dependent variable	Prob. adoption	Acceptable payment (1,000€)	Prob. adoption	Acceptable payment (1,000€)
Decoupled income support (100€/ha)	0.003***	0.155***	0.004***	0.599***
Income support for suckler cows (1,000€)	0.001***	0.178***	-0.001***	-0.174***
Standard gross production (1,000,000€)	-0.279***	-5.709***	-0.027***	6.087***
Depreciation (100,000€)	0.005*	1.783***	0.010***	4.182***
Utilised agricultural area (100ha)	0.081***	2.405***	0.013***	7.004***
Share of permanent grasslands	0.122***		0.037***	
Permanent grasslands (100ha)		-0.728***		2.646***
Grazing livestock density (LU/ha)	0.023***	-2.396***	-0.024***	1.141***
Share of rented land	0.035***	-1.550***	0.009***	3.511***
Land rent (1,000€/ha)	-0.013***	3.883***	-0.007***	-0.437***
Labour (AWU)	0.002***	0.226***	0.001***	-0.088***
Natura2000 area	0.075***	-0.165	-0.012***	-2.300***
LFA	-0.017***		0.000	
LFA payment (1,000€)		-0.064***		-0.203***
Age (years)	0.000	0.048***	-0.001***	0.037***
Agricultural education	0.009***	0.164***	-0.000	-0.142**
General education	0.012***	-0.179***	0.006***	-0.454***
Organic certification	0.093***	-0.609***	0.173***	-1.419***
Delayed payment received for 2018		1.095***		-1.794***
ρ	-0.188***		0.052+	
σ		5.863***		7.332***
N	7193	794	7193	525
Log likelihood	-180,231		-102,058	
Schwarz criterion	361,856		205,524	
Pseudo-R2 (McFadden)	0.12		0.33	

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Simulation: transfer of 7.5% of income support towards AECM and OFS

	Current uptake		With a budget transfer	
Scenario	AECM	OFS	AECM	OFS
Total scheme budget (1,000€)	232,345	207,844	519,338	462,790
Share of beneficiary farms	**11.0%**	**7.2%**	**17.5%**	**13.9%**
Cumulated UAA of beneficiary farms (ha)	3,860,222	1,734,725	6,523,590	3,593,359
Share of total UAA	**14.7%**	**6.6%**	**24.9%**	**13.7%**
Environmental payment of participants (€) (D=1)	7,271	9,978	10,273	11,493
Environmental payment of additional budget beneficiaries (€) (D=1)			9,110	13,116

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Does shifting more budget to the environmental measures enhance CAP greening?

- Direct effect of the budget increase:
  - Dedicating 7.5% of income support to OFS and AECM more than double their current budget → significant increase of participation in environmental schemes
- Indirect (average) effects:
  - Less income support:
    - (Marginal) decrease of AECM adoption probabilities
    - Decreases AECM acceptable payments
  - → Favours AECM adoption by livestock farms (beef and dairy) for which the model predicts the highest participation probabilities
  - Less decoupled payments :
    - (Marginal) decrease of OFS adoption probabilities
    - Decrease of OFS acceptable payments, in particular for field crop farms
  - Less coupled payments for suckler cows :
    - (Very marginal) increase of OFS adoption probabilities
    - Increase of OFS acceptable payments, in particular for grazing livestock farms
  - → Favours OFS adoption (conversion) by field crop farms

Discussion

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Limits

Difficulties in modelling AECM uptake:

In particular, the model seems to underestimate adoption probabilities for field crops farm.

Could be improved with panel data (5 years)?

But the issue of missing information in the data would remain.

Difficulties in modelling AECM uptake due to data limitations:

- Heterogeneity of measures in terms of payment per ha enrolled
- Eligibility of farmers:
  - Only in territories with an "agro-environment-climate" programme (within regions)
  - Not all measures are available in all territories…
- Heterogeneity of farmers behaviour in terms of "adoption intensity": some will enrol a small share of their UAA, others a high share…

→ Factors affecting participation decision and observed farm-level payments that we cannot capture.

Conclusion

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Policy implications

- The budget transfer mechanism increases the uptake of environment-friendly practices
- Increase of participation is less than proportionnal to the budget increase
  - Other complementary levers to increase environmental commitments attractiveness: instrument design…
  - Go beyond 15% of transfer? (in particular to reach the target of 25% of organic UAA by 2030)

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Thank you for your attention!

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