RURAL DEVELOPMENT POLICIES AT REGIONAL LEVEL IN THE ENLARGED EU. THE IMPACT ON FARM STRUCTURES

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ABSTRACT

This paper provides an investigation of the effectiveness of the main measures applied in Rural Development Programs, in particular those for farm structure intervention, at regional/national level on the basis of cluster analysis with spatial econometric tools. The main results are: (*i*) the identification in the enlarged Union of the main rural systems, (*ii*) the suggestion of some indications for the rural policies after 2013, in particular for the farm structures intervention.

Keywords: Spatial Cluster Analysis, Territorial Systems, Rural Development Programs, Farm Structures.

1. INTRODUCTION

Recently there has been growing interest for the research directed to the study of territorial differentiations of the agricultural and rural development, with a special concern to the long-term transformations. Indeed it is becoming more and more urgent to understand how the farm structures at regional level are adjusting to the deep changes in progress, in particular o for the measures introduced by the CAP reform of 2003 and for the Cohesion Policies (Lisbon Strategies).

The aim of the present work, that starts from the results obtained from a previous analysis at regional level for the EU-27 States (Montresor, 2007a; Montresor et al., 2007b; Pecci and Sassi, 2008), is to point out some relevant methodological issues in order (A) to identify the main rural systems, (B) to suggest some indications for the rural policies after 2013, in particular for the farm structures intervention.

In our work we start from some considerations:

1. The development of competitive and efficient farm structures has been one of the central goals of the EU agricultural policies. However, the EU agricultural policies have worked in many regions counteractively to these goals by creating distortions in the use of resources;

2. Within the EU, there is a marked difference in farm structures between Northern and Southern countries, with the average size of holdings much smaller in the latter than in the former. Because of farming demographic in the Southern Regions, a large drop of farm numbers is to be expected. By contrast, farms in the Northern Regions will tend to be medium-sized or large;
3. Ten New Member States (NMS) acceded to the EU on 2004 and 2007 and this enlargement requires careful consideration. The analysis is complicated by dual structure of farms, by the distorting impact of the CAP and finally and by the importance of the agricultural sector in the NMS;

After 2013, the EU decision makers have to find differentiated tools for this polarized situation characterized by different demand of intervention. In particular, our analysis will contribute to answer to a question: how the agricultural and rural policies after 2013 can contribute to a new social sustainability at territorial level in the rural world, taking into account the differences in the farm structures, in the management methods and in the income levels?

In the light of these considerations, the paper provides a preliminary investigation of the effectiveness of the main measures applied in Rural Development (RD) programs at regional/national level on the basis of:

a) cluster analysis with spatial econometric tools, in view of obtaining homogeneous groups in terms of needs of the respective programming area and of reducing the complexity produced by the number of RD programs (81).
b) analysis of the measures applied in the RD programs in the light of the results of the clustering, in order to verify the correspondence between the measures and the cluster-specific findings with emphasis on Axis 1 (Improving the competitiveness of agriculture and forestry).

In the second paragraph we explain the indicators utilized in the spatial clustering, in the third the spatial analysis methodology and its results and in the fourth paragraph we describe the clusters.

2. DATA SET

The intervention logic of each RD programs should be based on the “hierarchy of objectives” or “objective tree”, according to Common Monitoring and Evaluation Framework (2006). The “Rules for Application of Council Regulation 1698/2005” define compulsory common indicators (both context-related and impact-related baseline indicators) which reflect

Community priorities and objectives. At the same time these indicators are supposed to depict the needs and the characteristics of the programming areas. They fall into two categories: objective indicators and context indicators. The objective indicators are directly linked to the wider objectives of the program and they reflect the situation at the beginning of the programming period and a trend over time. The context indicators provide information on relevant aspects of the general contextual trends that are likely to have an influence on the performance of the program. The latter indicators serve two purposes: (i) contributing to identify the strengths and weaknesses within the region and (ii) helping to interpret impacts achieved within the program in light of the general economic, social, structural or environmental trends. Consequently these indicators have been the starting point for the selection of the baseline indicators for clustering the programming areas. The aim was to group programming territories; they range from socio-demographics features; economic development; structure of the labour market; agricultural indicators divided by land allocation, livestock, structure, efficiency and competitiveness (Table 1).

