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The political economy determinants of agri-environmental funds in the European Rural Development Programmes

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Abstract. In recent years, agricultural policies have expanded their scope to include funding for the promotion of environmental sustainability in agriculture. However, these policies have been often overlooked in the political economy literature. This article aims to investigate the factors influencing the allocation of funds towards environmental goals in the Rural Development Programmes of the European Union Common Agricultural Policy. The main findings of this study indicate a positive correlation between GDP per capita and the allocation of the environmental budget. Conversely, delegating the management of these programmes to sub-national polities has a negative impact on the budget allocation. Therefore, it seems that maintaining some central control over the budget allocation might favour the environmental sustainability of the agricultural sector.

Keywords: EU Rural Development Policy, political economy, agri-environmental schemes, environmental federalism.
JEL Codes: D72, O13, Q18.

1. INTRODUCTION

Agriculture has been historically the subject of pervasive policy interventions, even though their nature has been extensively developed over time. The general pattern is that, with economic development, interventions tend to switch from dis-incentivization toward subsidization of agricultural activities (Anderson et al., 2013). Even within high income economies the support to agriculture has substantially evolved over time, from price support, toward coupled and ultimately non-coupled subsidies (Anderson et al., 2013). Especially in high income economies, since the 1980s, the scope of government interventions has broadened from a support to production to larger shares of funds allocated to e.g. R&D (Swinnen et al., 2000), infrastructures development (OECD, 2020) and the environmental goals (Baylis et al., 2008). For example, in the European Union since the 2000s, funds of the Common Agricultural Policy (CAP) have been allocated, through the Rural Development Programmes (RDPs), to agri-environmental schemes, aimed at incentivizing the provision of environmental public goods (Matthews, 2013).

To explain the existence and persistence of agricultural policies, the literature has relied on the lens of political economy (Swinnen, 1994). A number of determinants have been empirically analysed, among the others: electoral incentives (Fałkowski and Olper, 2014), personal preferences of the legislators (Bellemare and Carnes, 2015), lobbying and institutional settings (Olper et al., 2014). However, the great bulk of the literature has focused on the determinants of the *extensive* margins of agricultural policies, i.e., to what extent the agricultural sector is affected by government interventions (Anderson et al., 2013). Surprisingly little has been said on in the *intensive* margins of agricultural policies, i.e. what determines the allocation of funds, within agricultural policies, for objectives that are beyond production or maintenance of agriculture.

The objective of this article is to assess the political economy determinants of the allocation of agricultural policy funds toward environmental goals. Our focus is on the European RDPs. The decisions on RDP fund allocations are set within a common, EU-level, framework (e.g., common priorities), but are eventually delegated to national or subnational authorities, according to the principle of vertical subsidiarity. Thus, they provide an interesting example for the issue here at stake. We address five main sets of explicatory variables: the societal demand for a greater environmental quality; the importance of the agricultural sector in the economy, which reflects into its bargaining power; the political characteristics –the ideology of the government coalitions in charge; the agri-environmental conditions of the area; and whether the RDP is managed at the national or subnational level (i.e., issue of decentralization). Using a fractional regression model, we find that the most robust determinants of environmental budget allocations are GDP per capita (positively correlated), population density and management decentralization (both negatively correlated).

The main value of the article is to complement the literature on the political economy of agricultural policies by unveiling the determinants of funds for agri-environmental goals, a topic largely ignored so far (Fredriksson and Svensson, 2003), even though on the rise (Mamun et al., 2021). Indeed, several articles focus on the determinants of *expenditures* on the agri-environmental schemes of the European RDPs (Bertoni and Olper, 2012; Camaioni et al., 2019, 2016, 2013; Glebe and Salhofer, 2007; Zasada et al., 2018), or of similar measures (Hackl et al., 2007). While expenditures and budgets are obviously connected, looking at the former adds the noise of the specific design of the measures and of the farmers uptake, and cannot be fully interpreted as a government choice (Glebe and Salhofer, 2007).

At the same time, this article also speaks to the more general literature on the relationship between institutions and environmental quality, which has not deepened the topic on agricultural policies (Dasgupta and De Cian, 2018). One of the few exceptions is the analysis by Fredriksson and Svensson (2003), who investigate the link between political instability and the stringency of environmental regulation (hence, not subsidy) faced by the agricultural sector.

Finally, we also contribute to the literature on effect of environmental policies decentralization (Droste et al., 2018; Fredriksson and Wollscheid, 2014; Sigman, 2014). The framework of the RDP implementations, that are managed by both national and subnational authorities, enables to give insights also on the consequence of policy decentralization, an issue that has been seldom investigated with respect to agricultural policies (Bareille and Zavalloni, 2020).

The results provide several policy implications. Despite the paucity of the literature on the issues, the environmental impact of the agricultural sector is a major concern (Crippa et al., 2021), and understanding the drivers of policies addressing it seems of paramount importance. Finally, decentralization of agricultural policies is often debated for the CAP reforms and our results can feed the debate revolving on it (*COM(2018) 392 final*, 2018). The remainder of the paper is structured as follows. Section 2 provides a policy background focusing on the environmental goals in agriculture and on the EU 2014-2020 programming period of the CAP. Section 3 describes selected data and implemented methods. Section 4 shows and discusses the main results. Section 5 concludes and provides some policy recommendations.

