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How rural is the EU RDP? An analysis through spatial fund allocation

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Abstract. Although representing less than 20% of total CAP expenditure, the Rural Development Policy (RDP) 2007-2013 is supposed to support rural areas which are facing new challenges. Currently, many EU rural areas are experiencing major transformations and the traditional urban-rural divide seems outdated (OECD, 2006). Going beyond dichotomous definitions and approaches, the paper applies at EU NUTS 3 level a new composite and comprehensive measure of rurality and peripherality (the PeripheRurality Indicator, PRI): the higher this index, the more rural and peripheral a given region is. Within a Principal Component Analysis (PCA) approach, this indicator takes into account both conventional socio-economic indicators and the relevant geographical characteristics of the region. On the basis of this analysis, the paper also puts forward a clusterisation of NUTS 3 regions across Europe and assesses the correlation between the RDP expenditure intensity, the PRI and the different regional clusters. This analysis is aimed at assessing the coherence of RDP fund allocation with the real characteristics of EU rural space.

Keywords. Rurality and peripherality, EU rural development policy, multivariate analysis

JEL codes. O18, Q01, R58

Introduction: the scope of the paper

This paper aims to investigate the links between the degree of rurality in EU NUTS 3 regions and the allocation of Rural Development Policy (RDP) expenditures throughout this area. Rural regions still play a key role within the EU economy and society, even though the relative dominance and major vitality of its urban space, from mega cities to the network of its medium-sized cities, has been repeatedly pointed out (ESPON, 2005). Moreover, EU rural space faces new challenges and new opportunities which are due to ongoing major transformations and an increasing heterogeneity, especially after the enlargement of the EU towards Eastern countries.

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With regard to this evolutionary pattern, the traditional urban-rural divide can be considered largely outdated (OECD, 2006). A new geography of EU rural space has emerged and new definitions and taxonomies are needed. Although in previous studies on EU rural space major geographical issues were substantially ignored (Copus, 1996; Ballas *et al.*, 2003; Bollman *et al.*, 2005; Vidal *et al.*, 2005; Copus *et al.*, 2008), a new representation of EU rural geography necessarily implies a proper consideration of how conventional rural features (e.g., low density, key role of agriculture, etc.) combine with geographical features (e.g., remoteness, integration with urban areas, etc.). In order to achieve this new representation of EU rural space, the present paper puts forward a new composite and comprehensive PeripheRurality Indicator (PRI), linking together both conventional rural and geographical features.

Such a multidimensional approach can help in defining different typologies of rural areas across the EU and, in turn, it could also support policy makers in better framing and targeting the EU RDP. The RDP is the second pillar of the Common Agricultural Policy (CAP) (funded by the European Agricultural Fund for Rural Development, EAFRD). It supports the implementation of rural development programmes across the EU. At present, for the 2007-2013 programming period, the RDP is aimed at supporting rural areas which are facing new challenges by promoting their economic restructuring, enhancing the sustainable management of natural resources, helping regions to meet future social, economic and environmental challenges (Sotte, 2009; Esposti, 2011). The analysis of the current spatial allocation of RDP expenditure can help in assessing how these declared objectives match the real characteristics of the EU regions and their true degree of rurality. The most disaggregated territorial level at which the analysis can be performed is EU NUTS 3 level. At this level, the spatial allocation of current RDP expenditure not only depends on the top-down *ex-ante* political decisions taken by the EU and/or the Member States, but also by the bottom-up capacity of each territory (NUTS 3 region) to attract and use these funds.

The paper is organised as follows. The second Section briefly summarises the in-depth debate about the definition of EU rural areas, ranging from the most "conventional" typologies proposed by the OECD (2006) and Eurostat (2010). The role of a multidimensional (i.e., multivariate) approach and the relevance of often neglected geographical aspects is then stressed. In In the third Section, the available data for a more thorough and comprehensive analysis of peripherality and rurality across Europe, together with some critical issues, are presented. The fourth Section briefly presents the adopted methodology, a combination of multivariate techniques (Principal Component Analysis and Cluster Analysis) through which a composite PeripheRurality Indicator (PRI) is computed. The fifth Section provides the main results of the analysis by showing how this PRI is distributed across the EU space. A clusterisation of rural regions is also illustrated and discussed. The sixth Section shows the allocation of RDP funds across NUTS 3 regions, by emphasizing the links between this distribution, the computed PRI and the identified urban-rural clusters. The final Section concludes the paper, suggesting some possible directions for future research.

Concept, definition and classification of the rural space in the EU

The concept of rurality

According to its relevance among EU main priorities and policies, rural development has become one of the major topics in agricultural economics as well as in other social sciences. Nevertheless, the concept of rural development remains a "disputed notion, both in practice, police and theory" (van der Ploeg *et al.* 2000, p. 404). The lack of a strong and common theoretical foundation still affects most of the literature on the concept and definition of "rural" itself and on the consequent taxonomy. Therefore, before providing taxonomies about the EU rural areas and assessing the allocation of EU RDP funds in this respect, the concept of "rural" has to be explicitly defined and discussed.

In focusing on the proper definition of rurality, many studies pointed out the relevance of the major evolution which has affected agriculture and rural areas in both developing and developed Countries over time (Johnston, 1970; Timmer, 1988; Saraceno, 1994; Basile and Cecchi, 1997; Romagnoli, 2002, Sotte, 2003; Sotte *et al.*, 2012). Those transformations, both from the historical and the geographical perspective, call for different approaches in classifying rural areas as well as in defining rural development policies.

In this work, we follow the evolutionary concept of rurality and of rural development suggested in Sotte (2003) and Sotte *et al.* (2012). In the 50s and 60s, due to the still crucial role of agriculture, the concept of "rurality" and the identification and classification of rural areas were mainly based on sectoral variables (e.g., the share of the agricultural employment) (the so-called *agrarian rurality* model). Since the 70s, the importance of agriculture in EU regions has fallen steadily. Thus, the *agrarian rurality* model has been progressively replaced by the *industrial rurality* framework. This decline in agricultural activities was accompanied by rapid rural depopulation and urbanization (Basile and Cecchi, 1997). Therefore, in the *industrial rurality* framework, rural areas were mainly defined and classified according to demographic criteria (i.e., population density). Despite these generalized demographic trends, some rural regions still experienced successful development patterns, often based on manufacturing, thanks to other favourable conditions (economic dynamism, social mobility and cohesion, etc.) (Esposti and Sotte, 2002).

Mostly following these cases of "rural success", in the 90s another form and concept of rurality emerged (the *post-industrial rurality*). Two major elements characterise rural areas within this new model. First, the territorial dimension of rurality has now become relevant, especially in terms of a stronger integration across the rural space and between rural and urban territories. Within this integration, the role assigned to the rural regions consists in supplying the society with a whole set of services associated to public goods, either environmental goods (e.g., clean air and water, biodiversity…) or "cultural" goods (e.g., landscape, historical heritage, agricultural traditions, etc.).