The socio-economic context, affecting agricultural productivity and being relevant for rural development, has been taken into account considering the following areas: economic development, labour market, infrastructure, and territorial attraction capacity in terms of economic activities and population. The demographic features have been represented by population density (*Denspop*) and ageing index (*Ageing*). The level of economic development has been approximated by per capita GDP in Euro (*GDPab*) and in PPS (*GDPpps*), the Gross Value Added for the agriculture, industry and services (*GVAagri*, *GVAindu*, *GVAserv*) in percent of the total GVA, that are the best estimates of the average programming areas income and productivity according to the available data. Labour market has been represented in terms of rate of employment in agriculture, industry, services and food industry (*Empagri, Empindu, Empserv, Empfood*), rate of total unemployment (*Unempto*), female unemployment (*Unempfe*) and long term unemployment (*Ltunemp*).

The selected agricultural indicators refer to efficiency, competitiveness, sustainability. Farm structures underline the efficiency and competitiveness of the farm sector, the well-being of farm households, the design of public policies and the nature of rural areas. It includes many dimensions among which farm organization, characteristics of farmers and their households, concentration of production, and tenure. Farm structures affect the social and economic territorial development levels and, in the same time, policy interventions affects farm structures.

The available data has allowed to consider:

- *Farm structure*. The ageing structure in agriculture in terms of share of farmers more than 55 years old (*Oldhold*), the average dimension of the farm (*UAAfarm*), the physical farm size distribution ratio as share of UAA in units with more than 50 ha of UAA (*Aar50ha*) and those with less than 5 (*Aar5ha*), the rate of the holding numbers with less than 5 ha of UAA (*Nfa5ha*) and more than 50 ha of UAA (*Nfa50ha*);
- *Land allocation* and *Livestock.* The indicators are: the rates of UAA under arable land (*Arable*), cereals (*Cereals*), industrial crops (*Indcrop*), permanent crops (*Permcrop*), forage crops (*Forage*), permanent pastures (*Permpast*), vineyards (*Vineyar*) and woodlands as percent of total agricultural surface (*Woodlan*). For the livestock the number of bovine animals over 1 year per ha of UAA (*BoviUAA*) and per ha of UAA under forage crops and permanent pastures (*Bovifor*); the same indicators are presented for the milk cows (*DaicoUA* and *Daicofor*). Furthermore, pigs (*PigsUAA*), goats (*GoatUAA*), sheeps (*ShepUAA*), and poultry (*PoulUAA*) per ha of UAA;
- *Productivity*. The agriculture Gross Value Added per ha of UAA (*GVAUAA*) and per annual work unit (*GVAAWU*). Two indicators, at last, were built with the Fadn standard results, Standard Gross Margin per ha of UAA (*SGMUAA*) and Gross Farm Income per ha of UAA (*GFIUAA*).

In the construction of the data-set and in the clustering some problems emerge:

- *Comparability of territorial units*. The programming areas within the RD programs are quite heterogeneous in terms of size. While national programs dominate in the NMS and the small older ones, the other states have split-up their programs into regional units (mostly NUTS 2) with the exclusion of France. Thus, the comparability for some indicators is impossible, because their needs and territorial condition are substantially different.
- *Data availability*. Only a limited number of indicators is easily available in the Eurostat-Regio database. Especially the environmental indicators have of a strong lack of data (both for the New MS as well as the regional (i.e. NUTS 2) level.

For overcoming the problem of different territorial size of the RD programming areas the indicator values had to be standardised $((x-\overline{x})/sdx)$. In order to depict rural development it would be misleading to include large agglomerations as their growth and employment potentials would hide the real needs of the rural areas. We have the possibility to remove the metropolitan regions from the programming territories. However it would have been necessary to cut out all agglomerations, but this is not possible in all the MS (especially in the NMS) since some indicators are available only at NUTS2 level. For this reason it was

necessary to execute the cut at NUTS2 level; that was determining the necessity of doing the same cut also for the resources allocated for the intervention axes. Since our data availability was not allowing to do this last cut, the largest metropolitan areas were not removed.