2. BACKGROUND: ENVIRONMENTAL GOALS IN AGRICULTURAL POLICIES AND IN THE EU RURAL DEVELOPMENT PROGRAMMES

Environmental goals attached to agricultural subsidies are a longstanding, albeit minor, presence. In the USA, a first example is the 1936 Soil Conservation Act, aimed at incentivizing soil conservation practices (Cain and Lovejoy, 2004). Only since the 1980s, however, in OECD countries the share of budget linked to environmentally friendly practices has substantially increased (Guerrero, 2021). Indeed in 1985 environmental protection became the main (nominal) rationale for the imple-

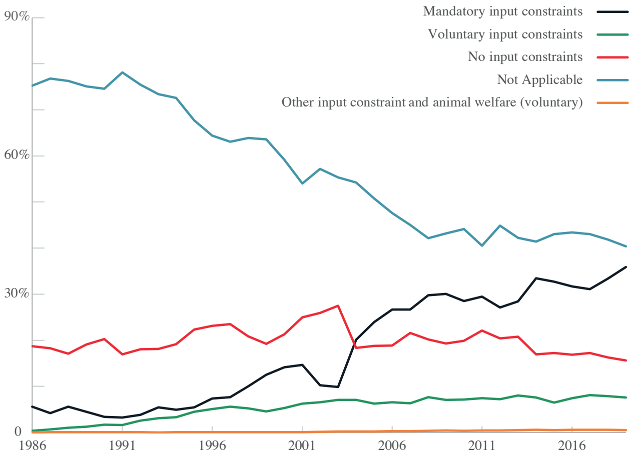

Figure 1. Share of subsidy type on the total Producer Support Estimate for a set of countries (OECD and others). Own elaboration on data from OECD (2020), downloadable at https://www.oecd.org/agriculture/topics/agricultural-policy-monitoring-and-evaluation/. For technical explanation of the variables, we refer to OECD (2016).

mentation of the USA Conservation Reserve Programme, subsidising practices aimed at e.g. improving environmental quality or providing wildlife habitat (Hellerstein, 2017). Similarly, in 1985 an EU regulation allowed member states to design incentives for farmers implementing environmentally friendly practices, even though the uptake of this possibility was rather limited (Matthews, 2013). For a set of countries (OECD and others), Figure 1 shows that most of the budget toward environmental goals is linked to general support to agriculture conditional on some forms of input constraint -*mandatory input constraints*, in Figure 1. Voluntary measures – *voluntary environmental input constraints*, in Figure 1 – such as the agri-environmental schemes have also increased over time, even though they remain limited to about 6-7% of the total support (Guerrero, 2021).

In the EU, voluntary agri-environmental measures are currently implemented within the RDPs. RDPs represent the so-called Pillar 2 of the CAP. They were first formulated in the Agenda 2000 reform, as part of a strategy to move away from coupled support and broaden the scope of the CAP (Matthews et al., 2017) and they are currently supported by the European Agricultural Fund for Rural Development (EAFRD) of the EU. Since the Agenda 2000 reform, four programming periods have taken place: 2000-2006, 2007-2013, 2014-2020, 2021-2027. A comprehensive overview of the CAP and its environmental goals is out of the scope of this paper, and we refer to e.g. Matthews (2013) for a detailed description of the topic.

The current version of the Rural Development Policy is the 2021-2027 one, which in fact has only started in 2023, i.e., with a two-year delay. It followed extensive negotiations between the European Parliament, the Council of the EU and the European Commission for the approval of the Multiannual Financial Framework of the EU (as a consequence of both Brexit process and the outbreak of the Covid-19 pandemics). Thus, due to the lack of data on the current programming period, our analysis focuses on the 2014-2020 programming period, when the RDPs were legislatively based on the Regulation (EU) No 1305/2013 of the European Parliament and of the Council, which provided the guidelines for their formulations and structure. Even though the general framework was set at the EU level and plans were approved by the EC, national authorities had some degree of freedom in implementing them (eventually increased in the current 2021-2027 programming period). First, following the vertical subsidiarity principle, member states could delegate the management of the RDPs to subnational authorities (Beckmann et al., 2009). During the 2014-2020 programming period, 20 EU Member States maintained a nation-wide implementation, while the remaining countries opted for a subnational implementation. On the one hand, Germany, Belgium, Finland, Portugal, and the UK opted for the NUTS-1 level implementation (considering either single NUTS-1 regions, e.g., the *Länder* in Germany or groups of them, as in the case of the UK). On the other, France, Italy, and Spain opted for the NUTS-2 level implementation (e.g., the *Régions* in France, the *Regioni* in Italy, and the *Comunidades Autónomas* in Spain). Second, the managing authorities – either at the national or the subnational level – chose their own allocation of funds, with some constraints, prioritising specific goals among the existing ones.

According to article 5 of the Regulation No 1305/2013, the RDP budgets, funded by the EAFRD, must be shared among, centrally determined, 6 priorities, or goals: (1) fostering knowledge transfer and innovation in agriculture, (2) enhancing farm viability and competitiveness, (3) promoting food chain organisation, (4) restoring, preserving and enhancing ecosystems related to agriculture and forestry, (5) promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy, (6) promoting social inclusion. At the same time, EAFRD budget was allocated to a set of measures, i.e., specific areas of interventions, aimed at achieving the aforementioned goals (Table 1).

