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Environmental assymetry between the pillars of the CAP: the case of Spain

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Abstract
The Common Agricultural Policy, which is both dynamic and systemic, has aimed to adapt with its various Reforms to the environmental challenges faced by agriculture in Europe. The 2013 Reform brought the greenest CAP and, for the first time, Pillar 1 included measures that coexisted with, and complemented, those of Pillar 2. The purpose of this study is to determine which pillar is most effective in the fight against climate change because, even though the environmental effects of the CAP have been widely studied, there have not been sufficient studies in the literature that deal simultaneously with Pillars 1 and 2. We have drawn up an environmental equation for Spain, estimated using the Driscoll-Kraay technique which is the most suitable for panel data with cross-sectional and time dependence. The model shows that the best results were achieved with the second pillar, indicating that the adaptations and changes in environmental measures under the first pillar were not satisfactory for farmers and did not achieve their full potential.

Keywords CAP · Pillar1 · Greening · Pillar 2 · Spain · Agriculture

1 Introduction

Climate change, resource depletion, pressure on elements that are essential for human life such as air or water, droughts, floods, the greenhouse effect, and famine make it necessary to consider how far the resources offered by the planet can be stretched (Theis and Tomkin, 2015; Ferrer et al., 2023). Sustainability is therefore a key objective and has become a new paradigm for achieving social and economic progress that can guarantee a good standard of living for current generations without affecting growth for future generations (Pomarici & Vecchio, 2019; Moscovici & Reed, 2018; Bermejo, 2014; Warner, 2007; UN, 2019; Muñoz et al., 2021). Although doubts have been expressed as to whether it is possible to reconcile

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development with sustainability (Bermejo, 2014; Ehrenfeld, 2005; Warner, 2007), the latter has now become a development goal for governments and institutions (Matschoss et al., 2020; UN, 2019). As a result, citizens, administrators, researchers and policy-makers are keen to find solutions for the use of resources (Costanza et al., 2016; D'Adamo et al., 2020; Drupp et al., 2018). However, this is a complex task because it involves a multitude of scale and geographical relations (Essletzbichler, 2012; Bridge et al., 2013, D'Adamo et al., 2022). Institutions are now seeking a transition towards more sustainable production and consumption systems that are based on innovations and biological materials (Falcone et al., 2019).

Environmental challenges are closely related to agriculture (Foley et al., 2005; Thomas et al., 2019). Reconciling the environment, natural resources and farming is a complex task, especially considering that, by definition, farming takes place in the natural environment (Segrelles, 2020). Over recent decades, the concept of the circular bioeconomy has been promoted, especially for the agricultural sector because it produces large volumes of waste (e.g. lignocellulose waste, animal slurry, food waste) which can be used to generate energy and fertilisers, thus reducing environmental contamination and greenhouse gas emissions; it can also create additional value for farmers and industries in the food chain (Feng et al., 2023).

In this scenario, the Common Agricultural Policy (CAP) has gradually been adapted to meet environmental requirements (Alons, 2017; Cortignani & Dono, 2019; Matthews, 2013a, b). In addition, with the Agenda 2000 in 1999, resolving problems caused by climate change became a fundamental and significant part of the gradual reforms of the CAP (Kuhmonen, 2018). The 2013 Reform was the greenest in that it considered sustainable management of natural resources and climate action, with an approach based on greenhouse gas reduction and protection of biodiversity, land and water. The Commission allocated more than one fourth of the CAP budget to an attempt to mitigate climate change and adapt to it, with measures included in Pillars 1 and 2 (Thomas et al., 2019).

Greening appeared in Pillar 1 as an ambitious environmental measure granted per hectare of farmland and benefiting farmers who were entitled to the basic payment and who used a set of stipulated practices: crop diversification on arable land, maintenance of permanent grasslands and creation of Ecological Focus Areas (Larrubia, 2017). Even so, opinions about this measure varied: the Spanish Agricultural Guarantee Fund (FEGA) described it as a positive instrument, whereas authors such as Bubbico et al. (2016), Martínez et al. (2017), Dupraz and Guyomard (2019) and Díaz et al. (2021) agreed on its low environmental efficiency.