The second element is that, given this large set of possible services, many different forms of rural-rural and rural-urban integration has emerged and may co-exist. Polymorphism has thus become one of the key feature of the rural space within the post-industrial rurality, e.g., in post-industrial societies. Together with the current co-existence of the three different models of rurality across the EU27, this polymorphism clearly affects how rural areas can be defined and classified. While none of the conventional measures (based on sectoral or demographic indicators) can capture these complex and polymorphic features, it seems increasingly evident that a proper definition and classification needs to be multidimensional and that it is still useful that these conventional indicators remain included within such multidimensionality.

Indicators, measures and typologies of rural areas: towards a multidimensional approach

As mentioned, the debate about the concept of rurality inevitably opens the debate about how to properly define rural areas. Actually, a univocal and homogeneous definition of rural areas is still lacking at international level (Montresor, 2002; Anania and Tenuta, 2008). For example, the European Commission (EC) does not provide any formal criteria to identify those areas where rural development policies are to be implemented: each Member State is autonomously in charge of defining its own rural areas. This lack is due to the considerable differences in terms of demographic, socio-economic, and environmental conditions occurring across the EU rural space (European Commission, 2006; Hoggart *et al.*, 1995; Copus *et al.*, 2008). Moreover, it may also be attributed to the lack of homogeneous and comparable statistical information at territorial level which may foster the identification of a common statistical definition of rural areas (Bertolini *et al.*, 2008; Bertolini and Montanari, 2009).

Nevertheless, since the 90s, significant steps forward in providing a homogeneous definition have been taken and some general criteria are now widely accepted. The most well-known urban-rural typologies are those adopted by the OECD (1994; 1996; 2006) and the EC (Eurostat, 2010). Both follow a similar and simple approach, based on demographic density and on the presence of major urban areas (thus recalling the aforementioned *industrial rurality* model). According to this OECD-Eurostat methodology, NUTS 3 regions in EU27 Member States are classified as *predominantly urban* (PU), *intermediate* (IR) and *predominantly rural* (PR).

However, this approach suffers from a major drawback. It measures "rurality" using a single indicator (i.e., demographic density) and, then, this indicator is collapsed into a discrete ordinal variable that distinguishes only three typologies of rurality/urbanity. Such measure seems too rough to capture the evident and increasing polymorphism observed across EU27 rural areas. Actually, the emergence of a post-industrial concept of rurality makes the measures just based on density outdated and insufficient. Recently, the OECD (and even the FAO) has launched new research strands in order to put forward new and more comprehensive measures of rurality based on a qualified set of variables (FAO-OECD Report, 2007; The Wye Group, 2007).

This is the underlying idea of multidimensional approaches to define and classify rurality. They consist in using a wide set of variables, usually ranging from socio-demographic (e.g. population density) and sector-based variables (e.g., the share of agriculture within the economy) to territorial/geographical features (e.g., land-use, remoteness, integration with the urban space, etc.). A thorough review of these multidimensional approaches can be found in Copus *et al.* (2008). Many of these works have identified the major typologies of rural areas across Europe, by applying multivariate statistical approaches and by taking into account a broad list of socio-economic indicators. Some of these analyses focus on either single (Auber *et al.*, 2006; Buesa *et al.*, 2006; Kawka, 2007; Lowe and Ward 2009; Merlo and Zaccherini, 1992; Anania and Tenuta, 2008) or a few EU Member States (Barjak, 2001; Psaltopoulos *et al.*, 2006), while other works analyse the rural space across the whole EU. To mention a few, Terluin *et al.* (1995) analyse less-favoured areas in the EU15; Copus (1996) analyses NUTS 3 regions in the EU12 comparing aggregative and disaggregative methods (factor analysis and K-means cluster analysis) with about 45 socio-economic indicators. Ballas *et al.* (2003) apply factor analysis and cluster analysis to EU27 NUTS 3 regions and also suggest a sort of *peripherality* index. Bollman *et al.* (2005) move from the original OECD urban-rural typologies and suggest an additional grouping of rural areas (*leading, middle, lagging regions*). Vidal *et al.* (2005) analyse the spatial features of rural areas in the EU12, according to demographic, economic, sector-based and labour market variables.

Combining socio-economic and geographical features

The present paper pursues the abovementioned multidimensional approach in order to analyse EU rural areas and at the same time suggests some further improvements in this direction. While the relevance of different (and conventional) socio-economic features in characterising rural areas is again stressed, an additional set of indicators covering geographical features is also proposed. The underlying idea is that geography matters when defining rural areas, as, according to the *post-industrial rurality* model, rurality and its different possible forms also have to do with the degree and quality of integration of a given area with the surrounding space. On the basis of this key idea, the paper adds a set of spatial/geographical variables to a more conventional set of indicators expressing rurality and its evolutionary stage (agrarian, industrial, post-industrial). Few studies have concentrated on a link between the economic and geographical features, which are explicit in defining rural areas (Cecchi, 1999; Ballas *et al.*, 2003), even though this has never been done at the NUTS3 level across the whole EU27 space.

In the present analysis, the four aforementioned dimensions of rurality are linked together by computing a composite and comprehensive indicator. It expresses the idea that rural areas can be defined according to an evolutionary combination of conventional features (e.g., population density and the role of agriculture) and indicators of their integration (or exclusion) with respect to the surrounding space. These are the major thematic areas considered here:

- Socio-economic indicators (*population-based approach);*
- The role of agriculture (*sector-based approach*);
- Land use and landscape features (*territorial approach*);
- Accessibility/remoteness over different territorial scales (*geographical approach*).

In particular, regional accessibility is considered as a key variable in this study. Despite the rapid increase in the use of Information and Communication Technologies (ICT) and the efforts made to reduce the digital divide, remoteness still remains a major feature of many EU rural areas. Several regions, although rural in a traditional sense, are closely integrated with (and provide many services to) the surrounding urban space. These spatial and geographical issues are included in this analysis taking into account two different perspectives: the distance from major urban areas and some indexes of potential accessibility.

To achieve a synthetic indicator of this spatial dimension, a distance matrix between the centroids of all the EU NUTS 3 regions is firstly computed. As remoteness usually refers to the distance from some major cities, for each region the distance from major EU urban areas is taken into account. In particular, the concept of MEGA (*Metropolitan Economic Growth Area*) is here used. MEGAs are the most important urban areas among the European FUAs (Functional Urban Areas), according to population, transport, tourism, industry, knowledge economy, decision-making and public administration (ESPON, 2005). Five typologies of MEGAs are identified: Global nodes (or Global MEGAs), Category 1 MEGAs, Category 2 MEGAs, Category 3 MEGAs and Category 4 MEGAs.

Secondly, regional remoteness is expressed according to the multimodal potential accessibility indexes. These indicators take into account the presence of physical infrastructures connecting regions, thus reducing travel times and costs. All of them measure how easily people living in one region can reach people located in other regions. Both the multimodal accessibility index (measuring the minimum travel time between two regions by combining road, rail and air networks) and the air accessibility index (taking into account only the air network) are considered here. Both indexes are computed by summing the population in all other European regions weighted by the travel time needed to reach them (ESPON, 2005)[2].

The combination of these two dimensions (distance from MEGAs and accessibility indicators) provides a detailed and somehow original representation of the real EU geography, where remoteness and peripherality do not only depend on geographical distance from major urban areas but also on the endowment and quality of infrastructures allowing integration between the rural and the urban space.

