Analysis of EU investment on rural development and its impact on Portuguese rural regions in the period 2011-2021

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ABSTRACT: EU's rural areas are an essential part of the European way of life, covering more than 75 % of the Union's territory and housing over 25 % of its population. However, they experience major imbalances compared to urban areas. Thus, it is important to analyse whether EU's rural development (RD) policy is effective in promoting the development of rural areas. This study uses a RD index for 9 Portuguese NUTS 3 regions, with data from 2011 and 2021. The results are then compared with the financial support delivered by EU funds and show their impact on RD in Portugal.

Análisis de la inversión de la UE en desarrollo rural y su impacto en las regiones rurales portuguesas en el periodo 2011-2021

RESUMEN: Las zonas rurales de la UE, que representan más del 75 % del territorio y el 25 % de la población, son un elemento crucial del modo de vida europeo. Sin embargo, experimentan grandes desequilibrios frente a las zonas urbanas. Así, es importante analizar si las políticas de desarrollo rural (DR) de la UE son eficaces para promover el desarrollo de estas regiones. Este estudio utiliza un Índice de DR en 9 regiones NUTS-3 portuguesas (datos de 2011 y 2021). Los resultados se comparan con el apoyo financiero de los fondos europeos y muestran su impacto en el DR.

KEYWORDS / PALABRAS CLAVE: Rural development, indicators, Portugal / Desarrollo rural, indicadores, Portugal.

JEL classification / Clasificación JEL: Q01, Q13.

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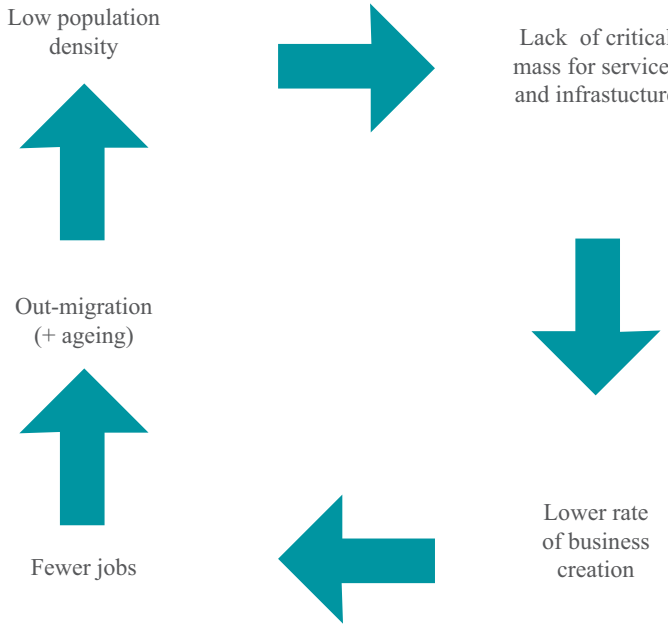
1. Introduction

1.1. Rural Areas and the monitoring of their development

Traditionally, rural areas are seen as lagging behind urban areas and economically weaker, with fewer opportunities for young people (Hennebry & Stryjakiewicz, 2020). In fact, by the second half of the 20th century, agricultural activity began to lose its economic and social relevance in many rural territories in the West, especially in Europe, leading to an ageing population, lower activity rates and higher illiteracy (Baptista, 2006). In the early 21st century, OECD even referred to the "circle of declining rural regions" where low population density due to out-migration and ageing leads to a lack of critical mass for services and infrastructure, low rates of business creation, and fewer job opportunities (OECD, 2006) (Figure 1).

FIGURE 1

The circle of declining rural regions



Source: (OECD, 2006)

In just one decade, the European territory classified as rural areas has decreased from more than 91 % to just over 75 %, and its population has fallen by more than a half to just 25.2 % of the European population in 2021 (Eurostat, 2022).

Although EU's rural areas are widely recognised and valued for food production, natural resource management, protection of natural landscapes, recreation and tourism, there is a general concern about the erosion of rural infrastructure and service provision, as well as shrinking employment opportunities, declining incomes or limited transport and digital connectivity in rural areas (European Commission, 2021). There are also opportunities, such as digitalisation, globalisation or demographic and climate change (Garcilazo, 2021), but rural development policies are needed to address these challenges and compensate for the handicaps of these areas.

With so many problems and given the heterogeneous nature of rural areas, rural development policies face the challenge of being broad and diverse enough to ensure the sustainability of these regions. This leads to the question of monitoring these policies to analyse if they are achieving their objectives and/or if it is necessary to introduce changes in the way European Funds are delivered to the population that invests or lives there.

For this reason, the authors analysed in a previous study the most common indices used to measure the development of a region, such as, Gross Domestic Product (World Bank, 1997), Human Development Index (HDI) (UNDP, 2016), Social Development Framework (Davis, 2004) or Multidimensional Poverty Index (Alkire & Santos, 2010). The intention was to analyse the feasibility of using them to assess the level of development of a particular rural area. However, the fact that none of these indices was specifically designed for rural areas soon led to the need to look for an alternative.

Therefore, in 2019, Abreu and Mesías started the process of constructing an index to measure development of rural areas, based on stakeholder participation. A Rural Development Index (RDI) was structured around 4 dimensions: population, social, economic and environmental (Abreu *et al*., 2019) The authors proposed 88 indicators to a panel of experts with different roles in rural development (RD) through the qualitative Delphi method, resulting in a selection of 25 indicators. The experts were also asked to determine the importance/weight that each of the 4 dimensions should have (Abreu & Mesías, 2020). Finally, the authors tested different aggregation methods accepted by the scientific community in order to construct the RDI, and the different results were again reviewed by a panel of Portuguese experts, who concluded for the most accurate method for aggregating the variables (Abreu *et al*., 2022). It is this Rural Development Index (RDI_{Abreu}) that is used to evaluate the level of development of the regions studied in this paper.