However, the 2013 Reform did not introduce substantial changes in Pillar 2 whose instruments still covered matters such as soil, water and air quality, animal welfare, the conservation of biodiversity, environmental protection and climate resilience (Larrubia, 2017; Schulze, 2019). This was in spite of the fact that Swales (2007) had suggested that Pillar 2 could play an important role in environmental results, providing that it continued to evolve and adapt to the challenges faced by Europe. He stated that inaction was not an option, nor was the support of investments and projects that could be damaging for the environment.

So Pillar 2 remained unchanged and the focus was placed on Pillar 1, but the study carried out by Underwood et al. (2020) showed that in Germany, Ireland, France, Croatia, Latvia, Hungary, Netherlands, Portugal, Romania, Slovakia, concluded that the Pillar 2 measures were better received and had a greater impact than those of Pillar 1. The same conclusions were reached by Díaz et al. (2021), Pe'er et al. (2014), Vanni and Cardillo (2013), Armsworth et al. (2012) and Thomas et al. (2019).

Considering the frequent adjustments and constant changes in the CAP regarding how to deal with environmental matters (Reidsma et al., 2018), this study aims to identify which of the Pillars has been most effective in the fight against climate change. As a case study we focus on Spain, a traditional European and Mediterranean country in whose economy agriculture plays a key role. It could serve as an example for other member states, such as Portugal, France and Italy, which have very similar bioclimatic characteristics and patterns of farming specialisation (Jordán et al., 2011). We specify a Driscoll and Kraay panel model for the period 2015–2019, which is the same as the period covered by the 2013 Reform. The paper is organised as follows. Section 2 offers a theoretical framework of the CAP, Sect. 3 gives data on the agricultural sector in Spain, Sect. 4 describes the data and methodology used, Sect. 5 gives the results, Sect. 6 discusses them, and Sect. 7 concludes.

2 Theoretical framework

The original goals of the CAP were to provide sufficient food at affordable prices, promoting growth in productivity, modernisation and structural adjustment of the main agricultural sectors (Tracy, 1989; Treaty of Rome, 1957). However, today there is concern both globally and on a European level about the impacts of agriculture on the environment, especially those resulting from land use and climate change (Kuhmonen, 2018). Proper resource management that takes environmental considerations into account should be at the heart of environmental and agricultural policies, such as the CAP (Blackstock et al., 2021).

Two decades after it was adopted, the CAP entered a crisis. The main factor was oversupply, which led to surpluses. Eliminating these created budgetary difficulties and, especially, excessive environmental pressure caused by secondary and induced intensification. The agricultural policy model began to lose its legitimacy in a society that was showing increasing environmental awareness. It therefore became clear that the goals of the CAP had to change. In 1983, the Commission made a proposal for integral reform that was formalised in 1985, with the publication of the Green Paper and the Regulations that were implemented during the second half of the 1980s (Colino & Martínez, 2005). In 1985, article 19 of the EC797/85 Regulation was passed whereby farmers were compensated for preserving and protecting the natural environment (Boisson & Buller, 1996; Robinson, 1994). This measure was instigated by the United Kingdom but faced objections from most of the Community states, especially those in the European periphery (Whitby, 1996). An attempt to find a solution led to another proposal for agricultural production methods that would be compatible with the requirements of environmental protection (CEC, 1990). However, the severity of the budget crisis in 1987 brought back article 19 of Regulation 797/85 and implementation of Regulation 1760/87 (Knickel, 1990). These were followed in 1998 by Regulations 1094/88 and 4115/88 to limit agricultural production and surpluses (Izcara, 2001). It was only in 1992 with the McSharry reform and the adoption of direct payments that the environment was seen as an important element and accompanying measures were established, in the form of instruments for direct agri-environmental effects. In 1999, Pillar 2 was introduced as a result of reorganisation of the rural development tools, and it became clear that the CAP had to be greener (García, 2002). Although the 2003 reform focused on the decoupling of direct aid, it placed greater weight on the environmental factor, with horizontal measures in the framework of conditionality. The CAP introduced some changes and conditionality was complemented by Greening, which made its first appearance in Pillar 1. No changes were made in Pillar 2.