3.THE SPATIAL ANALYSIS

The model has been run using the *Geographically Weighted Regression* (GWR) approach in order to verify the role of spatial dependence and heterogeneity and to implement the model, with the variables that are locally significant. GWR is a useful technique to explore spatial non-stationarity (Fotheringham et al., 2002) by calibrating a varying coefficient regression model with the form

$$(1) \qquad y_i = a_0(u_i, v_i)\sum_{j=1}^{p} \beta_j(u_i, v_i)x_{ij} + \varepsilon_i, \qquad i = 1, 2,\ldots.., n,$$

where y_i are the observed dependent variables, (x_{i1}, x_{i1},…, x_{ip}) the explanatory variables at the location (u_i,v_i) in the studied area and ε_I are the error terms that are assumed to be independent and normally distributed with zero mean and common variance σ^2.

The GWR is a non parametric technique that enables to consider in each programming area how much the relationship between the dependent variable and the explanatory variables might varies depending on the localization at which the regression is undertaken. It has importance for policy makers because policy response might be related not only to the amount of financial resources allocated in the single axis of intervention, but also to allocation in the different measures. Furthermore, the GWR results enables to detect the existence of subgroups of programming areas which are influenced by homogeneous values of non-stationary parameters. In other word, the estimates allows to understand both factors that contribute more accurately to dependent variable outcome and the spatial relationships between the dependent variable and each explanatory variable across the study area.

The variable selection in our GWR model was made considering the variables with the strong correlation with the Agricultural Value Added. For identifying potentially significant variables, GWR regression were performed to test the relationship between the dependent variable and each of the independent variables.

The model that in our case exhibits the more efficient estimate is[1]:

[1] In the GWR model with the dependent variable *SGMUAA* and the same explanatory variable, non-stationary parameters are the same. We have preferred to adopt the model illustrated in Table 2 because all the variables come from the Eurostat-Regio database. That assures, according to us, a bigger degree of data homogeneity.

$GVAUAA_i = b_0(i) + b_1(i)\ Aar5ha_i + b_2(i)\ Bovifor_i + b_3(i)\ Cereals_i + b_4(i)\ Oldhold_i + b_5(i)\ Nfa50ha_i + b_6(i)\ SheeUAA_i + b_7(i)\ Vineyar_i + b_8(i)\ GVAagri_i + b_9(i)\ GVAindu_i + b_{10}(i)\ Ltunemp_i + b_{11}(i)\ Denspop_i$

where:

$b_0(i)$ is intercept term of programming area *i*;

$b_{(1\ to\ 10)}(i)$ are the local parameters of the independent variables.

The results shows a significant improvement in the GWR estimation, in term of residual sum of square, 4.995, with respect to ordinary least square, 23.575. The value of the global F-test of non-stationarity, as proposed by Brundson et al. (1999), is 3.535 (p-value = 0.000); it confirms that the choice of the GWR model is appropriated.

In the analysis of the rural development, the relationships between the level of development and various factors are generally assumed to be stationary in space. As a result, it produces an 'average' or 'global' relationship that might not be valid over the entire study area. In fact, it is reasonable to assume that the relationships between the level of rural development and various factors at the regional level are different in different regions.

The parameter estimates of various factors affecting rural development in the EU programming areas show different spatial variations indicating possible spatial non-stationarity. Thus, the GWR technique appears to be a useful method to investigate spatial non-stationarity. For testing the presence of nonstationarity in our GWR model we have adopted the testing method F3 developed by Leung et al. (2000).

The results reveal some important points. *Vineyar*, *GVAindu* and *Ltunemp* do not show significant spatial variation, while *Aar5ha*, *Bovifor*, *Cereals*, *Oldhold*, *Nfa50ha*, *SheeUAA*, *GVAagri* and *Denspop*, are significantly varying across the space. This underline that spatial non-stationarity plays important role in the explication of different levels of agricultural value added in the EU RD programming areas.

Figure 1 show the choropleth map of the local values of R^2; the map indicates that there is some little variation in the R-square statistic; however, the statistic ranges from 0.881 to high values (up to 0.95), with the highest values occurring to the east of the study area. These results must nevertheless be interpreted with care, since the model is potentially non-stationary (Fotheringham et al. 2002).