1.2. European Structural and Investment Funds (ESIF) 2014-2020

In 1997, the importance of the rural areas and the need to develop them was finally recognised by the European Union (European Commission, 1997), and Rural Development became the second pillar of the Common Agricultural Policy (CAP),

introduced as part of the Agenda 2000 reform and bringing together various pre-existing structural and territorial measures under a common umbrella.

The Commission identified three main priorities for rural development policy[1]:

- Making agriculture more competitive;
- Ensuring the sustainable management of natural resources and climate action;
- Achieving a balanced territorial development of rural economies and communities, including job creation and maintenance.

Since then, rural development has become more important on agricultural policies –in addition to agriculture and agri-food activities, which remain a major component of RD policies (European Commission, 2017)–, and the focus for the 2014-2020 programming period was set on coordinating the action of the different financial Funds to improve effectiveness and harmonise its implementation.

In fact, the rationale for EU support to rural areas can largely be derived from the Treaty based on the obligation that the Union should aim to reduce economic, social and territorial disparities[2], and significant proportion of EU financial resources is therefore directed towards reducing disparities between regions (Ferrer *et al*., 2023).

In this line, the EU's long-term budget for 2014-2020, more than half of the EU funding was channelled through 5 European Structural and Investment Funds (ESIF)[3], consisting of:

- Cohesion Policy Funds: Cohesion Fund (CF) + European Regional Development Fund (ERDF) + European Social Fund (ESF);
- European Agricultural Fund for Rural Development (EAFRD); and
- European Maritime and Fisheries Fund (EMFF) (European Parliament and the Council, 2013).

Given the specificities of the CF (which supports transport and environmental projects in countries where per capita GNI[4] is less than 90 % of the EU average) and the EMFF (which supports fishermen and coastal communities), this paper will focus on studying the impact of the ERDF, ESF (together referred to as Cohesion Policy)

[1] https://www.europarl.europa.eu

[2] Article 3 (3) TEU.

[3] https://commission.europa.eu/funding-tenders/find-funding/funding-management-mode/2014-2020-european-structural-and-investment-funds_en

[4] Gross National Income.

and EAFRD (Rural Development Policy) on the development of rural areas in the 2014-2020 multiannual financial framework. From now on, these 3 Funds will be referred to in this study simply as EU Funds when considered together.

In addition, there are some Member States (such as Portugal) where rural development policies are designed only in accordance with the EU CAP and are completely separate from cohesion policies, which leads to the possibility that areas classified as rural are targeted by both policies. These policies pursue objectives and support initiatives that often overlap and create gaps due to the lack of a clear definition of the distribution of institutional responsibilities (Ferrão, 2014). It will therefore be important to consider the impact of these policies on the development of rural areas.

Given the multi-sectoral needs to address rural decline and the small share of agriculture in the overall employment and sectoral contribution of rural economies, it is important to reconsider the link between this Policy and Cohesion Policy, ensuring appropriate complementarity and coherence. Rather than developing measures that overlap with those of the EU's regional policy, there is a need for a much deeper integration of the two, as rural areas fall within the territorial scope of regional plans. Support for agricultural and forestry activities may be important, but it must be accompanied by measures to address the decline of other sectors and to develop high value-added activities. Close coordination of policies is needed (Ferrer *et al*., 2023).

In this context, this study applies a rural development index, previously validated by a panel of experts (Abreu *et al*., 2022), to 9 rural Portuguese NUTS-3 regions, using the values obtained from the statistical data of the last two Portuguese censuses (2011 and 2021). The results are then compared with the financial support provided by the EAFRD and the two Cohesion Funds (ERDF and ESF), in order to study the effectiveness of the application of these European Funds in the 2014-2020 Multiannual Financial Framework. This monitoring will allow some adjustments to be made to the demands and needs of the rural population as soon as they are signalled, thus improving the efficiency of the policy and responding to the demands of the rural world.

The paper is structured as follows. First, the following section (section 2) presents the Rural Development Index used, the territories targeted by the study and some details about the data collection. In section 3, the paper examines the results obtained and investigates the existence of a positive correlation between EU Funds and variations on RDI. Finally, Section 4 presents the main conclusions of the study and makes some considerations that the authors believe should be taken into account by stakeholders and policymakers when designing rural development policies.

2. Materials and methodology

2.1. RDI_{Abreu}

As stated above, the aim of this paper is to compare the evolution of rural areas between two periods and to conclude whether there is a positive relationship with 3 European Structural and Investment Funds under the EU's 2014-2020 long-term budget: ERDF, ESF and EAFRD.

Thus, in order to study the effectiveness of the investments supported by these 3 Funds, the authors try to answer the question: "To what extent is the objective of the ESIF, to support the implementation of the Union's strategy for smart, sustainable and inclusive growth (including economic, social and territorial cohesion) (European Parliament and the Council, 2013) being achieved?".

To this end, and as the level of rural development of a region depends on a wide range of variables, this study uses RDI_{Abreu}, a Rural Development Index constructed by the authors and validated by experts on previous studies (Abreu *et al*., 2022). These considered that 4 dimensions should be represented in an RDI (population, social, economic and environmental) (Abreu *et al*., 2019), and so 88 indicators were selected from the most common development indicators used in the literature: Sustainable Development Goals (United Nations, 2017), Common Agricultural Policy (Directorate-General for Agriculture and Rural Development, 2017), Portuguese Rural Development Programme – PRODER 2007-2013 (MAMAOT, 2012), Proposal on Agri-Environmental Indicators (Eiden et al., 2001), and OECD (1996). This set of indicators was then presented to a panel of experts with different roles in rural development, and the qualitative Delphi methodology was chosen to conclude the selection of 25 indicators that should constitute a rural development index, as well as to determine the weight of each of the 4 dimensions in the index (Abreu & Mesías, 2020).