For the last period, 2023–2027, the CAP is currently undergoing a new process of change which aims to strengthen the measures established in 2013. It has strategic goals, including the fight against climate change, care of the environment and protection of landscapes and biodiversity (European Commission, 2018; IFOAM, 2020; Blackstock et at., 2021). Pillar 1 has introduced the Eco scheme concept, which is voluntary for farmers and aims to encourage more sustainable agricultural and land management by means of direct payments. And in Pillar 2 emphasis is placed on agri-environmental and climate measures to tackle the main challenges of the environment through rural development programmes, which are voluntary for farmers and land managers (IFOAM, 2020). Other measures related to the European Green Deal will be implemented within the CAP itself, such as carbon border adjustment or voluntary markets in carbon farming (European Parliament, 2021).

Authors such as Koning (2017) or Collantes (2020) have pointed to recurring unpragmatic or unrealistic references to the environment in the communal discourse. And in spite of many reforms of the CAP, in the European Union trends can still be found that are not promising for the environment. (Blackstock et al., 2021). It is doubtful whether the architecture of the CAP, which entered into force in 2014, will be able to effectively turn such trends around (Matthews, 2013a, b; Pe'er et al., 2014; Thomas et al., 2019). Gamero et al. (2017) conclude that the various policies adopted by the European Union (EU) have simply mitigated environmental problems in croplands rather than solving them (Blackstock et al., 2021). One explanation for this is given in Kuhmonem (2018), namely, that it is complicated for the CAP, being a complex, adaptive system that is evolving and receiving feedback, to find solutions to problems, and multi-dimensional sustainable development is one of the most inter-connected problems. It is therefore essential for studies like this one to examine the environmental effects of the measures adopted and instruments applied in the previous CAP. Emphasis should be placed not only on increasing the budget for environmental goals and the fight against climate change, but also on designing the most effective tools to be applied.

3 Case study: Spain

Today the EU is made up of 27 member states. As stated by Cortignani and Dono (2019), even though each country has different agricultural activities, greening practices have been defined in a uniform way for all of them. This means in general that studies have tended to focus on specific areas (Cortignani & Dono, 2018; Louhichi et al., 2018; Solazzo & Pierangeli, 2016) because studies on groups of territories have to make certain ad hoc assumptions (Cantelaube et al., 2012; Louhichi et al., 2017a, b). Therefore, in the changing scenario of agricultural policy, assessments of specific territories can help in decision-making (Reidsma et al., 2018).

This research focuses on Spain because: (a) there has been little research on this territory; (b) even though each territory has its own peculiarities, it can serve as an example for other similar territories (Jordán et al., 2011); and (c) in Spain, agriculture is a strategic sector that provides great economic, social, territorial and environmental value.

Spain is the second country in the EU for surface area dedicated to agriculture (23.2 Mha), second only to France (27.8 Mha), and represents almost 15% of the total EU surface area (Epdata, 2022). Over recent decades, its agricultural production has been linked to environmental deterioration (González de Molina et al., 2020). Our analysis covers the most recent phase and considers the changes brought by public regulation. In 2019, Spain generated a GVA of 26.556 b€ and employed 782,100 people. It is in fourth position within the EU-27 for the number of jobs in agriculture, behind Romania, Poland and Italy (Eurostat, 2020). However, the COVID-19 health crisis destroyed jobs. In the second quarter of 2020, up to 21,400 jobs were lost, according to the labour force survey of the Spanish National Statistics Institute. Even so, agriculture is one of the sectors that was least affected by the pandemic. Agriculture accounts for 1.2% of the European Union's GDP, and 2.4% of that of Spain (Epdata, 2022). (see Table 1). The inflationary trend caused by the Ukraine war and logistics bottlenecks have brought instability to the sector within the general framework of the fight against climate change.