Within the current framework and according to the classification provided in Table 1, environmental measures are granted a specific attention. According to article 59 of the Regulation No 1305/2013, at least 30 % of the total EAFRD contribution to each RDP shall be reserved

Table 1. Description of measures and related articles in the Regulation No 1305/2013.

Articles	Short description	RDP codes
14	Knowledge transfer and information actions	M01
15	Advisory services, farm management and farm relief services	M02
16	Quality schemes for agricultural products, and foodstuffs	M03
17	Investments in physical assets	M04
18	Restoring agricultural production potential damaged by natural disasters and catastrophic events and introduction of appropriate prevention actions	M05
19	Farm and business development	M06
20	Basic services and village renewal in rural areas	M07
21-26	Investments in forest area development and improvement of the viability of forests	M08
27	Setting -up of producer groups and organisations	M09
28	Agri-environment-climate	M10
29	Organic farming	M11
30	Natura 2000 and Water Framework Directive payments	M12
31-32	Payments to areas facing natural or other specific constraints	M13
33	Animal welfare	M14
34	Forest-environmental and climate services and forest conservation	M15
35	Co-operation	M16
36-39	Risk management	M17
40	Financing of complementary national direct payments for Croatia	M18
42-44	Leader	M19

for the following measures: M04 (only considering environment and climate related investments), M08, M10, M11, M12 (except for Water Framework Directive related payments), M13 and M15. This is to achieve specific environmental goals in the EU.

3. DATA AND METHODS

3.1. Empirical model and data

The goal of this article is to assess the determinants behind the decision to allocate funds to environmental goals in the RDPs of the CAP. The shape and type of policies result from the interactions of several elements. Similarly to other analyses (e.g. Bertoni and Olper, 2012; Fredriksson and Svensson, 2003), we argue that the resulting share of budget allocated to environmental goals is determined by the interaction among five main factors: i) the societal demand for higher environmental quality, ii) the bargaining power of the agricultural sector, iii) the political environment, iv) the environmental conditions of the area, v) the polity level that manages the funds. Our expectation is that higher demand for environmental quality will be translated into relatively larger budget for environmental goals. At the same time, low environmental quality will also call for larger budget for environmental goals. However, while the funds we are investigating are targeting agriculture, the sector might prefer support to investments and efficiency, rather than sustainability goals, and hence greater bargaining power would result in lower budget for environmental goals. The political environment builds upon those two blocks. Party ideology and the composition of the government might filter the general preferences of the public. Moreover, decentralization of agri-environmental policies, while might result in better targeting of local public goods, could end up in free-riding behaviour due to spillover effects.

In the next paragraph, we describe the dependent and the explanatory variables that we use to proxy the aforementioned elements. Given the structure of the RDP managing authorities, the analysis is grounded on a territorial basis. Indeed, our units of analysis are the polities covered by each RDP managing authority, either at national or sub-national level. For the current analysis, we consider 100 RDPs and the related polities, excluding from the full set: i) the French DOM (namely, Guadeloupe, Guyane, La Réunion, Martinique and Mayotte) due to data availability, ii) the UK RDPs, for the difficulties to account for the functioning of the local (i.e., subnational) polities in that country, and iii) the national level RDPs, when the lower tiers are the main managing authorities (i.e., in the case of France, Italy, Spain).

The dependent variable is represented by the share of the RDP budget allocated to environmental measures in year 2014 (i.e., considering the first budget allocation). To operationalize the preferences for environmental goals we address the constraint set by article 59 of the Regulation No 1305/2013, in terms of both key measures and minimum budget allocation (see Section 2). We define our dependent variable, *M-environment* as the ratio between the RDP funds for environmental goals (i.e., budget allocated to measure 4, measure 8, measure 10, measure 11, measure 12, measure 13, and measure 15) that go beyond the minimum level fixed by the EU Regulation and its complementary. For example, imagine the RDP budget is 100€, and budget allocated to environmental goals is 37€. Our dependent variable is given by 7/70.

As robustness check, we also run two additional models. In the first one, we define the dependent variable as the share of the budget (year 2014) allocated to priorities (4) "restoring, preserving and enhancing ecosystems related to agriculture and forestry" and (5) "promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy" (*P-environment*); in the second one, we define the dependent variable as the share of the budget (year 2014) allocated to agri-environmental schemes only, i.e. to measure 10 (*M10*).

Figure 2 shows the rather uneven allocation of *M-environment*, *P-environment*, and *M-10* at the programming level across the EU. Data on the RDP budget allocations have been collected from the European Commission website (https://cohesiondata.ec.europa.eu/) and in all cases we considered the total financing, i.e., including both the EU EAFRD funds and the national co-financing. In particular, Table 2 returns the main descriptive statistics for the alternative specifications of the dependent variables.

We now turn to the set of explicatory variables. When considering them, the first dimension we address is the demand for environmental quality. Following previous research (e.g. Franzen and Vogl, 2013), we take into account GDP per capita and population density as a proxy for the societal demand for environmental quality. The large literature on the environmental Kuznets curve indicates that, after a certain threshold, income is a key driver of environmental quality and policy implementation (Dasgupta et al., 2002; Dinda, 2004; López and and Mitra, 2000; Maddison, 2006). Moreover, we use population density as a proxy for the degree or urbanization, which is also expected to be positively correlated to higher environmental quality, and hence higher share of budget allocated to environmental goals (e.g. Franzen and Vogl, 2013).