Each dimension (Population, Social welfare, Economy, and Environment) is the result of an arithmetic mean of the different indicator values selected by the panel of experts. For example,

$$POP = \frac{DmgDep + Pop65 + Pop16 + PopDens + NatInc}{5} \quad [1]$$

Finally, different aggregation methods accepted by the scientific community were tested to construct the RD index, and the different results were also reviewed by a panel of Portuguese experts, which concluded for the most accurate methodology for aggregating the variables (Abreu *et al*., 2022), resulting in RDI_{Abreu}:

$$RDI_{Abreu} = \sqrt[4]{POP} \times \sqrt[4]{SOC} \times \sqrt[4]{ECO} \times \sqrt[4]{ENV} \quad [2]$$

TABLE 1

Description and weighting of the indicators included in the Rural Development Index

		Abbrev.	Data Year
Population (21.4 %)	Demographic Dependency Index (%) - ratio between those 65 and older plus those under 15 and the population in the working ages (ages 15-64)	DmgDep	2011-21
	Proportion of population aged 65 or over (%)	Pop65	2011-21
	Proportion of population aged 16 or under (%)	Pop16	2011-21
	Population density (inhab/km^2)	PopDens	2011-21
	Rate of natural increase (%)	NatInc	2011-20
Social welfare (26.2 %)	Coverage of essential health services (%)[5]	HlthServ	2013-21
	Share of workforce with al least post-secondary education completed (%)	WorkQual	2011-21
	Literacy (%) – Proportion of the population aged 10 or more who can read or write	Lit	2011-21
	Proportion of youth and adults with ICT skills (%)	ICT	2015-21
	Share of university students (%) - Proportion of students in universities	Univ	2011-21
	Proportion of conventional dwellings of regular residence with facilities (%)	Facil	2011-21
	Proportion of population covered by a mobile network (%)	MobNet	2013-21
Economy (28.4 %)	Average earnings *per capita* (€/inhab)	Earn	2011-20
	Gross family income (€/year)	FamInc	2013-20
	Per capita purchasing power (%)	PurcPw	2013-20
	Unemployment rate (%)	Unemp	2011-21
	Total income primary[1] sector (Million €)	IncPrim	2011-20
	Total Gross Value Added of the primary sector (% of GDP)	PrimGVA	201120
	Research and development expenditure as a proportion of GDP (%)	R&D	2011-20
Environment (24.0 %)	Renewable energy share in the total final energy consumption (%)	RenEn	2011-21
	Proportion of treated wastewater (%)	WasteW	2011-21
	Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas (%)	ProtectA	2011-21
	Proportion of bodies of water with good ambient water quality (%)	WatQlt	2011-21
	Proportion of agricultural area under productive and sustainable agriculture (%)	SustAgr	2009-19
	Total expenditure *per capita* spent on the preservation, protection and conservation of all cultural and natural heritage (€/inhab)	ExpHer	2011-21

Source: Own elaboration.

[5] Composite indicator that considers the Number of Medical doctors per 1,000 inhabitants and the Number of beds in hospitals (arithmetic mean of these two normalized values).

2.2. Data Collection

In order to select the regions to be studied, the relevance of rural areas was taken into account. Thus, Portugal was selected because it is a country where 88 % of the land area is considered rural (Almeida, 2018), and 33 % of the population lives in non-urban areas (Instituto Nacional de Estatística de Portugal, 2020). According to this data, Portugal is one of the EU countries with the highest percentage of its population living in rural areas, as the EU average is less than 30 % (European Commission, 2021).

The administrative unit chosen was the NUTS classification (Nomenclature of Territorial Units for Statistics), a hierarchical system used to divide up the economic territory of the EU for the purposes of collecting, developing and harmonising European regional statistics, socio-economic analysis of regions and the formulation of EU regional policy (Eurostat, 2020). Although the NUTS-2 level is the basic regional dimension for the application of regional policies, this paper uses the NUTS-3 level (small regions for specific diagnoses), as it is possible to disaggregate the application of the Funds at this administrative level, thus providing a more fruitful analysis for the design of public policies for small rural territorial units.

Portugal has 3 NUTS-1, 7 NUTS-2 and 25 NUTS-3 regions. For this paper 9 NUTS-3 regions were selected in order to reflect the different realities of the country in terms of population, economic development and industrial activity: 2 NUTS-3 from each NUTS-2 region - Norte (Alto Minho: AM; Terras de Trás-os-Montes: TTM), Centro (Região de Coimbra: RC; Beiras e Serra da Estrela: BSE) and Alentejo (Alentejo Litoral: AL; Alto Alentejo: AA)- together with Algarve (ALG), Autonomous Region of Madeira (RAM) and Autonomous Region of Azores (RAA), where NUTS-2 and NUTS-3 regions coincide. Map 2 shows the 9 NUTS-3 regions used in this research.

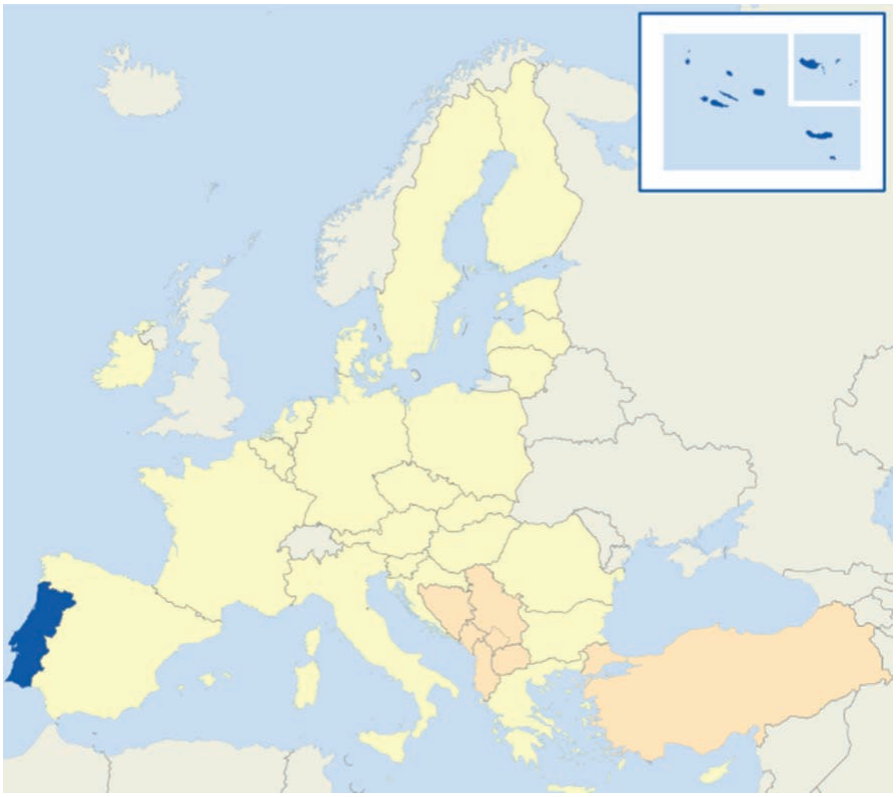
The two periods to be compared are 2011 and 2021, as they correspond to the last two census data for Portugal and can be directly related to the 2014-2020 multiannual financial framework: 2011 can be considered as the starting point and 2021 is the year when it can be assumed that all EU funds were committed and almost all the results that can be expected had been produced.