The agri-food industry in Spain, with turnover of 130.796 b€, is in fourth position with 9.7% of the EU-27 total, behind France (19.7%), Germany (17.5%) and Italy (11.7%). This turnover represents 23.3% of the industrial sector, 22.1% of employed persons and 19.2% of value added. There are 30,573 firms in the food and beverage sector, accounting for 15.6% of Spain's manufacturing industry. 96.1% of them have less than 50 employees (29,389), and 79% less than 10 (24,160). The total number of people working in the food, beverage and tobacco sector is 506,200 (a drop of 2% in relation to the previous quarter). This sector's rate of female employment (39.5%) is higher than in the rest of the manufacturing sector (26.9%) (MAPA, 2022) (see Table 1). Exports by the Spanish agricultural sector represents about 16.4% of all Spanish exports. In 2020, it exported 51.4 b€, the majority to European Union countries (34.7 b€) (EC, 2021) (see Table 1).

Regarding aid from the CAP, in 2020 Spain received 6.9 b€, broken down as follows: 74.2% for Direct payments, 8.7% for Market measures and 17.1% for Rural development. This allocation is similar to that of the EU-27 as a whole, although for the latter it was higher in Rural development (25.5%) and lower in Direct payments (69.9%) and Market measures (4.6%) (European Commission, 2021). This aid represents 12.4% of the Union's total. 5.7 b€ were allocated under Pillar 1 as opposed to 1.2 b€ under Pillar 2 (17%). Of these amounts, the total allocated to environmental aid for Greening was 1.4 b€ and 0.4 b€ for Pillar 2 measures (European Commission, 2021) (see Table 2).

In Spain, emissions of CO2-equivalent dropped by − 12.5% in 2020 in the context of both the Covid-19 pandemic and a − 10.8% decrease in GDP. Emissions by the agricultural sector, which represent 14% of total emissions by Spain, increased in 2020 by 2.2% over the previous year, mostly because crops increased by 3.4% (MITECO, 2022). In terms of growth, based on MITECO (2022) data, emissions had seen fluctuations and had decreased from 1990 to 1993. In the framework of the 1992 reform and in a period of economic growth, emissions rose until 2003 subsequent to the new reform of uncoupled aid. During the final stage of growth and until the economic crisis of 2008, they dropped once again until 2013 and recovered in parallel with recovery from the crisis. Spain's emissions amounted to 8% of those of the EU as a whole (see Table 3), although its GVA was 15% of the EU figure, as shown in Table 1.

4 Data and methods

4.1 Sample and variables

The data base used is a panel in which the cross-cutting units are the Spanish Autonomous Communities and the time units cover the period 2015–2019, which is when the Green

Table 1 Basic figures on the agricultural sector in Spain and the EU-27 for 2019–2020

	Agricultural area (Mha)	GVAB of farming (MM€)	Jobs in farming (thousands of persons)	GVA of the food sector (MM€)	Jobs in the food sector (thousands of persons)	Exports of agricultural products (MM€)
Spain	23.2	26.6	782.1	26.25	506.2	51.4
EU-27	156.7	177.1	9,476,6	240.19	4,820	185.1
Proportion Spain/EU-27 (%)	15%	15%	8%	11%	11%	28%

Source: Drawn up by the authors based on data from: https://www.europarl.europa.eu/factsheets/es/sheet/104/the-common-agricultural-policy-in-figures

Table 2 CAP allocation for Spain for 2020

	Total EAGF Pillar 1 (MM€)	Total EAFRD Pillar 2 (MM€)	Greening Pillar 1 (MM€)	Environment/climate Pillar 2 (MM€)
Spain	5.7	1.2	1.4	0.4
EU-27	40.7	13.1	11	4
Share Spain/EU-27 (%)	14%	9%	13%	10%

Source: Drawn up by the authors based on data from: https://agridata.ec.europa.eu/extensions/DashboardIndicators/Financing.html?select=EU27_FLAG,1

Table 3 Greenhouse gas emissions from agriculture

	Greenhouse gas emissions from agriculture (kt CO2-eq)	Share of total emissions (%)
Spain	35,532	12.0%
EU-27	444,746	12.7%
Share Spain/EU-27 (%)	8%	–