3.1 Multicollinearity

In the GWR approach with more than two explanatory variables it is very difficult to interpret the VIF values, because it doesn't consider collinearity with the constant term and doesn't

clarify the nature of the collinearity. Belsley (1991) suggest another diagnostic tool for collinearity that uses singular value decomposition (SVD) of the design matrix **X,** $\mathbf{X} = \mathbf{UDV}^T$, where **U** contains the eigenvectors of **X** and **D** is a diagonal matrix containing eigenvalues, to form condition indexes of this matrix and variance-decomposition proportions of the coefficient of the covariance matrix. Belsley highlights that a large value of the condition index is associated with each near linear dependency, and the variables involved in the dependency are those with large proportions of their variance associated with large condition indexes; the variance-decomposition proportions in excess of 0.5 indicate the variables involved in specific linear dependencies. The joint conditions of condition index > 30 and variance-decomposition proportions > 0.5 diagnose the presence of strong collinear relations as well as determining the variables involved[2].

Prudentially assuming a discriminating value of the condition index equal to 15, Table 3 shows the condition indexes and variance-decompositions proportions for the largest variance component for the observation index greater than 15, only for the variables with variance-decomposition proportions that exceeds 0.5. The joint conditions of condition index > 15 and variance-decompositions proportions > 0.5 indicate that collinearity doesn't disturb our model. The variance-decomposition proportions for *Aar5ha*, and *Denspop* shows values > 0.5 in tree programming areas (Cyprus, Sicily and Malta), while *Nfa50ha* and *GVAagri* shows values > 0.5 only in Malta.

4. THE CLUSTERS

The nine non-stationary parameters of GWR results (see Table 2) were submitted to the clustering procedure; for this purpose we have utilized the MCLUST library of R environment. It implements parameterized Gaussian hierarchical clustering algorithms and the EM algorithm for parameterized Gaussian mixture models (Fraley and Raftery, 2006).

The overall aim of the cluster analysis consists in reducing the complexities of the territorial realities in EU-27. This means that a balance had to be achieved between the maximum of homogeneity within the clusters and the minimum possible number of clusters with a reasonable distribution of homogeneous territorial units involved in RD programming in each of them. The results of the mixture clustering approach show that a number between 10 and

[2] In the GWR framework SVD of design matrix is (Wheeler, 2007)

$$\mathbf{W}^{1/2}(i)\,\mathbf{X} = \mathbf{UDV}^T$$

where $\mathbf{W}^{1/2}(i)$ is the square root of the diagonal weight matrix at location *i* calculated from the kernel function.

12 clusters would be optimal. The final decision of thirteen clusters (Figure 2) was based upon the most equal distribution of territorial units among the different clusters.

The main territorial systems in the enlarged EU can be described as follows (Table 4 and Table 5)

A) *The Mediterranean Systems.* This is a large share of European territory where the level of socio-economic development is significantly lower than the rest of the EU (only 16% of total GDP). The contribution of these areas is high for both agricultural productivity (28.9% of the GVA) and employment (20.6% of total agricultural employees). Inside them the major structural problems are the wide presence of small farms and the old age of holders (22.7% in the first case and 26.5% in the second one).

This comprehensive system includes two profoundly different sub-systems:

• The southern Italian regions (cluster 11) and Greek ones (Cluster 1) with lower socio-economic development, but with higher agricultural productivity. Especially in these territories the remarkable structural problems influence substantially the profitability per agricultural employees. At territorial level the small farms represent a large share of the total universe in both cases (almost 80%), while the older holders exceed 67% in Italian regions and 57% of the Greek ones.

• The Spanish and Portuguese regions (clusters 7 and 8), in which socio-economic development trends are different, but where agricultural productivity per hectare is lower, however not influence the profitability per employee, given the relatively minor presence of structural problems. Although the greater presence of larger farms (more than 50 ha), it still remains the problem of the ageing, even if less than in the system described above.

Almost one quarter of total budget of Pillar II (22.7%) was addressed to these regions. In both sub-systems, a large part of the funds were directed to Axis 1 and a minor measure to Axis 2. The budget allocated in the Axis 3 is less than the minimum threshold required by the Community strategic guidelines (10%). However, in the clusters 11, 7 and 8, the budget for the LEADER program is higher than the minimum threshold, demonstrating a clear preference for development planning from the bottom. The breakdown of the measures under Axis 1 (Table 6) shows that, despite the wide presence of elderly farmers, resources for the measure 112 (setting up of young farmers) oscillate only around 10-13%, with minimum standards for the measure 113 (early retirement). The local policy makers have preferred to concentrate resources on the measure 121 (farm modernization), especially in the Italian regions, while, in the Greek and Spanish ones, the emphasis has been placed on measures 123 (adding value to agricultural products) and 125 (improving and developing infrastructures).