The second element is the economic relevance of the agricultural sector. A larger magnitude of the agricultural sector might turn into a larger bargaining power of the sector itself, which, we argue, eventually turn into a reduction of the support to environmental measures in the RDP (Fredriksson and Svensson, 2003). However, following Olson (1971), even the counterargument can be made: the larger the sector, the more is difficult to coordinate and hence the lower the bargaining power. To have proxies for the bargaining power of the agricultural sector, we rely on three indicators: share of utilised agricultural area with respect to the total area of the relevant polity, number of farmers per million inhabitants and share of Gross Value Added of agriculture out of the total Gross Value Added.

As a third group of variables, politics aspects are considered. In terms of politics, first, we consider the ideology of the government in charge. Several papers find that ideology plays a role in the level of protection and support to agriculture (Klomp and Haan, 2013; Olp-

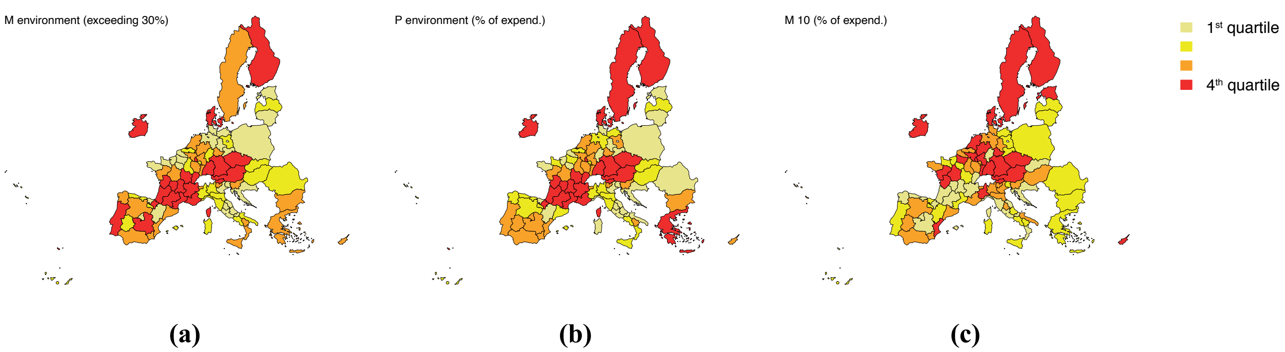

Figure 2. Allocation of environmental budget across the EU in 2014: a) M-environment, b) p-environment, and c) M-10. Source: authors' elaboration.

Table 2. List and description of the variables included in the models, by type.

	Name	Meaning	Year	Specification	Source	Mean (Std. Dev.)
Dependent variables	M-environment	Ratio of the share of the total RDP budget allocated to measure 4, measure 8, measure 10, measure 11, measure 12, measure 13, and measure 15 exceeding minimum (30%) over the total range.	2014	Share	cohesiondata.ec.europa.eu	0.27 (0.18)
	P-environment	Share of the total RDP budget allocated to priority 4, and priority 5	2014	Share	cohesiondata.ec.europa.eu	0.52 (0.12)
	M10	Share of the total RDP budget allocated to measure 10	2014	Share	cohesiondata.ec.europa.eu	0.15 (0.08)
Environmental demand	Density	Population density (thousand inhab. per square km)	avg. 2010-2014	continuous (1000 inhab.)	Eurostat - Population density	0.17 (0.19)
	GDP	Per capita income (in thousand €)	avg. 2010-2014	continuous (1000€)	Eurostat - GDP at current market prices by NUTS 2 regions	25.71 (7.86)
Bargaining power of agriculture	UAA_share	Utilised Agricultural Area (UAA) out of total land area	2013	share	Eurostat – Farm Structure Survey	0.41 (0.15)
	Farm per mill inhab	Number of farms per million inhab.	2013	continuous	Eurostat – Farm Structure Survey	19.92 (22.81)
	GVA_share	% of Agricultural Gross Value Added out of total Gross Value Added	2013	%	ARDECO database	2.85 (1.95)
Politics	Parties	Number of parties in the cabinet that was in charge at the date of approvation of the RDP	-	continuous	Authors' elaboration on Döring and Manow, (2020) Schakel and Massetti, (2018)	1.90 (1.00)
	Left_right	Average position of the cabinet in terms of its overall ideological stance (from left to right), by considering the position of each party in the coalitions (weighted by the number of their seats)	-	continuous (0 = Extreme left to 10 = Extreme right)	Authors' elaboration on Döring and Manow (2020), Schakel and Massetti (2018), Polk et al. (2017)	4.30 (1.70)
Agri-environmental conditions	N_sur_kg_ha	Average Nitrogen surplus (kg per ha), based on 16 Nitrogen surplus estimates	avg. 2010-2014	continuous	Batoo et al. (2022)	35.35 (18.15)
	Animals_ab	Thousand cows and live swines per thousand inhab.	avg. 2010-2014	continuous	Eurostat - Animal populations by NUTS 2 regions	0.57 (0.67)
	HNV	Share of high nature value (HNV) farmland out of the total area	2012	%	Authors' elaboration on European Environment Agency (EEA) data on the basis of the Corine Land Cover (CLC) accounting layers	18.76 (14.06)

(Continued)

Table 2. (Continued).

