Greening Obligations, Avoidance behavior, and Farms' Environmental and Economic Performance: Insights from FADN

Greening Obligations, Avoidance Behavior, and Farms' Environmental and Economic Performance: Insights from FADN

Zelda Brutti[1][0000-0002-7017-0684], Marzia Freo[1][0000-0003-4541-5288] and Laura Serlenga [1][0000-0002-7987-4880]

[1] European Commission, Joint Research Centre (JRC), Ispra, IT

Abstract. Starting in 2014, a new European Union-wide environmental regulation aimed at curbing soil degradation and promoting biodiversity has required farmers to diversify the type of crops cultivated on their land. A significant part of Direct Payments to farmers were made conditional on compliance with Greening requirements. In this article, we estimate the causal impact of the crop diversification Greening requirement among farms. Leveraging data from the FADN survey, we examine the effects on avoidance behavior, as well as the environmental and economic performance of farms that were not previously compliant with regulatory requirements. We show that the crop diversification measure is effective in increasing the average number of crops cultivated on arable land held by holdings above 10 hectares, but also induced avoidance behavior among a portion of farms under the scope of the policy. Additionally, we identify increases in pollutant inputs per hectare. Furthermore, we observe positive shifts in total farm output consistent with some ex-ante simulations.

Keywords: Policy evaluation; Green Direct Payments.

1 The Greening Policy

Adapting to a world increasingly concerned about climate change, last cycles of the Common Agricultural Policy (CAP) have been characterized by a progressive increase in the attention to the environment; measures taken to this end included the gradual introduction of environmental criteria to be met by farmers for the allocation of direct aid. Starting with the CAP policy cycle that begun in 2014 (Regulation EU No 1307/2013), so-called `Greening' payments were introduced as a large, compulsory component of Direct Payments to farmers. This was enforced without altering the overall direct payment budget, so that funds were set aside from basic direct payments and earmarked for the Greening scheme ([1]).

Greening payments are granted at the farm-level and are meant to support farmers who adopt or maintain farming practices that contribute to the EU's environmental and climate goals. Greening components represent about 23% of the whole CAP budget, or about EUR 12 billion per year. For the individual farmer, Greening payments represent

on average 30% of all direct payments received; non-compliance with the environmental requirements leads to severe financial loss in terms of direct aid, up to 1.25 times the amount of Greening payments, and additional penalties may be imposed by national governments since 2017 ([2] and [3]).
In this article, we focus on the first Greening requirement, crop diversification (CD), which was a complete novelty of the 2014-2021 CAP cycle and was applied uniformly across the EU. The CD requirement varies according to the size of the farm's arable land (AL); the main conditions of obligation to the CD practice, set out by Article 44 of the Regulation (EU) No 1307/2013, require a) farms from 10 to 30 hectares of AL to cultivate at least 2 crops and dedicate less than 75% of AL to the main crop, and b) farms over 30 hectares of AL to cultivate at least 3 crops and dedicate less than 75% of AL to the main crop and less than 95% to the two main crops ([4]).

The Greening policies introduced to EU farming have been the subject of a number of evaluation studies over recent years, with a wide variation in terms of geographical scope and methodologies employed. The most frequently pursued objective of the existing evaluations has been quantifying the reaction of EU farmers to the new policy, in order to allow a subsequent assessment of impacts on environmental or economic outcomes. One wave of assessment studies was carried out in very early stages of the 2014-2020 CAP policy cycle, either before its implementation or in its first years, employing mostly predictive methodologies. Exiting literature also features a smaller number of ex-post evaluation studies of the Greening policy, based on actually observed data on farm behavior and changes thereof. The number of ex-post evaluations is considerably smaller than those employing modeling techniques, and a large majority focuses on specific geographic areas, such as subnational regions ([6], [7], and [8]). This paper leverages the Farm Accountancy data Network data source to explore two main aspects: 1) the responses of farmers to CD regulation, and 2) the effects of this regulation on farmers' decisions regarding land allocation, usage of pollutant inputs, and farms' performance. We present evidence on avoidance behavior by European Union farmers as a response to the Greening policy and estimate the causal effect of the CD on farms' behaviors and performance.