In cluster 1 and 11 the indicator per hectare is considerably higher, even for the choice of increasing the co-financing, while it is lower in Spanish and Portuguese regions. In this way EU aids represent a substantial part of the agricultural productivity in the first sub-system, while in the second their role decreases significantly. In any case the impact of these aids on the socio-economic development is almost irrelevant, unless we consider the multiplier effect.

B) *The PECO systems*. A large part of the European territory is included in these systems in which socio-economic development trends are situated strongly below the European average (only 6% of total GDP). Inside them, the primary sector plays a key role with over half of total agricultural employees in EU, but with the lowest productivity rate (6% of total GVA). The structural problems are relevant, with over 68% of the total farms UAA with a size of less than 5 hectares and nearly 60% of elderly holders.

Even in this case we can identify two sub-systems, with significant structural differences, while the average GDP per capita and the agricultural profitability are almost similar:

• In the Czech, Hungarian, Romanian, Bulgarian regions (cluster 12), the farms below 5 hectares represent over 90% of the total and the older holders almost 64%;

• In the Polish, Lithuanian, Estonian and Latvian regions (cluster 6), the main problem is the wide presence of small farms, while we find a large presence of young holders.

A large part of the II Pillar budget (almost 40%) was directed to these systems, in particular the resources for the Axis 3 represent more than 67% of the forecasted funds for this axis. Indeed the agriculture of these regions requires high levels of rural development measures in order to increase their competitiveness; the restructuration should especially encourage the reduction of employment in primary sector with the aim to increase labour productivity, but this requires significant interventions for diversifying economic activities at local level.

The analysis of the programs shows that the budget resources were directed mainly to Axis 1 in both the sub-systems and to a lesser extent to the Axis 2, while those engaged in the Axis 3, although above the threshold strategic lines (18.8% and 20% respect to 10%), are not so relevant. The budget for the LEADER program is rather low, because of the lower capacity to promote local programs. The breakdown of the measures under Axis 1 shows that the resources for the setting up of young farmers have been throughout minimal, but those for the early retirement are high only in Czech, Hungarian, Bulgarian and Romanian regions. Policy-makers have preferred concentrate the resources on the measure 121 (farm modernization) in the Estonian, Lithuanian, Latvian and Polish regions (over 41%) and on the measure 123 (adding value) in the others.

The indicator per hectare of UAA, although high, is lower than that observed in the others regions ex ob. 1. However, these aids represent an important part in agricultural productivity (respectively 24% and 20% of GVA) and they can increase the competitiveness of these regions, but even in these cases, the impact on the socio-economic development is irrelevant, without taking into account the multiplier effect.

C) *The continental systems*. In these regions we find the high levels of development (nearly 53% of total GDP), with a strong contribution to the EU agricultural productivity (43% of the GVA), but with a low role in agricultural employment (only 20% of total agricultural employees). Inside them, the structural problems are almost irrelevant: a large part of the UAA falls within large farms (almost 50% of the total) and the presence of elderly holders are also low, slightly more than 8% of the European total.

Also in this case, we can observe the presence of some sub-systems, characterized by some small differences in their structures and in their agricultural productivity:

• The Dutch and Belgian regions (cluster 3) and in German ones (cluster 2) represent the territories where the structural problems are almost absent; a large proportion of the UAA falls in large farms, led by young holders. However, there are significant differences in the agricultural productivity, higher than the European average in the Dutch and Belgian regions.

• In the British and Irish regions (cluster 4) and French (cluster 9), there are instead almost 50% of older holders and significant differences in agricultural productivity; in particular the regions of cluster 4 shows the latter indicator below the European average.