	Name	Meaning	Year	Specification	Source	Mean (Std. Dev.)
	Erosion moderate-severe	Share of agricultural areas, forest and semi natural areas under moderate or severe level of erosion, out of the total agricultural areas, forest and semi natural areas	2010	%	Eurostat - Estimated soil erosion by water, by erosion level, land cover and NUTS 3 regions (source: JRC)	17.19 (15.88)
NUTS	Nuts	RDP being managed at the sub-national level	-	Dummy	authors' elaboration	
Control variables	Pop	Total resident population	avg. 2010-2014	Continuous (million inhab.)	Eurostat - Population	4.33 (5.23)
	EEC	RDP belonging to an Eastern Europe Country	-	Dummy	authors' elaboration	

er, 2007) as well as for the level of environmental protection (Pacca et al., 2020). Following Klomp and Haan (2013), we address the ideology of the whole government cabinet (rather than simply the government head) by computing the average position of the cabinet in terms of its overall ideological stance (from left to right). Polk et al. (2017) computed ideological stance of EU parties, by assigning each of them a position on a scale from 0 (extreme left) to 10 (extreme right). Parties on the economic left wanted government to play an active role in the economy, while those on the economic right emphasized a reduced economic role for government: privatization, lower taxes, less regulation, less government spending, and a leaner welfare state. For the sake of our analysis, and as a reference point, we take the average score for the whole cabinets that were in charge of the relevant polity in the period up to the approval of the first RDP version, i.e., in most of the cases year 2014. Note that regional politics might be more complex than the national one, as regional parties are often a key player in local elections and hence governments and the local institutional architectures exhibit a great degree of heterogeneity across EU Member States (Schakel, 2013; Schakel and Massetti, 2018). Second, we also consider the number of parties that compose the government coalitions. This has been considered to affect state expenditures (Perotti and Kontopoulos, 2002) and protection to agriculture (Beghin and Kherallah, 1994).

The fourth element we address is the agri-environmental conditions of the relevant polities to which the RDPs refer. Agri-environmental measures are aimed at reorienting the sector toward more environmentally friendly practices, thus the lower the agri-environmental quality of the area, the higher the agri-environmental funds should be (Bertoni and Olper, 2012). As a proxy for environmental quality, we use four indicators: average Nitrogen surplus, number of animals (cows and live swine) per thousand inhabitants, share of high nature value (HNV) farmland out of the total area, share of agricultural areas, forest and semi natural areas under moderate or severe level of erosion. All of them are expected to be negatively correlated to environmental quality, but the share of HNV farmland.

Lastly, we address whether the RDP was managed at the national level, or if its implementation was delegated to lower tiers. We consider such an element because it is a structural characteristic of (some) RDPs, which in fact has been usually disregarded by the political economy literature of agricultural policies (as they are mostly set at the national level). However, the variation in the polity level decision making, within the same policy framework, enables to explore the effect of decentralization on (agri-) environmental policies and hence to add results to the increasing literature on environmental policy decentralization (Fredriksson and Wollscheid, 2014) and more in general on the environmental federalism (Shobe, 2020).

In addition to the previous explanatory variables, in any of the selected models we also add two variables to control for population size and Eastern European Countries (EEC). Population size is crucial to disentangle the effect of decentralization, holding the demographic size of the polity constant. The inclusion of a geographical dummy for EEC addresses the 20th-century historical differences across Europe. The list of the variables and their sources is listed in Table 2.

3.2. Econometric strategy

In the framework of the CAP, different polities manage different budget size. To control for it, we focus on the relative share of the total budget for environmental goals, rather than on its absolute value. However, fractional dependent variables – as the one under consideration here – pose some methodological challenges.

The first challenge is related to the functional form of the model (Ramalho et al., 2011). Firstly, fractional dependent data (as in this case) are bounded only within the [0, 1] interval, whereas standard econometrics generally assumes normally distributed dependent variables (Ronning, 1990). Secondly, a "negative bias" (Aitchison, 1986, p. 53) affects them, as fractional dependent variables add up to one. Even in the case of more than two categories, there will be always at least one pair of negatively correlated shares. Due to these specific properties, conventional regression models – which simply ignore the bounded nature of the dependent variable and assume a linear conditional mean model for it – should be avoided. Some scholars opted for assuming the logistic relationship, preferring to estimate by least squares the log-odds ratio model. However, this empirical strategy has some important drawbacks (see Ramalho et al., 2011 for details).

For the sake of this analysis, we adopt the fractional regression models, as originally modelled by Papke and Wooldridge (1996). Following their approach, the simplest solution for dealing with fractional response variables only requires the assumption of a functional form for y that imposes the desired constraints on the conditional mean of the dependent variable, i.e. $E(y|x) = G(x\theta)$, where G(·) is a known nonlinear function satisfying $0 \le G(\cdot) \le 1$. Papke and Wooldridge (1996) suggested as possible specifications for G(·) any cumulative distribution function. Among alternative choices, the logistic function is considered as an obvious choice, hence: $E(y|x) = \frac{e^{x\theta}}{1+e^{x\theta}}$. As suggested by Papke and Wooldridge (1996), this function may be consistently estimated by using the robust quasi-maximum likelihood (QML) method, which is based on the Bernoulli log-likelihood function (see Ramalho et al., 2011 for deeper details).