2 Evaluating the Impact of the Greening Policy using FADN

The Farm Accountancy Data Network (FADN) data source is employed in this study. FADN is a survey carried out each year and harmonised at the EU level regularly, with a sample of 80 000 farms across Member States (MS) from a population of 10.8 million in 2013. It collects data from commercial farms above a minimum size, and represents 50% of the EU farming population, more than 90% of the production, and the area.

Farmers under the obligation to adhere to the CD had to adhere to the requirements from 2015. This provides a time variation in the treatment which clearly provides the basis for a Differences-in-Differences (DID) causal identification strategy in the relevant population of interest provided that a control group can be found. A consideration is requested for adherence to greening requirements. Some farms already either (or do

not adhere) to standard Greening practices prior to the application of the policy. This certainly applies to the Crop Diversification measure where the empirical literature identifies a significant adherence level of farms with the crop diversification requirements, despite the policy implementation. Farms adherence to CD requirements can be assessed by exploiting the longitudinal nature of FADN, and selecting the panel of farms observed both before and after the policy's implementation, specifically from 2014 to 2018. The treated group may be formed by non-already adherent to obligation conditions farms before 2015, while the control group is formed by the already adherent ones. In this setting the interest is on how outcomes of non-already adherent farms changed conditional to CD implementation. Analyses focusing the pre-policy period reveal significant levels of heterogeneity in crop diversity across countries, farm types and sizes, types, and other structural variables. Consequently, we enhance a Propensity Score Matching (PSM) DID approach. The PSM-DID counterfactual method appears suitable for addressing such extensive heterogeneity, and the absence of a sufficiently long period to observe common trends.

The estimation of the policy impact proceeds as follows. Firstly, a propensity score model is estimated by adopting the Covariate Balancing Propensity Score method ([9]). As for the choice of matching variables, we considered: country; type of farm; sizes in hectares of arable land, vineyards, other permanent crops, permanent grassland; livestock units; and paid labour input in Annual Working Unit. Secondly, control units are matched to treated ones based on the nearest neighbor values of the estimated propensity score, after imposing the exact matching condition on country and type of farm. The process is repeated until the balancing and overlap conditions are validated. Thirdly, the impact on each outcome is estimated using a DID specification, by a regression weighted by population weights.

We conducted estimations on the panel of all farms consistently present and under the scope of the CD regulation from 2014 to 2018 for evaluating the policy's impact.

Table 1 displays the Average Treatment Effects on Treated farms, highlighting the differential changes in outcomes observed in 2017, the third year after the introduction of the CD regulation, compared to what would have occurred in its absence. The results indicate a trend of avoidance behavior among farms. Specifically, farms that were not compliant in 2014 and had Agricultural Land (AL) exceeding 30 hectares tended to downgrade to a lower AL classification with less stringent requirements. In detail, farms with 30-50 hectares of AL showed proportions that were 4.5% higher than their counterparts in the counterfactual scenario without the regulation. Similarly, farms with 50-100 hectares of AL exhibited proportions that were 2.4% higher compared to their counterparts.

Significant and consistent differences were observed in the responses to policy requirements when compared to the control group, aligning with the expected direction of the effect. On average, the regulation led to an increase of 0.819 in the number of crops grown by farms. Additionally, there were notable reductions in the shares of arable land allocated to specific crops: a decrease of 19.3 percentage points for the main crop and a 9.8 percentage point decrease for the two main crops combined.

It's also worth noting that the proportion of farms compliant with the regulation reached 71.5%. This suggests a substantial level of adherence to the policy among the

farming community, indicating the effectiveness of the regulatory measures in influencing farming practices and land allocation decisions.

The quantitative evidence indicates that there were no significant changes in “Agricultural land” for the treated farms following the policy introduction. However, there was a noticeable redistribution of land among major crop classes. Post-policy, there was a trend of reallocating land from categories like "Cereals" and "Harvested green" to "Dry pulses", "Root and tubers", and "Industrial crops". This shift suggests a strategic adjustment in crop choices by farmers in response to the policy.