In these systems, it was allocated almost 25% of the budget of the II Pillar, in particular those addressed to Axis II are higher than average, given the need to deal with the environmental problems related to the conflict in resource use, due to demographic settlements and to the productive activities. The analysis of the programs highlights how the aids for Axis 1 are about 30%, with the exception of the French regions where they represent only 13.6%. The funds for the Axis 2 are considerably higher: they reach the highest point in English and Irish regions (72%). The share of resources for the Axis 3 gather prominence in the British, Irish and German regions (about one quarter of the total).

Given the almost absence of structural problems in the regions of Belgium, Holland and Germany, the breakdown of resources Axis 1 highlights how the plans have not been included funds for setting up of young farmers and for early retirement, preferring to concentrate resources on the measure 121 and especially on the measure 125 (improving end developing infrastructures), which amounts to 42% of the total in the Dutch and Belgian regions. The second sub-system shows a different situation because of the wider presence of elderly

holders. In the French regions 26% of resources are devoted to the setting up of young farmers, while in the Irish and English ones 16% is addressed to the early retirement.

The indicator per hectare shows that the EU aid is the smallest of the European scenario, but, excluding Dutch and Belgian regions, the funds of local institutions have almost doubled the EU funds. Therefore, only through local and national intervention, the impact of these aids affects agricultural competitiveness in Dutch, Belgian and Irish regions, while there is no apparent impact on the socio-economic development at local level.

D) *The others systems*

- *The hinge regions between Mediterranean and continental systems (cluster 10)*

These regions occupy a small part of European territory; their main characteristic is that the agriculture represents a link between continental and Mediterranean systems. Inside them, it falls almost all northern and central regions in Italy, with a high level of socio-economic development (7% of GDP) and agricultural productivity (5.9% of the total GVA). At territorial level the primary sector plays a more relevant role both for income, and for employment (nearly 4% of local employees), attributable to the remarkable presence of agro-food industry, often of quality products. Analysing their structural profile we can observe the presence of some relevant problems at territorial level: almost 64% of the farms have less than 5 hectares and 66% of the units have en older holder.

In these territories only 2% of the budget of the II Pillar was assigned. The analysis of the submitted programs shows a slight majority of resources for Axis 2 (almost 43%) than for Axis I. The measures for the Axis 3 are in line with the strategic guidelines, while those for LEADER program is relevant, privileging so the planning from the bottom. For facing up the major structural problems, regional policy makers have preferred to concentrate resources on the measure 121 (almost 41%) and 123 (adding value), allocating only 15% of resources for the setting up of young farmers. The indicator per hectare shows a remarkable intervention of local institutions with an increase of almost 130% of the funds, but the impact of this aid on agricultural competitiveness is minimum (only 2% of GVA).

- *The northern regions (cluster 5)*

These regions present the highest level of socio-economic development in the EU (6.7% of GDP) and a substantial agricultural productivity (5.5% of GVA) associated with the minimum agricultural employment (only 2, 8% of total employees). The agriculture system of these territories appears solid with no significant structural problems. The farms with less than 5 hectares of UAA represent only 10% of the total at the territorial level; however, approximately 40% of units are run by older holders.

In these regions it has been allocated over 5% of the resources of the II Pillar. The analysis of the plans reveals that the majority of funds are allocated to Axis 2 measures, not just to resolve a conflict in resource use (the population density is very low), but mainly for the protection and preservation of the environment. The resources for Axis 1 are low (just 14%) and they are allocated for both the setting up of young farmers (almost 15%), and the farm modernisation (34%). The indicator per hectare shows a high intervention of national and local institutions, with an increase of co-financing of nearly 160%.

- *The systems with the prevalence of mountain agriculture (cluster 13)*

Austrian and Slovenian regions, which fall into this system, have an average level of socio-economic and agricultural development. Their main characteristic is represented by a wide spread of mountain agriculture; permanent pastures represent over 58% of the UAA and woodland 41% of total area. From a structural profile, large farms are widely diffused, but with significant presence of elders.

These territories have been targeted 5.6% of the resources forecasted for the II Pillar. The examination of the plans shows that the majority of funds were allocated to Axis 2 (over 68%), while to the Axis 1 only almost 18%. The breakdown of resources Axis 1 shows that almost 10% of the resources have been addressed to measure 112 and 40% to the farm modernisation. The indicator per hectare shows that the EU subsidy is the highest compared to all other systems (more than 1215 Euros), with further increase by local and national institutions of more than 65%. Relevant is therefore the contribution to agricultural productivity (16% of GVA).