With regard to the empirical strategy, we estimate – for each of the dependent variables, i.e., *M-environment*, *P-environment* and *M10*, – six alternative models, as it follows:

$$\mathbf{Y} = \boldsymbol{\beta}_d\mathbf{D} + \boldsymbol{\beta}_a\mathbf{A} + \boldsymbol{\beta}_p\mathbf{P} + \boldsymbol{\beta}_e\mathbf{E} + \boldsymbol{\beta}_r\mathbf{R} + \boldsymbol{\beta}_c\mathbf{C} + \boldsymbol{\varepsilon} \quad (1)$$

$$\mathbf{Y} = \boldsymbol{\beta}_d\mathbf{D} + \boldsymbol{\beta}_c\mathbf{C} + \boldsymbol{\varepsilon} \quad (2)$$

$$\mathbf{Y} = \boldsymbol{\beta}_a\mathbf{A} + \boldsymbol{\beta}_c\mathbf{C} + \boldsymbol{\varepsilon} \quad (3)$$

$$\mathbf{Y} = \boldsymbol{\beta}_p\mathbf{P} + \boldsymbol{\beta}_c\mathbf{C} + \boldsymbol{\varepsilon} \quad (4)$$

$$\mathbf{Y} = \boldsymbol{\beta}_e\mathbf{E} + \boldsymbol{\beta}_c\mathbf{C} + \boldsymbol{\varepsilon} \quad (5)$$

$$\mathbf{Y} = \boldsymbol{\beta}_r\mathbf{R} + \boldsymbol{\beta}_c\mathbf{C} + \boldsymbol{\varepsilon} \quad (6)$$

Where:

- **Y** is the (n × 1) vector, where n = 100, indicating the share of budget allocation devoted to the environmental issues, according to alternative specifications (*M-environment, P-environment* and *M10*).
- **D** is the (n × 2) matrix of the proxies for the demand for environmental quality and $\boldsymbol{\beta}_d$ is the (2 x 1) vector of respective unknown parameters.
- **A** is the (n × 3) matrix of agricultural sector variables and $\boldsymbol{\beta}_a$ is the (3 × 1) vector of respective unknown parameters.
- **P** is the (n × 2) matrix of politics and polity variables and $\boldsymbol{\beta}_p$ is the (2 × 1) vector of respective unknown parameters.
- **E** is the (n × 4) matrix of environmental-quality variables and $\boldsymbol{\beta}_e$ is the (4 × 1) vector of respective unknown parameters.
- **R** is the (n × 1) vector of decentralization variable and $\boldsymbol{\beta}_r$ is the respective unknown parameter,
- **C** is the (n × 2) matrix of control variables and $\boldsymbol{\beta}_c$ is the (2 × 1) vector of respective unknown parameters.
- **ε** is the (n × 1) vector of error terms.

The implementation of the fractional regression models was performed by using the software R (R Core Team, 2021).

4. RESULTS AND DISCUSSION

Table 3 reports the results of all the models. Across model specifications, three are the most robust results. First, the results indicate that *GDP* is positively correlated with the budget allocated to environmental goals (see section 3 for the description of the dependent variables). This result is in line with the large literature on the relationship between economic development and environmental quality (Grossman and Krueger, 1995) and with previous results on the political economy determinants of the stringency of environmental regulations to agricultural activities (Fredriksson and Svensson, 2003). Note that even *expenditures* on agri-environmental measures are found to be positively correlated to the GDP per capita of the area (e.g. Bertoni and Olper, 2012). The result is robust to the model specification being positive and significant also when *GDP* is isolated from the other variables (model 2) and with different specification of the dependent variables (P-environment and M-10). The odd ratios (Table 4) indicate that an increase by €1000 in GDP per capita induces an increase by 3.2% in the budget allocated to M-environment. Second, *DENSITY* is negatively correlated to budget for environmental goals. This is in contrast with our expectations, i.e., on the intuition that more urbanized areas would have demanded for a higher allocation of funds to the environmental goals. One interpretation of this result might lie in the idea that, at the EU level, population density actually captures other dimensions than per capita income, both in the North and in the South of the continent. The odd ratios indicate that additional 1000 inhabitants per square kilometre translate in a large reduction for the environmental budget (M-environment) (almost by 91%), an effect that is larger than the (positive) effect of *GDP*.

Third, decentralization (*NUTS*) is negatively correlated to the environmental budget. The dummy indicating a subnational polity is statistically significant and negatively correlated to the environmental budget share in any model specification. The literature on the topic is rather ambiguous and finds that the impact of decentralization on the allocation of funds to the environmental goals depends on the type of pollutants taken into account (Fredriksson and Wollscheid, 2014; Sigman, 2014, 2005). In our case, the result seems to indicate that decentralization would lead to a race to the bottom (Millimet, 2003) in allocating environmental budgets in the RDPs. While further analyses are required to understand the mechanisms behind it, such a result can also be interpreted in terms of governance scope (Schakel, 2009). For example, in Italy only some policy aspects are delegated to regional administration (health policies, for example), and hence, probably, a greater grip from lobbying is on them. The odd ratios suggest that decentralization has a strong effect: the delegation to lower government tiers induce a reduction in the budget allocated to *M-environment*, *P-environment* and *M-10* by respectively 61%, 45% and 36%.