Furthermore, there were significant increases in pollutant inputs, as evidenced by total expenditures on fertilisers and pesticides per hectare of utilized agricultural area.

On a positive note, there were shifts in total farm output that aligned well with some pre-policy simulations.

This suggests that while there were challenges and adjustments in response to the policy, farms were able to maintain or even improve their overall production levels. These findings underscore the complex interplay of factors at play when policies are implemented in the agricultural sector, with farms adapting in various ways to meet both regulatory requirements and economic considerations.

Table 1. Estimated ATET on listed outcomes by size of arable land (ha).

			of whom:			
	All		10-30 ha		30-50 ha	
Prevalence of intra-class movements	0.013		0.070	*	-0.045	*
N. of crops	0.819	*	0.715	*	0.852	*
Share of main crop	-0.193	*	-0.243	*	-0.165	*
Share of the two main crops	-0.098	*	-0.060	*	-0.120	*
Share satisfying requirement	0.715	*	0.692	*	0.717	*
Land in hectares allocated to						
Arable land	0.215		1.550	*	-1.181	
Cereals	-1.398	*	0.068		-2.264	*
Dry pulses	0.799	*	0.665	*	0.874	
Root and tubers	0.219	*	0.235	*	0.240	*
Industrial crops	0.976	*	0.147		0.685	
Vegetables and flowers	-0.098		-0.042		-0.032	
Fodder and fallows	-0.164		0.526	*	-0.640	
Harvested green and other arable	-0.119	*	-0.047		-0.045	
Other outcomes (value in euro)						
Pesticides per ha	5.6	*	5.6		5.5	
Fertilisers per ha	8.9	*	12.2		5.6	
Total farm output	4844	*	2899		3303	

3 Discussion

The CAP has been one of the most significant policies of the European Union (EU). In 2020, it represented 34.5% of the total EU budget. Despite efforts in recent programming periods to integrate environmental objectives, criticisms have been levied against the effectiveness of current CAP environmental measures in significantly improving environmental and climate performance. The empirical researches on ex-post evaluation of the CAP Greening Policy are often limited to regional or national case studies, and not conclusive. Consequently, there is an urgent call for sustained efforts in conducting high-quality evaluations of the CAP.

This paper present rigorous evidence, at the EU level, based on FADN data about the responses of farmers to CD regulation, and the effects of this regulation on farmers' decisions regarding land allocation. Preliminary results on environmental and economic performance are also discussed.

References

1. European Court of Auditors (2017). Greening: a more complex income support scheme, not yet environmentally effective. Special report No 21. LU: Publications Office
2. European Union (2013). Regulation No 1307/2013 of the European Parliament and the Council establishing rules for direct payments to farmers under support schemes within the framework o he common agricultural policy and repealing Council Regulation (EC) No 637/2008 and Council Regulation (EC) No 73/2009.
3. Gocht, Alexander et al. (2017). “EU-wide Economic and Environmental Impacts of CAP Greening with High Spatial and Farm-type Detail”. Journal of Agricultural Economics 68.3, pp. 651–681.
4. European Parliament (2022). First pillar of the common agricultural policy (CAP): II – Direct payments to farmers. (Apr. 2023). Financing of the CAP.
5. Bertoni, Danilo et al. (2018). “Farmland Use Transitions After the CAP Greening: a Preliminary Analysis Using Markov Chains Approach”. In: Land Use Policy 79, pp. 789–800.
6. Michalek, Jerzy (2022). “Environmental and farm impacts of the EU RDP agri-environmental measures: Evidence from Slovak regions”. In: Land Use Policy 113.
7. Kurdyś-Kujawska, Agnieszka, Agnieszka Strzelecka, and Danuta Zawadzka (2021). “The impact of crop diversification on the economic efficiency of small farms in Poland”. In: Agriculture 11.3.
8. Imai Kosuke and Ratkovic Marc (2014) Covariate Balancing Propensity Score, Journal of the Royal Statistical Society Series B: Statistical Methodology, 76(1), pp.243–263.