Data was collected directly from the official website of the National Statistics Institute of Portugal (INE) (www.ine.pt) and the Portuguese National Communications Authority (www.anacom.pt) during the first quarter of 2023. For some indicators, 2021 data was not yet available and data from other years had to be used, as is the case for almost all economic indicators, which had been updated by INE only up to 2020.

For the investments supported by the European Funds in the 2014-2020 multiannual financial framework included in the study, ERDF and ESF data were collected directly from the Regional Operational Programme sites consulted on 31.03.2023, and EAFRD data were provided by the PDR2020 Authority Management.

MAP 1

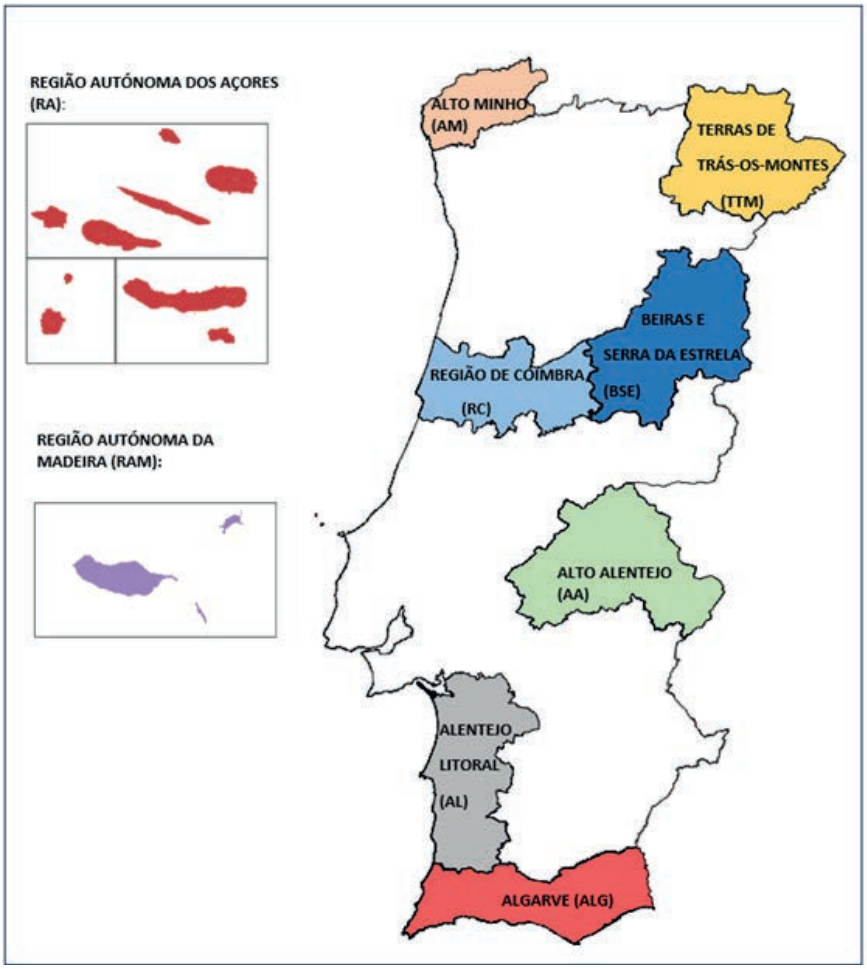
Geographical location of Portugal within EU



Source: Eurostat (2020).

MAP 2

The 9 Portuguese NUTS-3 regions selected



Source: Own elaboration.

2.3. Relationship between EU Funds and RDI

In order to investigate the existence of a positive correlation between the financial support from the EU funds and the RDI_{Abreu} in each of the 9 NUTS 3 regions, Spearman's correlation coefficient (rs) was used. Spearman's rank correlation coefficient assesses how well an arbitrary monotone function can describe a relationship between two variables, without making any assumptions about the frequency distribution of the variables. Unlike Pearson's correlation coefficient, it does not require an assumption that the relationship between the variables is linear (Hauke & Kossowski, 2011) and it is also less sensitive to extreme values because it is rank-based. Due to these advantages, it is widely used as a measure of association between two measurements (Yu & Hutson, 2024).

The value of Spearman's coefficient varies between -1 and 1, and the closer this value is to zero, the weaker the monotonic relationship between the two variables (Chok, 2010). In general, a correlation coefficient lower than 0.20 is usually considered very weak/negligible. Correlation coefficients of 0.30-0.40 are often classified as a low/regular/mild relationship, 0.40-0.70 as a moderate relationship, 0.70-0.90 as a strong/high relationship and greater than 0.90 as a 'very high' relationship (Alsaqr, 2021).