The dataset

Following such multidimensional approach, 24 variables are collected in order to identify the heterogeneity of EU rural areas (Table 1). The variables refer to the aforementioned four different thematic areas: i) socio-demographic features (7 variables); ii) structure of the economy (7 variables); iii) land use (3 variables); iv) geography (7 variables). Although most of these variables are conventional in multidimensional approaches to rurality (except the fourth area), some comments are needed for the variables "Population" and "Average SGM".

In the former case, it is worth noticing that all adopted variables are expressed in relative terms in order to make them independent on regional size that shows a remarkable heterogeneity in the sample. For instance, the group of variables "Socio-demographic features" are meant to express the demographic structure and dynamics (as in the case of "Population Variation") regardless the regional size. Nonetheless, the lack of any variables expressing the regional size would prevent from separating those regions whose specificity is, in fact, being dominated by the presence of large towns or urban agglomerations. Therefore, the "Population" variable turns out to be necessary to isolate this group of highly urban regions and identify their main characteristics.

Variable "Average SGM" is included among the second group of variables ("structure of the economy"), although, in fact, it does not represent the relevance of the agricultural sector within the regional economy but the characteristics of the regional farms both in terms of economic performance and size. Therefore, it seems needed to distinguish "agricultural" regions due to a relatively underdeveloped economy from highly devel-

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[2] In order to avoid distorting "edge" effects, in computing accessibility and distances European regions bordering the territory covered by ESPON have also been taken into account.

oped regions where agriculture still maintains a relevant share within the economy due to highly competitive farms. In the latter case, the strength and relevance of the agricultural sector within a given rural region is often caused by a strong integration with the urban space; this is not necessarily true in the former case (von Thünen, 1826).

These variables are collected at EU27 NUTS 3 territorial level. Although the NUTS 2010 classification is currently in force (Commission Regulation (EC) No 105/2007), Eurostat data have not yet been fully updated. Therefore, for the purpose of the current work, the NUTS 2006 classification (Commission Regulation (EC) No 1059/2003) is adopted. Thus, the original sample size is composed of 1303 NUTS 3 regions. However, further adjustments in the sample have been made to exclude specific regions. In particular, regions far from the European continent have been excluded (the NUTS 3 regions belonging to the French *Departements d'outre-Mer* and to the Spanish and Portuguese Atlantic Islands). Thus, the final sample is made up of 1288 NUTS 3 regions.

The NUTS 3 level allows a detailed representation of EU rural space. Previous studies mainly focused on the NUTS 2 level (see, for instance, Shucksmith *et al.*, 2005) which is, in fact, too large a scale to be representative in terms of rural features: most NUTS 2 regions usually include both urban and rural space. An even smaller scale (e.g., the LAU 2 level) could improve the analysis further but it is unfeasible given the current data availability for all EU Member States. Nonetheless, working at NUTS 3 level may still lead to some practical problems. Firstly, some of the adopted variables (Table 1) are not available at NUTS 3 level for all EU countries. Secondly, even when available in principle, several variables show a large amount of missing values. Missing observations have been replaced with data observed at the closest higher territorial aggregation that is either NUTS 2 or NUTS 1 level.

A third issue concerns the considerable size heterogeneity of NUTS 3 regions in the EU27. In fact, NUTS 3 regions in peripheral and more sparsely-populated countries tend to be larger than NUTS 3 regions in more central areas. A final issue about the NUTS 3 territorial scale has to do with its appropriateness for policy analysis. In particular, it may be debatable whether this scale is appropriate when analysing fund allocation for those policies whose decisions are taken at a higher level (EU or country level). This is the case of the RDP studied here. This issue will be discussed in more detail in next sections

According to the time coverage of the available data, the analysis focuses on the last observed year, ranging between 2006 and 2010. As most of the selected variables are structural, it is reasonable to assume that they are not significantly influenced by the negative economic trend which has started in 2008. In addition, two variables are included to express the main long-term dynamics within the EU in terms of population growth (2000-2010 variation) and the change in multimodal accessibility (2001-2006 variation).

A new composite measure: the peripherurality indicator (PRI)

The 24 variables described in Table 1 are expected to capture the heterogeneity of rurality and of its evolutionary stages across EU space. The passage from such multidimensional set of features to a composite measure of rurality, and then to rural typologies, is here obtained following a 3-step methodology.

First of all, conventional Principal Component Analysis (PCA) is applied to the 24 elementary variables. This technique reduces the dimension of the problem to be

Table 1. Variables adopted in the analysis grouped in 4 thematic areas.

	Variable	Definition	Year	Source	Mean	Standard Deviation
Socio-demographic features	Population	Resident population (000)	2010	Eurostat	386.00	462.34
	Population Variation	Average annual variation (in %) of the resident population	2000-2010	Eurostat	0.15	0.74
	Net Migration Rate	Ratio of the difference between immigrants and emigrants with respect to the average population, including statistical adjustments	2010	Eurostat	1.22	5.36
	Density	Ratio of the resident population on the total surface of a given area (in km2)	2010	Eurostat	456.23	1056.67
	Unemployment Rate	Unemployed population (aged 15-64) as % of the total economically active population	2009	Eurostat	8.36	3.82
	Young-age dependency ratio	Ratio of the number of people aged 0-14 with respect to the number of people aged 15-64	2010	Eurostat	22.45	3.71
	Aged dependency ratio	Ratio of the number of people aged 65+ with respect to the number of people aged 15-64	2010	Eurostat	29.02	6.39
Structure of the economy	GVA Agriculture (%)	Share of GVA from sector A (NACE classification rev. 2) on the total	2009	Eurostat	2.94	3.36
	Employment Agriculture (%)	Share of employment in sector A (NACE classification rev. 2) on the total	2009	Eurostat	7.22	9.43
	Employment Manufacturing (%)	Share of employment in sectors C-E(NACE classification rev. 2) on the total	2009	Eurostat	18.84	8.06
	Employment Services (%)	Share of employment in sectors G-U(NACE classification rev. 2) on the total	2009	Eurostat	66.43	12.36
	Per capita GDP	GDP in Euro per inhabitant (PPS)	2009	Eurostat	21,945	9,465
	Average farm size	Average agricultural area (in ha) per agricultural holding	2007	Eurostat (Farm Structure Survey)	42.74	52.57
	Average SGM	Average Standard Gross Margin (in ESU) per agricultural holding	2007	Eurostat (Farm Structure Survey)	41.13	42.13

Table 1. Continued.