Source: Drawn up by the authors based on data from: https://www.europarl.europa.eu/factsheets/es/sheet/104/the-common-agricultural-policy-in-figures

payment of Pillar 1 coexisted with the Agri-environmental Measures of Pillar 2. The data from the Ministry for Ecological Transition and the Demographic Challenge (MITECO), the Ministry for Agriculture, Fishing and Food (MAPA) and the Spanish Agricultural Guarantee Fund (FEGA) were normalised using the OECD (2008) method to avoid unbiased estimators. So a variable x_{it}, for a community i at time t, is normalised ($x_{it}Nor$) using the following expression: $x_{it}Nor = (x_{it} - x_{\min}/(x_{\max} - x_{\min})$, with $0 \leq x_{it}Nor \leq 1$, and where $x_{\min}$, $x_{\max}$, respectively, are the minimum and maximum values of the set of observations of x_{it}. Table 4 includes the descriptive statistics of the variables.

Finally, we drew up a data panel for the period 2015–2019, in which the dependent variable is Emissions from Agricultural Land (Y). The independent variables are the surface areas of Pillar 1 (SPI) and Pillar 2 ($SPII$). The funds allocated to each Pillar, respectively, are: ($GPPI$), ($GPPII$).

4.2 Functional form of the model

To carry out the study, we used the Pooled Cross Section Time Series technique, with Driscoll and Kraay correction (1998). This was selected because, firstly, it suits the data available because the data panel is not balanced and, secondly, to guarantee valid statistical inference with non-constant variance, $\sigma_{\varepsilon}^{2} \neq cte$, and serial error correlation, $Cov\left(\varepsilon_j, \varepsilon_l\right) \neq 0, \forall j \neq l$. In this situation, as pointed out by Hoechle (2007), traditional corrections are insufficient. Driscoll and Kraay (1998) propose estimation of the variance–covariance matrix of the

Table 4 Variables in the model

Variable	Units	Source	Mean	Std.Dev	Min	Max
Land use emissions (Y)	Kt	MITECO	716.1976	735.2871	46.68323	2,544.388
Pillar 1 land area (SPI)	has	FEGA	681,749.5	868,721.4	16,398,98	3,043,196
Pillar 2 land area (SPII)	has	MAPA	103,210.1	209,031.2	2,343.51	932,647.5
Pillar 1 public spending on environmental measures (GPPI)	€	FEGA	8.16e+07	1.14e+08	6,648,129.61	4.33e+08
Pillar 2 public spending on environmental measures (GPPII)	€	FEGA	1.88e+07	2.62e+07	197,957.55	1.36e+08

estimated parameters $\hat{\theta}$, which provides robust standard deviation with heteroskedasticity and self-correlation. That is, we propose a consistent and robust estimator $\hat{\theta}$. This method allows us to work with a larger number of observations and to reduce the collinearity of the explanatory variables. The main limitation is that the method does not provide estimations of the fixed time and cross-sectional terms for analysis of the specific impact of the time period and of the economic agents involved (Castillo et al., 2015).

We consider a model:

$$y_{it} = x_{it}'\theta + \varepsilon_{it} \quad i = 1, \dots, N;\ t = 1, \dots, T$$

in which y_{it} is the dependent variable, x_{it} is a vector $(k+1)\times 1$ of independent variables whose first element is 1; θ is a vector $(k+1)\times 1$ for unknown coefficients, i denotes cross-sectional units, and t denotes time.

It is assumed that the regressors x_{it} are not correlated with ε_{it}; ε_{it} is allowed to be self-correlated and heteroskedastic and to have cross-sectional dependence. On the basis of these assumptions, θ can be estimated by Ordinary Least Squares (OLS), resulting in:

$$\hat{\theta} = \left(X'X\right)^{-1}X'y$$

The Driscoll and Kraay standard errors for estimations of coefficients are obtained as the square roots of the diagonal elements in the matrix of asymptotic covariance ($V(\hat{\theta})$):

$$V(\hat{\theta}) = \left(X'X\right)^{-1}\hat{S}_T(X'X)^{-1}$$

in which $\hat{S}_T$ is defined as in Newey and West (1987):