3. Results and discussion

Table 2 presents the original values (2011 and 2021) for each indicator and NUTS-3 regions. All data were normalised to a range between 0 and 1 in order to compare the values of indicators with different units of measurement (OECD, 2006). An "inverse" normalisation was applied to those indicators that have a negative impact on the Rural Development Index, in which case the NUTS-3 region with the lowest value was assigned a value of 1 and that with the highest value was assigned a value of 0, as other authors have done (Kynčlová *et al*., 2020). This procedure was applied to the indicators:

- Demographic dependency index;
- Proportion of population aged 65 or over (%);
- Unemployment rate (%).

TABLE 2

Values of each indicator for the 9 NUTS-3 regions analysed (2011 and 2021)

		Alto Minho (AM)		Terras de Trás-os-Montes (TTM)		Região de Coimbra (RC)		Beiras e Serra da Estrela (BSE)		Alentejo Litoral (AL)		Alto Alentejo (AA)		Algarve (ALG)		Região Autónoma dos Açores (RAA)		Região Autónoma Madeira (RAM)	
		2011	2021	2011	2021	2011	2021	2011	2021	2011	2021	2011	2021	2011	2021	2011	2021	2011	2021
Population	DmgDep	35.40	46.37	45.00	59.53	34.90	45.51	43.10	57.41	37.80	42.11	43.60	44.73	30.00	37.79	18.70	24.03	20.90	29.67
	Pop65	22.72	28.14	27.60	33.80	22.55	27.72	26.62	32.92	23.94	26.16	26.50	29.91	19.50	23.74	12.93	16.54	14.40	19.96
	Pop16	11.17	13.28	9.42	11.11	11.36	12.88	9.74	11.61	11.71	12.68	11.80	12.78	13.43	14.85	14.62	17.91	12.74	16.44
	PopDens	110.00	104.10	21.10	19.30	105.40	101.10	37.00	33.40	18.40	18.30	19.30	17.20	89.30	93.20	106.50	101.80	329.80	313.50
	NatInc	-45.00	-81.0	-70.00	-123.00	-34.00	-69.00	-76.00	-113.00	-48.00	-67.00	-86.00	-122.00	-1.00	-25.00	15.00	-14.00	-3.00	-34.00
Social Welfare	HlthServ	2.45	3.01	3.08	3.70	8.13	9.25	2.29	2.56	2.18	2.66	2.89	3.24	2.44	2.90	2.97	3.80	3.01	4.44
	WorkQual	18.76	26.23	23.87	31.77	26.51	35.25	21.15	29.13	15.81	21.11	18.67	25.26	20.53	28.47	17.41	25.07	21.36	29.65
	Lit	93.15	96.03	89.86	93.88	94.15	96.63	91.22	94.60	88.42	93.74	89.05	93.70	94.66	96.86	95.34	96.90	93.03	95.49
	ICT	41.80	50.50	41.80	50.50	45.20	53.00	45.20	53.00	44.80	46.70	44.80	46.70	45.10	57.20	47.80	51.20	42.80	49.40
	Univ	2.58	2.79	4.06	6.08	4.58	4.16	3.54	3.46	2.78	2.24	2.78	3.23	2.76	2.93	2.61	2.69	2.89	3.59
	Facil	99.96	99.93	99.94	99.95	99.93	99.96	99.94	99.98	99.74	99.71	99.75	99.84	99.81	99.84	99.91	99.95	99.96	99.98
	MobNet	59.20	88.10	59.20	88.10	33.20	88.80	33.20	88.80	27.60	77.30	27.60	77.30	19.60	83.80	20.70	96.30	23.10	99.00

TABLE 2

Values of each indicator for the 9 NUTS-3 regions analysed (2011 and 2021)

		Alto Minho (AM)		Terras de Trás-os-Montes (TTM)		Região de Coimbra (RC)		Beiras e Serra da Estrela (BSE)		Alentejo Litoral (AL)		Alto Alentejo (AA)		Algarve (ALG)		Região Autónoma dos Açores (RAA)		Região Autónoma Madeira (RAM)	
		2011	2021	2011	2021	2011	2021	2011	2021	2011	2021	2011	2021	2011	2021	2011	2021	2011	2021
Economy	Earn	860.80	1,057.20	830.40	988.20	964.90	1,119.50	815.50	1,013.40	1,169.70	1,206.60	881.20	1,029.50	942.50	1,071.00	986.00	1,131.30	1,049.80	1,171.40
	FamInc	13,600	15,968	14,508	16,851	17,100	19,738	14,067	16,637	15,124	16,984	14,386	16,723	14,469	16,222	16,265	18,569	15,951	18,194
	PurcPw	77.57	80.50	75.93	80.40	93.93	93.60	76.83	79.29	92.86	95.05	81.67	86.49	96.74	100.84	82.35	87.96	85.05	87.75
	Unemp	11.84	5.96	10.87	7.55	10.27	5.95	13.18	6.79	10.90	6.17	15.66	7.65	15.74	11.80	11.13	6.87	14.65	12.07
	IncPrim	61.84	97.79	83.89	111.15	273.08	345.65	55.56	129.22	259.22	521.06	151.80	223.16	187.40	331.54	264.95	332.65	45.89	78.22
	PrimGVA	0.03	0.06	0.03	0.14	0.09	0.16	0.02	0.07	0.11	0.32	0.04	0.07	0.11	0.24	0.13	0.19	0.02	0.04
Environment	R&D	0.53	0.68	0.66	0.67	2.31	2.55	0.92	0.97	0.09	0.48	0.28	0.67	0.41	0.49	0.39	0.34	0.30	0.51
	RenEn	0.21	0.21	0.15	0.15	0.20	0.20	0.16	0.16	0.21	0.21	0.11	0.11	0.38	0.38	0.25	0.25	1.43	1.43
	WasteW	54.00	62.00	83.00	91.00	77.00	78.00	78.00	86.00	70.00	72.00	83.00	85.00	77.00	85.00	66.10	67.90	66.10	67.90
	ProtectA	28.10	28.00	40.40	42.40	9.20	9.20	30.00	30.50	30.60	30.50	35.40	35.40	37.00	36.90	24.10	24.10	58.70	59.50
	WatQlt	64.30	67.10	76.20	69.70	66.70	57.30	65.50	45.90	50.00	43.50	56.00	46.20	65.80	63.20	66.36	71.03	96.77	92.31
	SustAgr	0.50	0.50	2.50	5.00	0.20	0.60	5.80	7.40	0.30	1.10	4.00	14.20	0.90	0.80	0.10	0.60	2.20	3.30
	ExpHer	41.59	53.74	95.43	107.03	61.70	75.61	61.33	75.13	72.94	109.42	70.20	125.29	87.89	136.25	40.31	78.46	113.75	127.84

Source: Own elaboration.