	Variable	Definition	Year	Source	Mean	Standard Deviation
Land use	Artificial areas (%)	Share of total surface which is covered by artificial areas (urban fabric, industrial and commercial units…)	2006	CORINE-Eurostat	12.88	17.18
	Agricultural areas (%)	Share of total surface which is covered by agricultural areas	2006	CORINE-Eurostat	51.31	20.73
	Forests (%)	Share of total surface which is covered by forests and other semi-natural areas	2006	CORINE-Eurostat	32.82	21.90
Geography (spatial dimension)	Air Accessibility	The index is calculated by summing the population in all the other EU NUTS 3 regions, weighted by the travel time to go there by air. Values are standardised with the EU average (EU27=100)	2006	ESPON (Project 1.1.1)	92.94	37.55
	Multimodal Accessibility	The index is calculated by summing the population in all the other EU NUTS 3 regions, weighted by the travel time to go there by road, rail and air. Values are standardised with the EU average (EU27=100)	2006	ESPON (Project 1.1.1)	95.65	38.54
	Multimodal Accessibility Change	Relative variation (in %) of the Multimodal Accessibility Index	2001-2006	ESPON (Project 1.1.1)	10.11	12.22
	Distance from MEGA1	Distance from closest MEGA1 (centroid)	-	Authors' elaboration	264.95	257.70
	Distance from MEGA2	Distance from closest MEGA2 (centroid)	-	Authors' elaboration	203.48	174.76
	Distance from MEGA3	Distance from closest MEGA3 (centroid)	-	Authors' elaboration	153.42	140.80
	Distance from MEGA4	Distance from closest MEGA4 (centroid)	-	Authors' elaboration	108.86	85.05

investigated, while preserving most of the original statistical information (Everitt and Hothorn, 2010)[3].

After the extraction of the Principal Components (PCs), it is possible to compute a standardised score for each statistical unit (i.e., for each of the 1288 EU NUTS 3 regions under study). The second step consists in using these PC scores as input for a conventional Cluster Analysis (CA). The 1288 regions are grouped according to the extracted PCs and respective scores, in such a way that the units in the same cluster are more similar (in terms of rurality and peripherality) to each other than to those belonging to other groups (Kaufman and Rousseeuw, 1990). Considering the specific dataset and problem under study, a hierarchical cluster analysis is performed here, as this approach seems more suitable for properly handling outliers and it does not require the *ex ante* definition of the

[3] Due to these properties, the use of the PCA to obtain a composite measure of rurality is not new in this literature (NUI Maynooth *et al.*, 2000; Ocana-Riola and Sánchez-Cantalejo, 2005; Vidal *et al.*, 2005; Nordregio *et al.*, 2007; Bogdanov *et al.*, 2007; Monasterolo and Coppola, 2010).

number of clusters[4]. Both the PCA and the CA stress the multidimensional characteristics of rurality in Europe. Nonetheless, they are still unable to provide a comprehensive and univariate (i.e., synthetic) measure of rurality of any given EU region.

Therefore, the third methodological step consists in using the PC scores to compute a composite *PeripheRurality Indicator* (PRI). To do this, an ideal region with "extreme" urban features is identified. This ideal region represents a sort of urban benchmark across the EU and it is defined on the basis of the two EU global MEGAs: Paris and London (ESPON, 2005). For each extracted PC, the average score is computed for the two NUTS 3 regions of Paris and London, thus representing the scores for this ideal EU benchmark. Secondly, the statistical "distance" between any NUTS 3 region and this ideal urban benchmark is computed as the Euclidean distance over the k-dimensional space of the PCs extracted[5]:

$$PRI_i = \sqrt{\sum_p \left(y_{ip} - y_{ubp}\right)^2}\text{, } \forall i = 1,\ldots,n \text{ and } \forall p = 1,\ldots,k \qquad (1)$$

where $N = 1, \ldots, n$ indicates the set of regions under consideration, y_{ip} represents the i-th region's score for the p-th PC and y_{ubp} represents the urban benchmark's score for the p-th PC. By construction, the greater the PRI the more rural and/or peripheral the i-th region is. The PRI captures both a socio-economic and a geographical (spatial) distance from "urbanity": therefore, here it is called the PeripheRurality Indicator (PRI).

Main results: the EU rural space

Principal Components and Cluster Analyses

Table 2 (upper part) shows the results of the extraction of the PCs[6]. Following the Guttman-Kaiser criterion[7] six PCs should be extracted. The same indication emerges from

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[4] When studying the urban-rural typologies, both hierarchical and partitioning approaches have been adopted: Copus (1996) and Vidal *et al.* (2005) applied partitioning methods; Buesa *et al.* (2006) and Dimara and Skuras (1996) adopted aggregative (hierarchical) clustering approaches.

[5] The Euclidean distance is used to compute the PRI from the selected PCs because this distance metric is more sensitive to extreme values (therefore, it highlights more extreme rural/urban features) than other distance metrics, e.g., the Manhattan distance. The adopted metric implicitly assumes a sort of complementarity among the k different "dimensions" (in this case, different PCs) over which the distance is computed. One can argue that this complementarity might overemphasize those features of rurality/urbanity that are redundant across these different dimensions. In the present case, however, the Euclidean distance is computed on PC scores and PCs are orthogonal by construction, thus they do not contain redundant information. For this reason, it seems preferable to apply this distance calculation to the extracted PCs rather than to the original 24 elementary variables where, definitely, a significant redundancy can be observed.

[6] It is preliminarily helpful to test whether the selected variables are suitable for PC extraction. The Kaiser-Meyer-Olkin (KMO) test is applied on the original variables. This is a test of sampling adequacy calculated as the ratio between the sum of squares of all correlations of the variables and the same sum plus the sum of all bivariate partial correlations. If this ratio is low all variables do not share much variance and the PC extraction becomes less meaningful. The KMO test ranges from 0.0 to 1.0. According to Kaiser (1974), scores lower than 0.5 are unacceptable, [0.5, 0.6) are miserable, [0.6, 0.7) are mediocre, [0.7, 0.8) are middling, [0.8, 0.9) are meritorious, [0.9, 1.0) are marvellous but satisfactory values should be greater than 0.5. In the present case, the KMO test on the variables under study is fully satisfactory (.738).

[7] The Guttman-Kaiser criterion suggests choosing those principal components which are able to explain at least 70-80% of the cumulative variance.

the analysis of the eigenvalues (PC with eigenvalues greater than 1). However, there is a substantial drop in all indicators between the 5th and the 6th PCs. Thus, in order to make the interpretation easier, only the first 5 PCs are extracted. They account for 67.46% of total variance, with each of them explaining at least 5% of total variance and showing an eigenvalue greater than 1.5. To provide an interpretation of these 5 PCs, the respective factor loadings are reported in the lower part of Table 2. Factor loadings are the correlation coefficients between the original variables and the PCs. Factors are regarded as not significant (and not shown in Table 2) when they are smaller than |.15|. The sign and the magnitude of these factor loadings allow an economic interpretation, and hence labeling, to be attributed to the extracted PCs.

PC1 – Economic and geographical centrality: this refers to both geographical and economic variables. It is positively related to accessibility indexes, share of employment in services, per capita GDP, share of artificial areas and demographic density. It is negatively related to the distance from MEGAs and the relevance of the agricultural sector. Thus, PC1 sums up most of the characteristics of "urbanity" in terms of both economic centrality and accessibility.

PC2 – Demographic shrinking and ageing: this PC mainly refers to socio-demographic features. It is positively related to the aged dependency ratio, whereas it is negatively related to the annual population variation, young-age dependency ratio and net migration rate. This PC thus captures two interrelated social phenomena, demographic shrinking and population ageing, which are deeply affecting many rural regions across Europe.