$$\hat{S}_T = \hat{\Omega}_0 + \sum_{j=1}^{m(T)} \omega(j, m)\left[\hat{\Omega}_j + \hat{\Omega}_j'\right]$$

$$\omega(j, m(T)) = 1 - j/(m(T) + 1)$$

To evaluate the effect on emissions we used panel models with Driscoll and Kraay standard errors. If x_{it} is replaced by a set of exogenous variables, we obtain

$$y_{it} = x'_{it}\theta + \varepsilon_{it} = \beta_0 + \beta_1 E_{it} + \beta_2 SPII_{it} + \beta_3 GPPI_{it} + \beta_4 GPPII_{it} + \varepsilon_{it} \text{ with } i = 1, 2, \ldots, 17, \quad t = 2015, 2016, \ldots, 2019$$

The variable y_{it} takes the values of the land emissions and, as exogenous variables x, we have Pillar 1 land area (SPI), Pillar 2 land area (SPII), public spending on Pillar 1 environmental measures (GPPI) and Pillar 2 public spending (GPPII).

5 Results

Selection of the estimation procedure requires taking into consideration the nature of the data base, i.e. an unbalanced panel with a very wide cross-sectional base of Spanish Autonomous Communities over a few years, with potential heterogeneity across time and across different variables. This suggests consideration of a cross-sectional time series model. OLS estimators are the best unbiased linear estimators on condition that the u errors are independent of each other and are distributed identically with constant variance σ_u^2. Unfortunately, these conditions are not met in our panel data sample. This is indicated by the Wald test for heteroskedasticity with chi2 (17) = 1.0e + 08 and an associated p-value of zero, Prob > chi2 = 0.0000; and by the Wooldridge test for self-correlation with F (16, 66) = 47.77 and a p-value of zero, Prob > F = 0.0000.

For this reason, we used Driscoll and Kraay correction because this method corrects the estimation of the standard errors to make them consistent with heteroskedasticity and self-correction in unbalanced panels.

Stata v15 was used to draw up the estimates. Statistical significance for all tests was set at a p-value not exceeding 0.05. The results of this estimation, given in Table 5, allow us to draw conclusions about the suitability of the variables for measuring emissions and significance.

All the variables, surface areas and expenditure of Pillars 1 and 2 are significant at individual level, with a p-value of < 0.05 associated with Student's t-test. Overall, the fit of the model is good, with a p-value associated with F-Snedecor below 0.05, R-squared close to one, and mean squared error close to zero.

Table 5 Driscoll and Kraay estimation

Y	Coeff	Drisc/Kraay Std. Err	*t*	*P* > |*t*|	[95% conf. interval]	
SPI	− 0.27284	0.089187	− 3.06	0.003	− 0.45086	− 0.09482
SPII	− 0.52445	0.045863	− 11.44	0	− 0.616	− 0.43291
GPPI	1.62086	0.069228	23.41	0	1.48268	1.759039
GPPII	0.152193	0.071087	2.14	0.036	0.010302	0.294084
cons	0.061851	0.013623	4.54	0	0.034659	0.089042
F(4, 67)	665.98					
Prob > *F*	0.0000					
R-squared	0.9320					
Root MSE	0.0793					

The negative sign of the estimated parameter of the surface areas indicates the capacity for absorbing emissions of such agricultural areas, with the Pillar 2 areas contributing more to absorption. Regarding public spending, the investment under Pillar 2 leads to a better impact on the environment than under Pillar 1.

6 Discussion

Regarding Pillar 1, the ecological measure may support biodiversity, but often does not achieve its full potential because of poor design. Along the same line, Bubbico et al. (2016), Martínez et al. (2017), Díaz-Poblete et al. (2021) for Spain, and Cortignani and Dono (2019) for Italy indicate that greening has limited and controversial impacts. And, in a global study of the EU, Louhichi et al. (2017a, b) indicate that the effects of the crop diversification measure for greening are small. Pe'er et al. (2014) commented on the inefficiency of the green payment in the first Pillar even before it was set up. The reasons given include the following: (a) the weak conditions required and the limited scope of application; (b) many farms already complied with the greening measures before they were implemented in the CAP 2015–2020, because they had already been covered in Pillar 2; (c) the same requirements applied to all farms in the EU, in spite of their diversity; (d) it is more difficult for small and specialist farmers to adopt such measures (Díaz-Poblete et al., 2021; Larrubia, 2017; Martínez et al., 2017).