Turning to the politics aspect of our problem, the number of parties that compose a cabinet is negatively correlated to the different proxies for environmental budgets (and significant in most of the models' specifications). This might suggest that environmental public goods require greater political coherence, in order to be funded. However, ideology seems not to be linked to any preferences for environmental budget allocation, as the coefficient for LEFT_RIGHT is non-significant. However, the effect of politics on budget allocations deserves a more comprehensive analyses, where e.g. electoral incentives are explicitly accounted for (List and Sturm, 2006; Pacca et al., 2020). Moreover, we only consider the government coalition in charge of the first version of the RDPs, to better address the effect of ideology it would be interesting to assess how changes in the government coalitions impact on the RDP budget allocations.

Surprisingly, the proxies for the bargaining power of the agricultural sector are all non-significant in any model specifications. To this regard, it is important to consider that we are analysing fund allocation among different goals but whose ultimate target is anyhow the agricultural sector. Probably, farmers preferences among the goals gets watered and no clear priority emerges. Note however that, when focusing on real expenditures rather than allocations, Zasada et al. (2018) also find that the agricultural bargaining power (proxied by the share of agricultural area) have little explanatory power. Similarly, Bertoni and Olper (2012) find a complex relationship between share of population working in agriculture and expenditures devoted to agri-environmental schemes.

Finally, a complex picture is drawn from the analysis of the agri-environmental conditions. The HNV and the nitrogen surplus are respectively negatively and positively correlated to the share of budget allocated to *M10*. When considering the other two dependent variables, the signs of the coefficients are reversed. This difference might be due to the different characteristics of each dependent variable under consideration. Actually, while measure 10 only supports activities that are strictly linked to agri-environmental measures and that represent a cost from the farmers point of view, other dependent variables encompass a broader set of interventions, including investments for higher resource efficiency.

5. CONCLUSIONS AND POLICY RECOMMENDATIONS

In this work, we analyse the political economy determinants of the share of the budget allocated for environmental goals in the EU RDPs, by considering the 2014-2020 programming period. The main idea is that such a budget is the result of some main determinants: i) demand of environmental quality, ii) bargaining power of the agricultural sector, iii) characteristics of the politics of the RDPs managing authorities, iv) environmental quality of the area; and v) tier levels of the RDPs managing authorities (national vs subnational levels). While a substantial literature has addressed the political economy of the support to the agriculture, very little has been said on the determinants of policies targeting the sustainability of the agricultural sector. In comparison to previous articles – which mostly addressed the determinants of the ex-post expenditures on agri-environmental schemes – the focus on budget allocation allows us to put a greater emphasis on the determinants of the political decision process behind the choice of allocating funds to the environmental goals rather than to other goals (often competing with each other).

Table 3. Results of the models (robust standard errors in parentheses).

	M-environment						P-environment						M-10					
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
(Intercept)	0.243	-1.571 ***	-0.558 *	-0.789 *	-0.835 **	-0.108	0.903 *	-0.292 °	0.268 °	0.322 *	0.301 *	0.613 ***	-2.005 ***	-2.629 ***	-1.908 ***	-2.207 ***	-1.676 ***	-1.325 ***
	(0.774)	(0.268)	(0.251)	(0.310)	(0.284)	(0.224)	(0.373)	(0.150)	(0.149)	(0.158)	(0.140)	(0.131)	(0.411)	(0.192)	(0.235)	(0.187)	(0.165)	(0.208)
Density	-2.401 *	-2.450 *					-0.699 *	-0.613					-0.872 **	-0.927 **				
	(1.192)	(1.085)					(0.330)	(0.463)					(0.268)	(0.326)				
GDP	0.032 °	0.035 ***					0.019 *	0.019 **					0.017 °	0.035 ***				
	(0.016)	(0.010)					(0.009)	(0.006)					(0.009)	(0.007)				
UAA_share	-0.514		-0.920				-0.148		-0.246				0.204		0.414			
	(0.794)		(0.751)				(0.412)		(0.395)				(0.490)		(0.575)			
Farm per mill inhab	-0.002		0.003				0.000		0.000				-0.003		-0.007			
	(0.005)		(0.005)				(0.002)		(0.002)				(0.003)		(0.004)			
GVA_share	-0.020		-0.032				-0.009		-0.027				0.033		0.005			
	(0.057)		(0.064)				(0.029)		(0.031)				(0.037)		(0.051)			
Parties	-0.270 ***			-0.077			-0.151 ***			-0.077 °			0.022			0.096 °		
	(0.075)			(0.094)			(0.040)			(0.045)			(0.054)			(0.057)		
Left_right	-0.066			-0.023			-0.058 *			-0.026			0.040			0.045		
	(0.053)			(0.047)			(0.025)			(0.024)			(0.034)			(0.036)		
N_sur_kg_ha	0.004				-0.003		-0.001				-0.003		0.007 **				0.006 *	
	(0.005)				(0.006)		(0.003)				(0.003)		(0.002)				(0.003)	
Animals_ab	-0.225				-0.102		-0.072				-0.041		-0.107 °				-0.029	
	(0.172)				(0.185)		(0.069)				(0.093)		(0.057)				(0.071)	
HNV	0.015 *				0.015 *		0.007 *				0.006 °		-0.010 *				-0.010 *	
	(0.006)				(0.007)		(0.003)				(0.003)		(0.005)				(0.005)	
Erosion moderate-severe	-0.008				-0.016 **		-0.006 *				-0.010 ***		-0.003				-0.008 °	
	(0.006)				(0.006)		(0.003)				(0.003)		(0.005)				(0.004)	
NUTS	-0.950 **					-0.938 ***	-0.593 ***					-0.558 ***	-0.442 *					-0.565 **
	(0.341)					(0.216)	(0.160)					(0.134)	(0.187)					(0.200)
Pop	0.007	0.018	0.002	0.007	0.006	-0.015	-0.001	0.002	0.000	0.003	0.003	-0.007	0.009	0.025	0.023	0.023	0.007	0.015
	(0.025)	(0.022)	(0.019)	(0.019)	(0.020)	(0.020)	(0.010)	(0.010)	(0.009)	(0.009)	(0.010)	(0.008)	(0.015)	(0.015) °	(0.016)	(0.015)	(0.013)	(0.014)
EEC	-0.996 **	-0.479	-0.562 °	-0.408	-0.708 *	-1.208 ***	-0.639 **	-0.247 *	-0.328 *	-0.257 *	-0.485 **	-0.793 ***	-0.478 °	-0.070	-0.116	-0.432	-0.209	-0.732 *
	(0.380)	(0.299)	(0.317)	(0.286)	(0.324)	(0.824)	(0.198)	(0.126)	(0.135)	(0.126)	(0.148)	(0.157)	(0.287)	(0.255)	(0.264)	(0.271)	(0.252)	(0.285)
Obs.deleted (missing)	4	0	0	4	3	0	4	0	0	4	3	0	4	0	0	4	3	0
Efron pseudo R-squared	0.402	0.233	0.055	0.030	0.091	0.142	0.389	0.144	0.066	0.078	0.131	0.161	0.384	0.239	0.089	0.076	0.204	0.136