*PC3 – Manufacturing in rural areas***:** this PC is positively linked to the share of employment in manufacturing activities and to the share of agricultural areas. The young-age dependency ratio is also positively related to the PC, while a negative factor loading is observed for the unemployment rate. This can be explained by the fact that, across Europe, manufacturing regions usually show a better performing labour market.

PC4 – Land use: forests vs. agricultural areas: this PC captures land use characteristics, by distinguishing agricultural regions from regions covered by forests. The average farm size also shows a negative factor loading. Regions with the highest scores for this PC are mountain regions (e.g., the Alps, the Pyrenean region and Northern Scandinavia), while the lowest scores are observed in the North-Western European plain areas.

PC5 – Urban dispersion: this PC is positively related to demographic density, % of artificial areas on the total, % of employment in manufacturing activities. Thus, positive values for PC5 are associated to urban and industrial areas. However, PC5 is also negatively related to annual population variation, net migration rate and the young-age dependency ratio. Thus, it captures a sort of declining "urbanity", or urban dispersion associated to industrial decline.

On the basis of the selected PCs, a standardized score can be assigned to each NUTS 3 region. Moving away from these factor scores, regions can be clustered applying a hierarchical CA (the agglomerative algorithm AGNES is used)[8] that generates the whole hierarchy of clusters. Finally, seven clusters of homogeneous regions are identified. Cluster centres for the five PCs are reported in Table 3 (upper part). According to these results,

[8] AGNES is the acronym of AGglomerative NESting. The algorithm is included into the 'cluster' package of Software R (R version 2.15.2 has been used).

Table 2. PC extraction (eigenvalues and variance explained of the first 7 PCs) and factor loadings (only significant values, ≥ |.15|, are reported).

	Variable	PC1	PC2	PC3	PC4	PC5	PC6	PC7
PC extraction								
	Eigenvalues	7.61	2.82	2.08	1.90	1.78	1.20	0.91
	% of variance	31.71	11.74	8.66	7.92	7.44	4.99	3.79
	Cumulative % of variance	31.71	43.45	52.11	60.03	67.46	72.46	76.24
PC factor loadings								
Socio-demographic features	Population		-0.302		-0.175			
	Population Variation		-0.348			-0.401		
	Net Migration Rate		-0.201			-0.327		
	Density	0.176	-0.237	-0.317		0.350		
	Unemployment Rate			-0.346	-0.231			
	Young-age dependency ratio		-0.270	0.199	-0.234	-0.286		
	Aged dependency ratio		0.388		0.194			
Structure of the economy	GVA Agriculture (%)	-0.287						
	Employment Agriculture (%)	-0.290						
	Employment Manufacturing (%)			0.381	0.274	0.326		
	Employment Services (%)	0.272		-0.290		-0.268		
	Per capita GDP	0.248			0.165			
	Average farm size		0.412	-0.201	-0.214			
	Average Standard Gross Margin		0.383		-0.283			
Land use	Artificial areas (%)	0.217	-0.186	-0.301		0.343		
	Agricultural areas (%)			0.403	-0.479			
	Forests (%)				0.541	-0.229		
Geography (spatial dimension)	Air Accessibility	0.314						
	Multimodal Accessibility	0.322				0.151		
	Multimodal Accessibility Change					0.162		
	Distance from MEGA1	-0.280	-0.168	-0.183				
	Distance from MEGA2	-0.296						
	Distance from MEGA3	-0.293		-0.157				
	Distance from MEGA4	-0.209		-0.226		-0.229		

Source: Authors' elaboration.

the clusters can be interpreted and labelled as follows: i) *Peripheries*; ii) *Nature-quality regions*; iii) *Cities*; iv) *Remote regions*; v) *Mixed-economy regions*; vi) *Shrinking regions*; vii) *Manufacturing regions*.

The EU geography emerging from the CA can be illustrated through the territorial distribution of the seven clusters (Figure 1) as well as through the distribution of the number of NUTS 3 regions, resident population and total area across clusters (Table 3, lower part). Nevertheless, a detailed description of the characteristics and territorial distribution of clusters goes beyond the scope of the present study. Here, our main interest is the representation of EU space that the cluster output generates.

Table 3. Defining typologies: cluster centres according to the 5 PCs and size in terms of number of regions, population, total area.

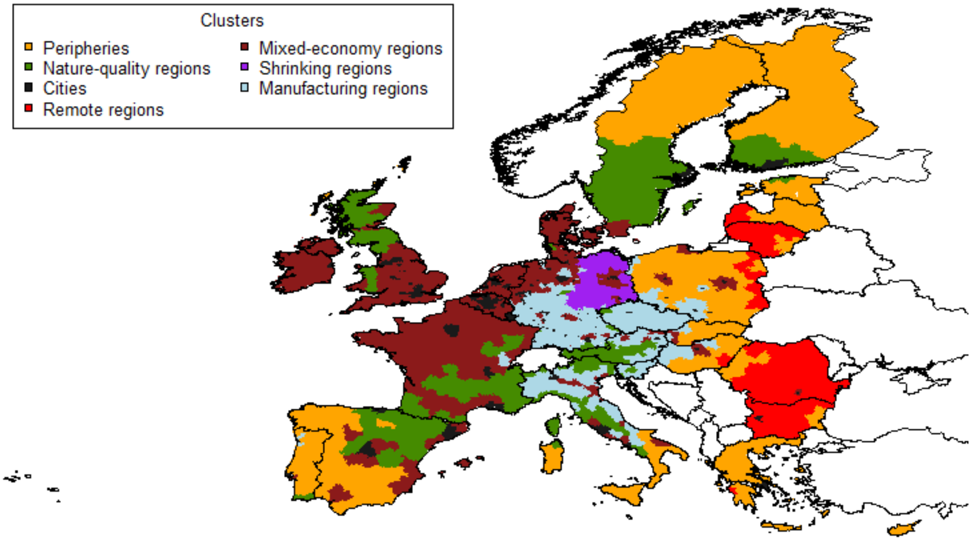
Clusters	PC1	PC2	PC3	PC4	PC5	
1. Peripheries	-3.25	-0.65	-0.68	0.08	-0.43	
2. Nature-quality regions	-0.10	-0.07	-0.41	1.43	-1.40	
3. Cities	3.42	-1.47	-1.29	-0.15	0.97	
4. Remote regions	-6.33	-0.89	0.00	-0.77	1.89	
5. Mixed-economy regions	1.10	-0.01	0.85	-1.06	-0.72	
6. Shrinking regions	0.38	4.09	-1.70	-1.10	0.46	
7. Manufacturing regions	0.54	0.42	1.16	1.10	0.53	
Clusters	No. NUTS 3 regions	Population (000 inhab.)	Area (km2)	% NUTS 3 regions	% Population	% Area
1. Peripheries	204	74,965	1,516,377	15.84	15.08	35.22
2. Nature-quality regions	140	42,546	774,287	10.87	8.56	17.98
3. Cities	185	133,075	118,173	14.36	26.77	2.74
4. Remote regions	77	27,065	411,722	5.98	5.44	9.56
5. Mixed-economy regions	315	132,382	927,612	24.46	26.63	21.54
6. Shrinking regions	91	10,774	93,351	7.07	2.17	2.17
7. Manufacturing regions	276	76,370	463,983	21.43	15.36	10.78
Total	1,288	497,177	4,305,504	100	100	100

Source: Authors' elaboration.