5. SOME CONCLUSIONS

The adopted methodology, the spatial analysis, allowed to determine the indicators which have characteristics of non-stationarity in order to define homogeneous groups of programming areas, reducing the complexity of the issues to be addressed in the preparation of regional plans. In particular, the clustering of the GWR non-stationarity parameters of the indicators leads to the individualization of 13 groups of programming areas, in which 81 regional programs are operating. This approach has encountered some difficulties related to the strong regional differences in dimension areas of each programming area. In fact these range from regions geographically limited (as Molise in Italy) with low spatial complexity, up to entire states (France, Poland), which contain strong spatial dishomogeneity within them.

Our study has allowed to achieve some results:

1) The funds for local planning of agricultural and rural development are still very limited and may not have a sufficiently strong redistribution effect in order to reduce disparities and consequently the structural differences existing in European agriculture. This occurs particularly in the regions of the PECO countries (clusters 6 and 12), where the lack of financial capacity involves a minimum co-financing, and partially in the Mediterranean regions with strong differences in socio-economic development (cluster 1 and 11), with a relatively modest increase of co-financing. The situation is different in the continental regions characterized by an high development level, where local and regional institutions substantially increased EU aids, often more than doubled. Regarding the choice between Axis, in all the systems a large part of resources have been concentrated in Axis 1, with the exception of some continental regions where there is no need of further strengthening of the sector (cluster 2, 4 and 5) and where decision makers preferred to substantially increase the budget of the Axis 2. The mountainous and northern territories of the EU also moved in this direction, since the environmental protection is a priority. Finally, with regard to the resources of the Axis 3 for the diversification of the activities and for the rural development, they line up almost anywhere on the threshold of strategic guidelines, with the exception of the systems in PECO countries and the German regions.

2) From a structural point of view, the main problems concern the ageing of the holders and the consequently necessary generational change. In this respect the choices contained in the plans highlight some results. The systems where the presence of older conduction threatens undermine competitiveness are often those where the funds in the setting up of young farmers (measure 112) and early retirement (size 113) are lower. This happens both in the territories included in the PECO countries (with the exception of the Polish regions, which have included substantial funding for the measure 113), and in the Mediterranean regions ex ob. 1. In other words, since they faced with serious problems of competitiveness and the need of overcoming of regional disparities, the policy makers preferred to direct resources towards the improvement of agricultural structures. It is questionable whether elderly farmers will be able to address the complexities of an increasingly global agricultural scenario, which requires innovation and human capital formation. Even in this case, the continental regions where this problem is lower are much more able to incorporate these measures in their programs. An example is given by France (cluster 9) that allocates more than a quarter of the funding of Axis 1 for the setting up of young farmers.

3) The second problem is that related to farm size. If small farms can provide an image of identity in rural scenery, it is also clear that in many territories the small farms will not be

able to face out global competition. In this direction, a large part of the resources in the Axis 1 was concentrated in measure 121 (farm modernization), which always exceeds one third of the total until more than 40% in cluster 12 (Czech, Bulgarian and Romanian regions) and in cluster 10 (northern and central Italy). Even in this case the regions of ex ob. 1 (cluster 1, 7 and 8), with large presence of farms below 5 hectares, devote fewer resources to farm modernization, although it should be noted that in Spanish and Portuguese regions (clusters 7 and 8) policy makers preferred to concentrate over than 50% of the resources in the Axis 1 for improving the quality of production and the agricultural infrastructure (measures 123 and 125).

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Table 1 - Indicators considered in our analysis