From the previous table, some relevant aspects can be highlighted, helping to understand the following results. Regarding the Population dimension, there are large disparities in *Population Density* values among the different NUTS-3 regions under study: less than 20 inhab/km^2 in TTM, AA and AL; more than 100 inhab/km^2 in AM, RC, RAA; more than 300 inhab/km^2 in RAM. And while it's true that population density can be considered beneficial for growth by enabling specialisation and increasing returns to scale and positive externalities (Greyling & Rossouw, 2017), it can also generate various drawbacks that do not necessarily result in higher quality of life (Glaeser & Gottlieb, 2006). Population decline is a reality in all the NUTS-3 regions analysed, with BSE and TTM showing demographic dependency values of over 50 %, which highlights the problem of ageing problem of these territories in particular.

With respect to the Social Welfare dimension, RC and TTM have the higher values for the indicator *Share of workforce with at least post-secondary education completed*, which maybe certainly due to the existence of universities in each of these two NUTS-3 regions.

Regarding the Economy –the dimension with the greatest impact on RDI_{Abreu} according to the panel of experts– although *Unemployment rate* has decreased in all the NUTS-3 regions studied, ALG and RAM were still in double-digit values in 2021, with both being areas where tourism is the main driver of the regional economy. Particularly in ALG, the arrival of hundreds of thousands of tourists between June and September leads to an increase in employment during this period, followed by a sharp decline in the following quarter[6].

Table 3 shows the normalized results of RDI_{Abreu} to 2021 obtained from the data presented in Table 2 and applying equation (1).

From the above values, we can calculate an average RDI_{Abreu} value of 0.329, with four NUTS-3 regions presenting upper values: RC, ALG, RAA and RAM. If we analyse the share of Gross Value Added of the companies of these NUTS-3 regions over the total of Portugal for 2021 (data in Table 4), we can see that RC and ALG are the regions (among the 9 NUTS-3 under study) that add more value, but from different types of activities: RC presents the highest gross added value on economic activities such as *Manufacturing* and *Wholesale and retail trade*; ALG supports its values on *Accommodation and food service activities* and *Wholesale and retail trade*, as well. On the other hand, AM presents a greater contribution to the National Gross Added Value when compared to RAA, but this is not reflected in RDI_{Abreu} as these two NUTS-3 regions occupy the 3rd and the 6th hierarchical positions in the Index.

[6] https://ec.europa.eu/eurostat/web/lfs/overview

TABLE 3

RDI results for the 9 NUTS-3 regions analysed (2011 and 2021)

	RDI_{Abreu}		RDI variation (%)
	2011	2021	
Alto Minho (AM)	0.224	0.216	-3.5
Terras de Trás-os-Montes (TTM)	0.189	0.091	-52.0
Região de Coimbra (RC)	0.482	0.438	-9.1
Beiras e Serra da Estrela (BSE)	0.227	0.200	-11.8
Alentejo Litoral (AL)	0.253	0.124	-50.9
Alto Alentejo (AA)	0.248	0.253	2.1
Algarve (ALG)	0.483	0.541	11.8
Região Autónoma dos Açores (RAA)	0.452	0.484	7.0
Região Autónoma da Madeira (RAM)	0.570	0.618	8.5

Source: Own elaboration.

TABLE 4

Proportion of the nine NUTS-3 regions in the total gross value added of enterprises in Portugal (2021)

	% Gross value added
Alto Minho (AM)	1.6
Terras de Trás-os-Montes (TTM)	0.4
Região de Coimbra (RC)	3.0
Beiras e Serra da Estrela (BSE)	0.9
Alentejo Litoral (AL)	0.9
Alto Alentejo (AA)	0.5
Algarve (ALG)	2.9
Região Autónoma dos Açores (RAA)	1.2
Região Autónoma da Madeira (RAM)	1.8

Source: Own elaboration.

As the intention of the authors of this paper is to study the impact of the EAFRD, ERDF and ESF, which are the main sources of support for rural areas (European Parliament and the Council, 2013), these European Funds have been analysed in the 2014-2020 framework in relation to the 9 NUTS-3 regions under study.

Several analyses were carried out on the basis of the Funds applied in the 2014-2020 framework: first, the EAFDR was separated from the Cohesion Policy (total and *per capita* values), and then the Cohesion Policy was disaggregated into each Fund (ESF and ERDF) to explore which Fund contributed the most to the RDI_{Abreu} values. The results are presented in Tables 5 and 6.

TABLE 5

Financial support from EU Funds, EFADR and Cohesion Policy (ESF and ERDF) separately in 2014-2020 framework (Total value and Value Per capita)

	EU FUNDS		EFADR		Cohesion Policy	
	Total (x 1,000 €)	per capita (€)	Total (x 1,000 €)	per capita (€)	Total (x 1,000 €)	per capita (€)
Alto Minho (AM)	283,586	1,226	49,703	215	233,884	1,011
Terras de Trás-os-Montes (TTM)	389,863	3,634	193,088	1,800	196,775	1,834
Região de Coimbra (RC)	594,477	1,361	128,830	295	465,647	1,066
Beiras e Serra da Estrela (BSE)	297,271	1,412	96,802	460	200,469	952
Alentejo Litoral (AL)	217,190	2,252	102,320	1,061	114,870	1,191
Alto Alentejo (AA)	338,043	3,222	107,723	1,027	230,321	2,195
Algarve (ALG)	414,885	888	70,667	151	344,218	737
Região Autónoma dos Açores (RAA)	1,633,360	6,909	317,124	1,341	1,316,236	5,568
Região Autónoma da Madeira (RAM)	510,855	2,037	108,527	433	402,328	1,605
Other NUTS-3	7,269,218	886	1,394,355	170	5,874,863	716
Total Portugal	**11,948,750**	**1,155**	**2,569,140**	**248**	**9,379,610**	**907**

Source: Own elaboration.