The PRI

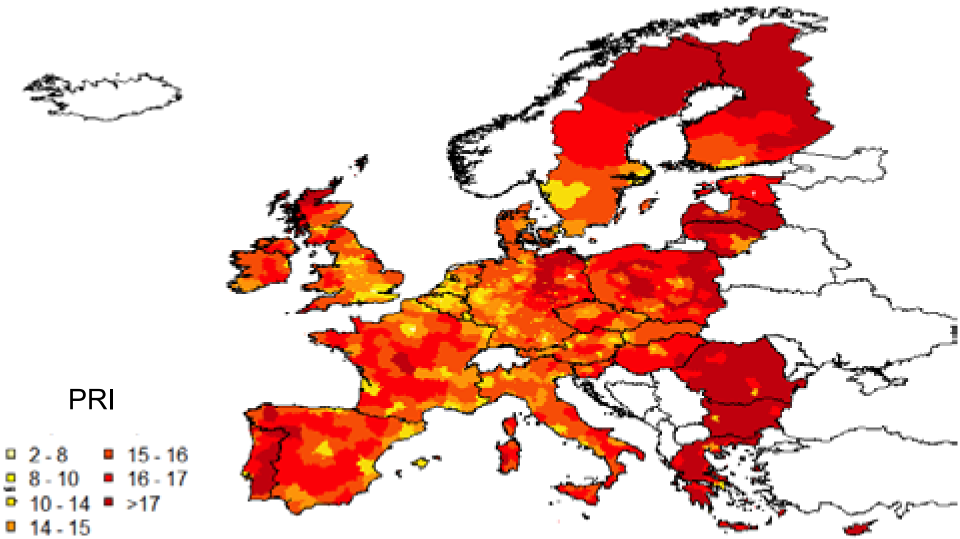
In order to achieve a composite measure of rurality, the PRI is computed applying (1) to the regional factor scores obtained from PCA. The PRI is expressed as the distance from an urban benchmark: thus, the greater this indicator, the more rural and/or peripheral is the given region. In Figure 2, the values of the PRI are mapped for the whole set of 1288 NUTS 3 regions. As expected, the lowest values are observed in capital-city regions and, more generally, in the urban space. On the contrary, the highest values are observed for Mediterranean regions, and for regions located in Central-Eastern Europe and in Northern Scandinavia. Looking at Figure 2 from a more general perspective, the PRI shows a wide range of variation, from very urban contexts (e.g., EU capital cities) to deep rural and remote conditions (peripheral EU areas). Therefore, this indicator draws a relatively new geography of EU regions, by including different but interdependent features in a single and comprehensive measure.

Figure 1. Territorial distribution of the seven clusters.



Source: Authors' elaboration.

Figure 2. PRI values across EU NUTS 3 regions.



Source: Authors' elaboration.

Although groups of regions with relatively homogeneous values can be identified, a large variability in the values of PRI is observed when considering the seven clusters previously identified. Table 4 shows the average values (arithmetic means) and the standard deviations of the PRI across clusters. On average, the PRI ranges from 11.32 ("Cities") to 18.50 ("Remote regions"). Some clusters share very similar PRI average values. Although standard deviations are generally low, it is debatable whether the difference observed in the average PRI has any statistical significance or not. To answer this question, an ANOVA (analysis of variance) was performed. It suggests that no statistical difference in the value of the PRI occurs between Mixed-economy regions and Manufacturing regions and between Manufacturing regions and Nature-quality regions. These clusters somehow represent a sort of middle ground between "urbanity" and "rurality". While some clusters clearly identify the urban space and others clearly show rural and peripheral features, "intermediate" clusters identify the combination of urban and rural features in a well-integrated continuum, representing one of the key features of European space[9].

Table 4. PRI across clusters: averages and standard deviations.

	PRI	
	Mean	Standard deviation
1. Peripheries	16.74	0.78
2. Nature-quality regions	15.46	0.74
3. Cities	11.32	2.03
4. Remote regions	18.50	0.91
5. Mixed-economy regions	14.99	0.85
6. Shrinking regions	16.28	1.06
7. Manufacturing regions	15.18	0.76

Source: Authors' elaboration.

The allocation of RDP funds across the EU space

In order to finally analyse the spatial allocation of the RDP funds at the adopted territorial scale, thus investigating its relationship with the aforementioned definitions of (periphe)rurality, data have also been collected for the expenditure of the European Agricultural Fund for Rural Development (EAFRD). We consider data on total EAFRD real expenditures, taking into account the total real payments as registered *ex post* by the EU bureaus. Payments at individual (anonymous) beneficiary level are then aggregated at NUTS 3 level, according to the NUTS 2006 classification (about 1300 regions). Years 2007 to 2009 are considered.

By themselves, these expenditure data do not allow directly representing the different support across regions due to their considerably different size. Therefore, the analysis on

[9] This feature is particularly evident in some EU countries or macro-regions; for instance, the North-Eastern and Central Italian regions (Esposti and Sotte, 2002).

fund allocation is performed here by means of three indexes expressing the expenditure intensity:

1. RDP expenditure per unit of Utilised Agricultural Area in ha (€/UAA);
2. RDP expenditure per agricultural Annual Working Unit (€/AWU);
3. RDP expenditure per thousand Euros of agricultural Gross Value Added (€/.000 €).

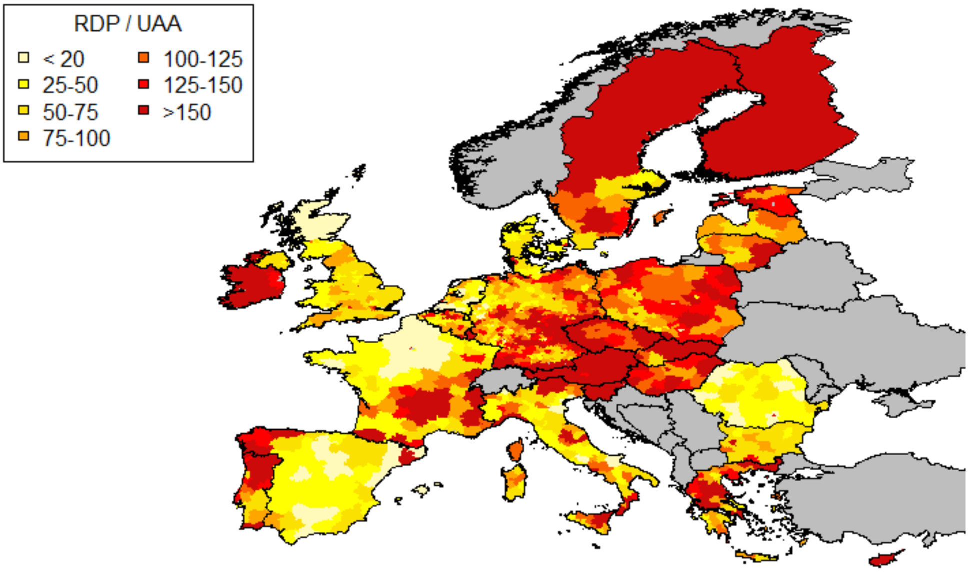
Data on utilised agricultural areas (UAA) and annual work units (AWU) are collected from the Eurostat Farm Structure Survey (2007). Data on agricultural GVA are taken from Eurostat National Accounts (the average value for years 2007 to 2010 is considered).