The results for Pillar 2 are more favourable for the environment, and this conclusion is also reached by studies focusing on Sweden, Ireland, England and Germany (Granvik et al., 2012; Natural England, 2013; Holman, 2010; Dwyer, 2013). One reason is that aid was used to change harmful farming practices. For example, in south-west England, farmers took actions to improve soil structure and reduce erosion and leaching (Natural England, 2013); in Ireland, manure processing facilities were improved on cattle farms (Holman, 2010); Germany took plans of action (Dwyer et al., 2013), and Spain acted to boost organic farming. These results are in line with the conclusions reached by Underwood et al. (2020), on a global level for the EU, who point out that measures under the second pillar contribute significantly to the biodiversity goals.

Otra explanation for these results could be that the Pillar 1 measures are mandatory whereas the Pillar 2 measures are voluntary. If farmers perceive a policy instrument as an attempt at control, their responses may be ambiguous (Bowles & Polanía-Reyes, 2012; Frey & Stutzer, 2006; Rode et al., 2015). Pillar 1 Greening measures might be seen as a means of control that imposes specific practices and reduces profitability and also poses the threat of sanctions. The Pillar 2 measures, on the other hand, might be seen as support, not only maintaining or increasing income but also allowing farmers to decide freely whether or not to participate in the agri-environmental measures, thus increasing their options (Thomas et al., 2019). Even though fewer resources are allocated to Pillar 2 than to Pillar 1, its effects are more positive for the environment. A possible explanation might the prevalence of pro-environmental preferences among farmers (Beedell & Rehman, 2000). This is in line with the study in Poland by Czyżewskiun et al. (2020) indicating that farmers are prepared to protect the environment, even if it incurs a cost for them. However, authors such as López et al. (2011), Feng and Fang (2014) and Halkos and Paizanos (2017) find that the relation between public spending and environmental quality varies. López et al. (2011) and Feng and Fang (2014) conclude that an increase in public spending does not reduce contamination. Halkos and Paizanos (2017) find that emissions increase with a country's economic growth, irrespective of the amount spent on fighting them. Thomas et al. (2019) consider the need to strengthen the EAFRD even if it means cutting back the EAGF.

7 Conclusions

We find that the measures under Pillar 2 of the CAP have been more efficient in relation to the environment in that they focus on the rural environment. Conversely, the Pillar 1 measures, which focus on the income of production agents and marketing functioning, leave environmental considerations in second place. For these reasons, the actions under the new CAP 2023–2027 should take into account the weakness of Pillar 1 and should not only implement the eco-schemes, stronger conditionality and the Farm to Fork strategy of the Green Deal but should also review other measures and tools for action in Pillar 1. In addition, the policy should be able to convince farmers that the fight against climate change presents opportunities that will enable them to gain maximum value from their efforts. At the same time it is important to consider the particularities of each territory. If measures do not take into account the needs of farmers and of the different territories, they are likely to never be put into practice or achieve environmental goals. So the CAP needs to be more adaptive and integrated (Zhou et al., 2023). Policymakers must take the development of green markets seriously and address environmental risks, taking into account co-promotion between the private and public sectors.

One of the limitations of this study is the lack of data broken down and standardised by pillars. This reduces the possibility of specifying alternative models. A possible avenue for future research would be to expand the study to the other EU countries to see if, as in Spain, Pillar 2 has been more efficient in the fight against climate change than Pillar 1.

By analysing sectoral and horizontal policy, this research provides greater insight into the effects of the CAP funds. It may be of assistance to European and national decision-makers when reviewing and structuring the goals and instruments of public regulation now that sustainability has become a keystone in the CAP and can be combined with the effectiveness of guaranteed income for European producers.

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Data availability Data sets analysed during the study are available from the authors on reasonable request.

Declarations

Conflict of interest The authors declare no conflict of interest.

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