From the data presented in Table 5, we can conclude that, among the nine NUTS-3 regions in study, RAA is the one with the highest financial support from EU funds, mainly due to the Cohesion Policy, presenting *per capita* values 6 times higher than the national average. As an outermost region, it has a special financial support from the EU to compensate for the constraints arising from its geographical remoteness. (European Parliament and the Council, 2023).

On the other hand, ALG presents a significant total EU Funds, 80 % coming from Cohesion Policy Funds, but the corresponding *per capita* values are significantly below the Portuguese average values. This may be an indicator of a lack of relationship between financial support from EU Funds and the development of this NUTS-3 region, which presents the second highest RDI_{Abreu} value.

Since there seems to be a relationship between the Cohesion Policy Funds and the RDI_{Abreu} values, the financial support provided by the ESF and the ERDF has been analysed separately, taking into account only the nine NUTS-3 under study (Table 6).

TABLE 6

Financial support from ESF, ERDF and Cohesion Policy (ESF+ERDF), on the nine NUTS-3 regions analysed, in the 2014-2020 period (total value and weight in these nine NUTS-3 regions)

	ESF		ERDF		Cohesion Policy	
	x 1,000 €	%	x 1,000 €	%	x 1,000 €	%
Alto Minho (AA)	38,830	6	195,054	6	233,884	6
Terras de Trás-os-Montes (TTM)	51,722	8	145,053	4	196,775	4
Região de Coimbra (RC)	52,082	8	413,565	12	465,647	11
Beiras e Serra da Estrela (BSE)	26,730	4	173,739	5	200,469	5
Alentejo Litoral (AL)	10,345	2	104,525	3	114,870	3
Alto Alentejo (AA)	27,259	4	203,061	5	230,321	5
Algarve (ALG)	91,597	14	252,622	10	344,218	10
Região Autónoma dos Açores (RAA)	335,929	49	980,307	30	1,316,236	33
Região Autónoma da Madeira (RAM)	43,676	6	358,652	26	402,328	23
Total	**678,170**	**100**	**2,826,577**	**100**	**3,504,747**	**100**

Source: Own elaboration.

As for the nine NUTS-3 regions, RAA, RAM and RC hold the top 3 positions in financial support by Cohesion Policy, although this hierarchical relation changes when we analyse the two Funds separately. Here, these positions are occupied, respectively, by RAA, ALG and TTM and RC ex-aequo in ESF; and by RAA, RAM and RC, in ERDF.

On the other hand, we can see that AL, AA and BSE have very low values of financial support. Since we are talking about investments that require to be applied

for, these values can be seen as a sign of the (lack of) dynamism of the territories or, in other words, of a policy that is less adapted to the needs of the territories that should be supported by the European Funds.

More important than just making an analysis quantifying the variation of RDI between 2011 and 2021, is to analyze its direction (increasing or decreasing) in order to conclude on the impact of Funds on rural development of these territories. In this line, however, it is interesting to see if there is a direct relationship between the direction of variation of RDI_{Abreu} in 2011-2021 and the amount of EU funds *per capita* invested in each of the nine NUTS-3 regions in study. These values, ranked from highest to lowest, are shown in Table 7.

TABLE 7

Direction of change in RDI between 2011 and 2021 and financial support by EU Funds per capita on the nine NUTS-3 regions in study

	RDI variation direction	EU Funds per capita
Região Autónoma dos Açores	↑	6,909
Terras de Trás-os-Montes	↓	3,634
Alto Alentejo	↑	3,222
Alentejo Litoral	↓	2,252
Região Autónoma da Madeira	↑	2,037
Beiras e Serra da Estrela	↓	1,412
Região de Coimbra	↓	1,361
Alto Minho	↓	1,226
Algarve	↑	888

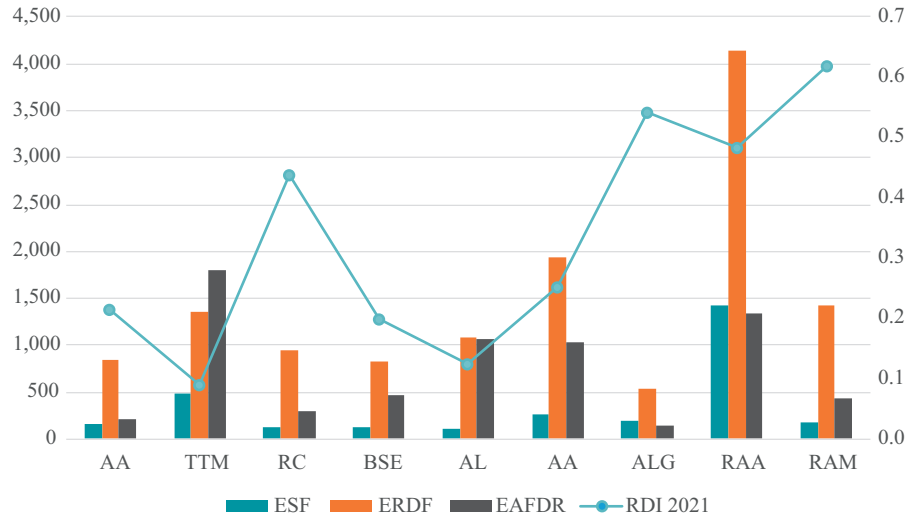
Source: Own elaboration.

Analysing the results presented in Table 7, it seems that the amount of financial support *per capita* doesn't influence the direction of the RDI_{Abreu} variation. For example, Algarve showed a positive evolution (increase in the Index value) although it was the NUTS-3 region with the lowest financial support *per capita* from EU Funds.