According to the declared objectives, the final step of the present analysis consists in linking these findings with the territorial allocation of the EU policy and funds dedicated to rural space, defined as the RDP. This link may eventually show to what extent the RDP is "rural", that is, to what extent its funds prevalently go to more rural regions. This research question is not new as previous studies have already investigated the territorial allocation of EU RDP funds (Shucksmith *et al.*, 2005; Crescenzi *et al.*, 2011). However, these works have , at the most, considered the NUTS 2 level, and the allocation of RDP support did not concern real expenditure but only the *ex ante* allocation of funds (as established by political decisions taken at EU and national levels), or the reconstruction of real expenditure based on some sample observations (e.g., FADN data). Moreover, these investigations limited their attention to the EU15. Therefore, what is new in the present analysis is the higher level of territorial disaggregation (NUTS 3 level) and coverage (EU27), and the nature of the expenditure data. The latter are the total real payments as registered *ex post* by the EU bureaus aggregating individual beneficiaries at NUTS 3 level. A further novelty is that, while previous studies prevalently linked EU support to the degree of rurality expressed through conventional indicators (mostly the OECD-Eurostat urban-rural typologies), here rurality is measured though a comprehensive and continuous indicator, the PRI.

It can be argued that the NUTS 3 territorial scale might not be appropriate for this kind of policy analysis, that is to say, for investigating the distribution of policies whose *ex ante* allocation decisions are taken at a higher territorial and institutional level (EU, NUTS 0 or NUTS 1 level). In fact, this is the main reason why working at NUTS 3 level with real expenditure data may offer greater insight than previous works. The expenditure observed at this territorial scale does not only depend on *ex ante* top-down political decisions but also on the bottom-up capacity of territories to attract and really use these funds. This kind of policy evaluation, therefore, does not only concern political decisions but also has to do with the real implementation of policies across space. With this implementation, the underlying higher-level political decision is only one of the factors involved. The other contribution is the capacity and the specific features of individual territories (NUTS 3 regions) which are likely to affect the expenditure they really receive.

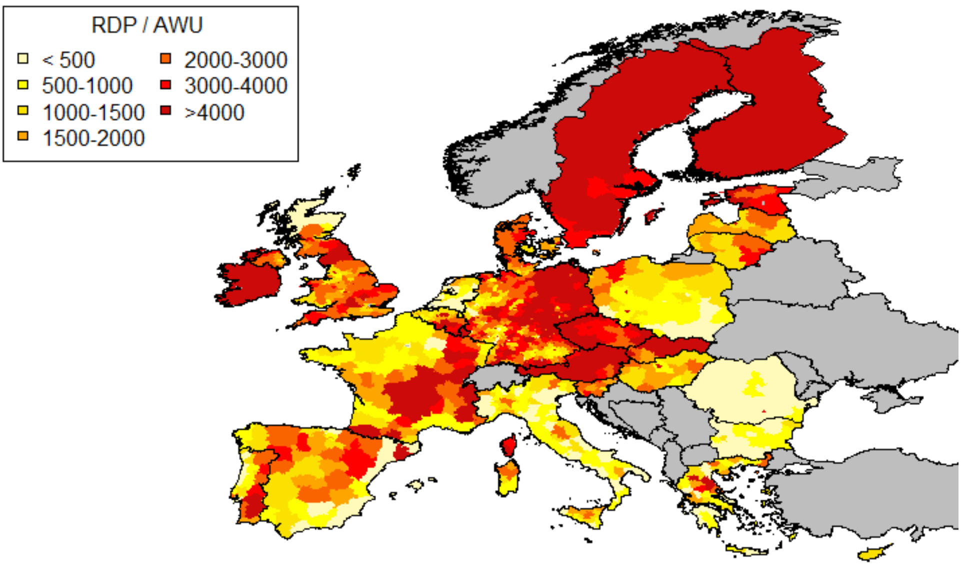
As discussed in previous sections, the allocation of the overall RDP funds for the period 2007-2009 is investigated here by looking at the RDP expenditure intensity. This indicator allows comparability despite size heterogeneity across the regions. Figures 3-5 map expenditure intensity per UAA, per agricultural AWU, per thousand Euros of agricultural GVA. The values show a remarkable heterogeneity, but the overall picture also significantly changes with the three indicators. For example, RDP expenditure intensity per unit of

Figure 3. 2007-2009 RDP expenditure per unit of Utilised Agricultural Area (€/UAA).



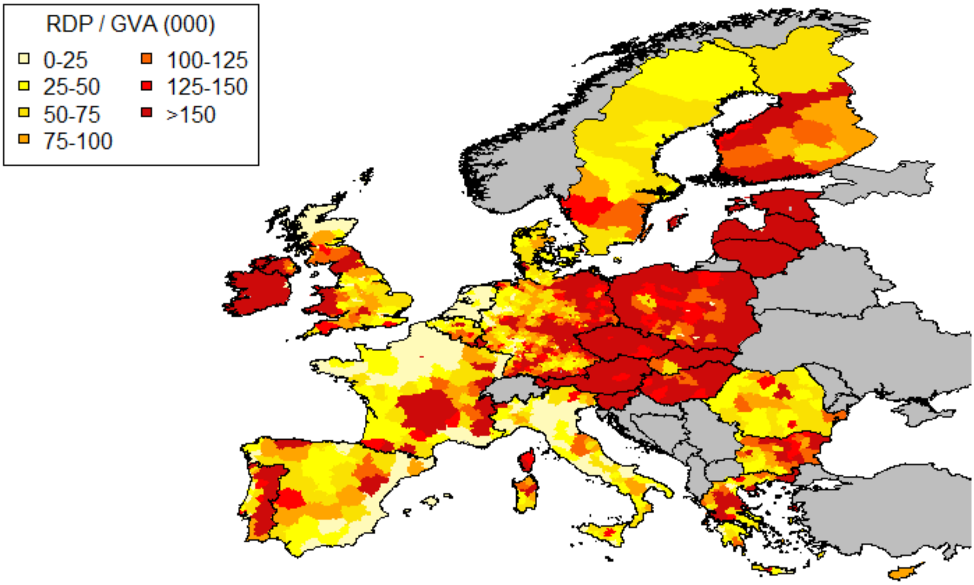
Source: Authors' elaboration.

Figure 4. 2007-2009 RDP expenditure per agricultural Annual Working Unit (€/AWU).



Source: Authors' elaboration.

Figure 5. 2007-2009 RDP expenditure per unit of agricultural Gross Value Added (€/.000 €).



Source: Authors' elaboration.

UAA is particularly low in the plain regions of Northern France and in Spain. Conversely, RDP expenditure intensity per agricultural GVA (in thousand €) is particularly high in the regions of Eastern European Countries due to their lower agricultural GVA levels.