Table 4. Results of the models – odd ratios.

	M-environment						P-environment						M-10					
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
(Intercept)	1.275	0.208	0.572	0.454	0.434	0.898	2.466	0.747	1.307	1.380	1.352	1.846	0.135	0.072	0.148	0.110	0.187	0.266
Density	0.091	0.086					0.497	0.542					0.418	0.396				
GDP	1.032	1.036					1.019	1.019					1.017	1.035				
UAA_share	0.598		0.398				0.863		0.782				1.227		1.513			
Farm per mill inhab	0.998		1.003				1.000		1.000				0.997		0.993			
GVA_share	0.981		0.969				0.991		0.973				1.034		1.005			
Parties	0.764			0.926			0.860			0.926			1.022			1.101		
Left_right	0.936			0.977			0.944			0.974			1.041			1.047		
N_sur_kg_ha	1.004				0.997		0.999				0.997		1.007				1.006	
Animals_ab	0.798				0.903		0.931				0.960		0.898				0.972	
HNV	1.015				1.015		1.007				1.006		0.990				0.990	
Erosion moderate-severe	0.992				0.984		0.994				0.990		0.997				0.992	
NUTS	0.387					0.391	0.553					0.572	0.643					0.569
Pop	1.007	1.019	1.002	1.007	1.006	0.985	0.999	1.002	1.000	1.003	1.003	0.993	1.009	1.025	1.023	1.024	1.007	1.015
EEC	0.369	0.619	0.570	0.665	0.493	0.299	0.528	0.781	0.720	0.773	0.616	0.452	0.620	0.932	0.890	0.649	0.812	0.481

The analysis shows that the determinants behind the allocation of the European Rural Development Policy budget to environmental goals are similar to those found in the literature concerning environmental policies in general. The results seem to show the critical role played by an increase in the average wealth (as proxied by GDP per capita) favouring a larger environmental support. This result is not new – being in line with previous literature– but it is confirmed also for the EU RDP. Moreover, different proxies for the lobbying power of the agricultural sector (as proxied by the UAA, the number of farms, and the agricultural GVA) show no significance, hence the supposed competition between the agricultural support on the one hand and a broader support toward multifunctionality, and the environment in particular, on the other does not find strong support. Decentralization is linked to lower budgets allocated to environmental goals and display a strong effect.

The combination of the effect of per capita income and of decentralization seems to suggest that delegating RDPs management to subnational authorities might be particularly problematic, given the high heterogeneity of development across European regions. The results seem to indicate that, if environmental issues are at stake, maintaining a relatively centralized grip on the environmental budget would be desirable. To this regard, the decision undertaken in the implementation of the current 2021-2027 RDPs can be considered as positive for the implementation of a policy more in favour of agri-environmental targets. Indeed, the Regulation No 2115/2021 sets that all new rural development actions will be incorporated into national-level CAP strategic plans, establishing specific rules on support for strategic plans to be drawn up by EU countries under the common agricultural policy.

The emerging results are insightful, despite the existence of some possible shortcomings in the work. For example, the choice of a cross-sectional analysis, rather than a panel one, might somehow affect this analysis, due to the potential presence of unobserved heterogeneity. However, it seems not possible to compare expenditure patterns across different programming periods, due to the large changes that have always affected Rural Development Policy over time. Thus, further analysis will not only address these possible flaws. It should also seek to further disentangle the drivers of environmental budget allocation, including robustness checks, such as controlling for alternative proxies for the main effects admitted at impacting the environmental budget allocation, and a throughout assessment of the effect of government party's composition on it.

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