Figure 2 shows the RDI_{Abreu} values for 2021 in the nine NUTS-3 regions and the *per capita* financial support from each of the Funds analyzed.

FIGURE 2

Per capita financial support for the 2014-2020 framework and 2021 RDI for the nine NUTS-3 studied



Source: Own elaboration.

Subsequently, Spearman's correlation coefficient (rs) was calculated with the objective of contrasting whether the EU policies applied in 2014-2020 were designed and implemented in Portugal in an effective way to boost the development of rural areas. If the results obtained were close to 1, it would indicate a strong correlation between the two variables, but this was not the case.

In fact, the value of the Spearman's correlation coefficient between RDI_{Abreu} and per capita EU Funds applied in the 2014-2020 framework was -0.27 (meaning that there was almost no relationship between these two variables, although the negative correlation is noteworthy). Calculating rs between the Index and each EU Fund *per capita* separately on the 2014-2020 framework (ESF, ERDF and EAFDR), the results were 0.22, 0.12 and -0.52 respectively (see Table 9), meaning a weak/very weak positive relationship between RDI_{Abreu} and both ESF and ERDF, and a moderate negative relationship between RDI and EAFDR (Ratner, 2009). In addition, the coefficient of determination (rs^2) on the positive Spearman correlation values was calculated to analyse to what extent the variability of the RDI_{Abreu} values can be explained by the share of funds in the applications approved in the 2014-2020 framework (Chiode, 2021). Both results are presented on Table 8.

TABLE 8

Spearman's correlation between RDI_{Abreu} values for the nine NUTS-3 regions analysed and per capita financial support from EU Funds

(per capita)	rs	rs^2
EU Funds	-0.27	0.07
ESF	0.22	0.05
ERDF	0.12	0.01
EFADR	-0.52	0.27

Source: Own elaboration.

Since the value of rs^2 can be interpreted as the percentage of correctness obtained by the regression (Chicco *et al*., 2021), we can conclude that only 7 % of RDI_{Abreu} values are explained by per capita financial support from the EU Funds. When analysing each EU Fund, the 27 % of RDI_{Abreu} values explained by EFADR stands out, while only 5 % and 1 % of RDI_{Abreu} values are explained by ESF and ERDF, respectively.

However, if we apply these analyses to Total financial supports (instead of using *per capita* values), the results are different, and all Funds have positive correlations with RDI, as presented on Table 9.

TABLE 9

Spearman's correlation between RDI_{Abreu} values for the nine NUTS-3 regions analysed and total financial support from EU Funds

	rs	Relationship
EU Funds	0.683	moderate
ESF	0.567	moderate
ERDF	0.850	strong
EFADR	0.067	negligible

Source: Own elaboration.

In addition, we can determine whether the association observed between the pairs of variables in the sample is significant by means of a hypothesis test: in this case, a two-tailed test was used (since the association could be positive or negative), with the following null and alternative hypotheses:

- H_0: There is no association between RDI_{Abreu} and the European Fund in question

- H_1: There is an association of any type (negative or positive) between RDI_{Abreu} and the European Funds considered

For n = 9 and a 5 % significance level, the critical value is $r_{scrit} = 0.700$. Since |0.700| is higher than the coefficients of determination of all the Funds except the ERDF, we cannot reject the null hypothesis, meaning that the test points to the non-existence of an association between RDI_{Abreu} and the ESF, ERDF and EU Funds (at global level).

4. Conclusions

This study aimed to analyse the effectiveness with which one EU Member State (in this case, Portugal) applies the European Commission's main sources of support to rural areas, namely the CAP's EAFRD and the ERDF and ESF of the Cohesion Policy. For this purpose, nine Portuguese NUTS-3 regions with mainly rural characteristics were selected, and a Rural Development Index previously validated by a panel of experts in a former study, RDI_{Abreu}, was applied.

Initially, it was expected that the higher the amount of investment supported by the Funds in each NUTS-3 region, the greater the improvement in RDI_{Abreu} values between the two periods under study (2011 and 2021), which would demonstrate the effectiveness of the application of these European Funds in the Multiannual Financial Framework 2014-2020.

However, and despite the fact that almost 1,500 million euros of the Funds were spent in these nine NUTS-3 regions, more than half of these territories presented lower RDI_{Abreu} values in 2021 than in 2011.

The Spearman correlation coefficient between RDI_{Abreu} and the EU Funds applied in the 2014-2020 framework was used, considering both total values and *per capita* values. When considering the Total values, the existence of a positive correlation between RDI_{Abreu} and all the Funds was concluded, with the existence of a strong correlation with ERDF, and a negligible correlation with EAFDR. However, when *per capita* values were analysed, a very different conclusion was found, where it stands out that 27 % of the RDI_{Abreu} values are explained by the EFADR. This is in line with a final test carried out to determine whether the association observed between the pairs of variables in the sample was significant, which concluded for the existence of an association between RDI_{Abreu} and one EU Fund, the EAFDR.

One issue that needs to be addressed is the availability of data, ideally for several years, so that indicators can be studied over a number of years, even if possible changes occur with a time lag of at least 2-3 years after the investments (Bergschmidt *et al*., 2008). This is also a limitation of this analysis, which should be taken into

account when the statistical decision-making authorities define the annual indicators to be collected, as well as the territorial dimension (disaggregation of data).

However, the preparation of the 2023-2027 framework should have included a thorough and serious reflection on the demands and needs of the rural population, as well as on the design of public policies at national level with the aim of effectively promoting the development of rural areas.

This also includes the need to evaluate rural development policies, which are designed purely in terms of agricultural policy and completely divorced from cohesion policies, without an overall rural development strategy that takes account of the various Funds involved, as a long-term response to the problems and opportunities facing rural populations.

In this context, this research can have interesting implications for EU policy-making at different levels. Firstly, due to the possibility of replicating it in other European regions in order to obtain a clear picture of the impact of the different policies applied, which has so far been lacking. And secondly, to provide guidance for the design of future rural development plans and to plan for the expected synergies between the different Funds.

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