Looking at the territorial distribution of these expenditure intensities, a preliminary remark concerns the particularly high values observed in a few cases. Analysing in detail the RDP expenditure intensity at NUTS 3 level, some outliers can be detected: they mainly refer to urban areas, where UAA and AWU are quite small but expenditure is still significant as several RDP beneficiaries are located in these regions. This implies "artificially" high levels of expenditure intensity. Thus, according to the distribution of these indexes (and by considering very high thresholds), these outliers have been eliminated from the dataset. After excluding these outliers from the dataset, the number of the observations under investigation is of 1273, 1271 and 1284 regions, respectively.

Table 5 reports the value of the expenditure intensities per urban-rural Eurostat typology and per cluster. When the Eurostat typologies are considered, the evidence fully confirms the expectations: PR regions are more supported than PU regions, both in terms of expenditure levels and intensities. Thus, the EU RDP seems properly targeted towards more rural areas.

However, when the expenditure distribution across the seven clusters is considered, a more complex pattern emerges. In terms of expenditure per unit of UAA, "Shrinking regions", "Nature-quality regions", "Manufacturing regions" and "Peripheries" are more supported than other clusters. On the contrary, both "Remote regions" and "Mixed-economy regions" receive much lower support. The expenditure per agricultural AWU tends to be higher in the "Shrinking regions" and "Nature-quality regions", while, once again, "Remote regions" receive less support than all the other clusters. This evidence is at least partially reversed in the case of expenditure per agricultural GVA: in this case, "Remote regions" receive higher support, due to the lower value of agricultural GVA registered in these areas.

The differentiated support intensity emerging for the clusters demonstrates that the allocation of RDP expenditure across EU space is much more articulated and controversial than it appears to be by simply looking at the Eurostat urban-rural typologies. Table 6 shows the correlation coefficients between the RDP expenditure levels and intensities and two alternative indicators of rurality: a quite conventional and frequently adopted indicator (i.e. population density); a multidimensional composite indicator taking explicitly into account the spatial dimension, i.e., the PRI. Firstly, it is worth noticing that PRI expresses rurality in the opposite direction to density: the greater the PRI, the greater the degree of rurality. Table 6 provides contradictory evidence if we look at expenditure levels. A higher density (lower rurality) implies lower expenditure, but the same occurs with a higher PRI (higher rurality). Therefore, these indicators are apparently not concordant in capturing rurality and the consequent RDP expenditure allocation. When considered in terms of expenditure intensity, however, the correlations seem to be more coherent. Whatever indicator of rurality we consider, it does not seem to be statistically correlated to RDP expenditure per UAA. On the contrary, the expenditure per agricultural AWU is lower in more rural regions regardless of the indicator we adopt. The opposite is found in the case of RDP expenditure per agricultural GVA: support is higher in more rural regions, although this correlation is not statistically significant when rurality is expressed simply by population density.

Table 5. 2007-2009 RDP expenditure per urban-rural typology and cluster (regional averages).

	Total expenditure (000 €)	Expenditure per UAA (ha)	Expenditure per AWU	Expenditure per agric. GVA (in .000 €)
Urban-rural typology				
Predominantly Rural (PR) regions	19,130	130.76	3,048.21	154.72
Intermediate (IR) regions	10,611	111.33	2,997.10	117.72
Predominantly Urban (PU) regions	5,786	101.07	2,625.86	89.82
Clusters				
1. Peripheries	23,393	135.55	1,801.96	137.13
2. Nature-quality regions	19,059	147.76	4,720.54	180.06
3. Cities	4,304	120.35	3,273.43	96.04
4. Remote regions	14,389	60.44	533.27	124.88
5. Mixed-economy regions	11,933	69.89	2,067.80	76.20
6. Shrinking regions	6,934	152.09	7,797.13	242.67
7. Manufacturing regions	9,851	141.76	2,714.20	127.04

Source: Authors' elaboration.

Table 6. Pearson correlation coefficients between RDP expenditure and different indicators of rurality (p-values in parenthesis).

	Density	PRI
Total expenditure	-0.051 (0.066)	-0.094* (0.001)
Expenditure per UAA	0.033 (0.245)	-0.023 (0.416)
Expenditure per AWU	0.091* (0.001)	-0.073* (0.009)
Expenditure per Agri GVA	-0.009 (0.760)	0.090* (0.001)

*: statistically significant at 5%.
Source: Authors' elaboration.

Some concluding remarks

The aim of this paper is to analyse the distribution of RDP support across the EU27 space and, in particular, to assess to what extent this supposedly "rural" policy really supports rural regions more than non-rural, or urban, ones. Answering these empirical research questions, however, brings to light a preliminary and preparatory conceptual and practical issue, that is, how to properly define "rurality". In this regard, the paper tries to go beyond the conventional definition of urban-rural typologies proposed by the OECD (1994; 1996; 2006) and Eurostat (2010). A multidimensional approach is suggested in order to capture the multiple features and the considerable heterogeneity within the EU rural space. While remoteness and peripherality still represent major weaknesses for many rural regions, it is true that there are many examples of rural areas showing high integration with the urban space and good economic and social performance. At the same time, the urban space may itself encounter serious difficulties and several urban areas show a clearly declining tendency. In the middle, a wide and heterogeneous intermediate space can hardly be interpreted according to the rough urban-rural dichotomy as it presents both dimensions, both manufacturing activities and agricultural specialisation, both good performance and declining trends.

Rurality must therefore be measured with a composite and comprehensive indicator (the PRI is proposed here) and at an appropriate territorial scale (NUTS 3 is considered here). By computing the PRI at NUTS 3 scale, the analysis of the degree and characteristics of rurality suggests a more complex geography at EU level. Following this "geography", the analysis of the spatial allocation of RDP expenditure may also provide unexpected evidence. On the basis of the results obtained, the EU RDP seems less "rural" than stated in the political intentions. In relative terms (per unit of land and, above all, of labour), urban and central regions tend to be more supported than strongly rural and peripheral ones.

In fact, this is not a completely new and surprising result. Although on a different geographical scale and coverage and using different policy data, previous findings have already questioned a clearly positive link between the degree of rurality and the amount of support delivered through the EU RDP (Shucksmith *et al.*, 2005, Crescenzi *et al.*, 2011).

In fact, assuming this is one major purpose of this policy, the RDP does not apparently induce any real redistributive effect from the urban to the rural space throughout the EU. Therefore, the present paper confirms that empirical evidence seriously challenges the territorial targeting of this EU policy and that a further research effort is needed to understand the main forces behind this spatial allocation and to analyse more thoroughly the RDP expenditure by looking at the spatial allocation by single axes and measures.

Nonetheless, the evidence provided here goes beyond the policy issue of better targeting the rural policy to the rural space. It also questions how the rural space itself is defined and identified within the EU. Urban-rural typologies and, more generally, dichotomous or discrete variables, but also univariate indicators (such as population density), do not provide an accurate enough representation of EU geography and, therefore, of the rural space. The multidimensional nature of rurality involves socio-economic characteristics, the structure of the economy, remoteness and peripherality. This multidimensionality also implies that rurality is naturally heterogeneous in its characteristics, especially across a quite diverse space like the EU27. All these features must be captured by composite and comprehensive indicators in order to allow a more accurate and insightful analysis of the link between policy support and the degree and nature of rurality.

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