Variable	*Description*	*Source*	*Year*
	SOCIO-ECONOMICS		
Denspop	Population density	Regio	2005
Ageing	Ageing index	Regio	2005
GDPab	Per capita GDP (euro)	Regio	2005
GDPpps	Per capita GDP (PPS)	Regio	2005
GVAagri	Gross value added Agriculture (% total)	Regio	2005
GVAindu	Gross value added Industry (% total)	Regio	2005
GVAserv	Gross value added Tertiary (% total)	Regio	2005
GVAfood	Gross value added Agriculture (% total)	Regio	2005
Empagri	Employees in Agric (% total)	Regio	2005
Empindu	Employees in Industry (% total)	Regio	2005
Empserv	Employees in Tertiary (% total)	Regio	2005
Empfood	Employees in Agrofood sector (% total)	Regio	2005
Unempto	Unemployment ratio	Regio	2005
Unempfe	Female unemployment ratio	Regio	2005
Ltunemp	Long term unemployment rate	Regio	2005
	AGRICULTURE		
	Structures		
UAAfarm	UAA per farm	Regio	2005
Aar50ha	% UAA of holdings with >=50 ha UAA	Regio	2005
Aar5ha	% UAA of holdings with less than 5 ha UAA	Regio	2005
Nfa50ha	% Holdings with >=50 ha UAA	Regio	2005
Nfa5ha	% Holdings with less than 5 ha UAA	Regio	2005
Oldhold	% farms with holder aged more than 55	Regio	2005
	Production systems		
Arable	% UAA under arable land	Regio	2005
Cereals	% UAA under cereals	Regio	2005
Indcrop	% UAA under industrial crops	Regio	2005
Permcrop	% UAA under permanent crops	Regio	2005
Forage	% UAA under forage crops	Regio	2005
Permpast	% UAA under permanent pastures	Regio	2005
Vineyar	% UAA under vineyards	Regio	2005
Woodlan	Woodlands (% of total agric. area)	Regio	2005
BoviUAA	Bovine animals over 1 year per ha of UAA	Regio	2005
Bovifor	Bovine animals over 1 year per ha of UAA under forage	Regio	2005
DaicoUA	Milk cows per ha UAA	Regio	2005
Daicofo	Milk cows per ha of UAA under forage	Regio	2005
PigsUAA	Pigs per ha UAA	Regio	2005
GoatUAA	Goats per ha UAA	Regio	2005
SheeUAA	Sheeps per ha UAA	Regio	2005
PoulUAA	Poultry per ha UAA	Regio	2005
	Labour and Productivity		
Famiawu	% Family labour forces	Regio	2005
AWUUAA	Total labour forces per ha UAA	Regio	2005
GVAUAA	Agriculture gross value added per ha UAA	Regio	2005
GVAAWU	Agriculture gross value added per AWU	Regio	2005
SGMUAA	Standard gross margin per ha UAA	Fadn	2007
GFIUAA	Gross farm incombe per ha UAA	Fadn	2007

Source: our elaborations and estimates

Table 2 - parameters of GWR model

Parameter	*Min.*	*Lwr Quart.*	*Median*	*Upr Quart.*	*Max.*	*Stationarity*
Intercept	-0.6478	0.1463	0.4113	0.5293	0.8848	No
Aar5ha	-1.0220	0.1486	0.4560	0.6647	1.0810	No
Bovifor	-0.0073	0.1552	0.3065	0.4052	0.5558	No
Cereals	-0.2841	-0.1496	-0.0243	0.0572	0.2454	No
Oldhold	-0.7947	-0.3294	-0.1162	0.0236	0.1339	No
Nfa50ha	-0.6628	-0.3566	-0.2095	-0.0807	0.1031	No
SheeUAA	-0.1489	-0.0756	0.0098	0.2478	1.3030	No
Vineyar	0.0672	0.1582	0.2098	0.2963	0.6134	Yes
GVAagri	-0.3732	-0.1149	0.1104	0.3784	0.8691	No
GVAindu	-0.3232	-0.1806	-0.0625	-0.0251	0.1671	Yes
Ltunemp	-0.4904	-0.2635	-0.1954	-0.1445	0.0276	Yes
Denspop	-0.2916	0.0909	0.4460	0.5179	1.5320	No

Source: our elaborations and estimates

Table 3 - Condition index > 15 and variables with variance-decomposition proportion > 0.5 (bold)

NUTS	*Condition index*	*Aar5ha*	*Nfa50ha*	*GVAagri*	*Denspop*
CY	19.807	**0.957**	**0.698**	**0.791**	**0.663**
ITG1	15.144	**0.924**	0.164	0.293	**0.833**
MT	17.800	**0.909**	0.184	0.320	**0.843**

Source: our elaborations and estimates

Table 4 - Main indicators of clusters (in percent of total EU-27)

Cluster	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
Programming Areas (n)	2	6	7	9	5	4	13	4	5	7	10	5	4
GDP	2.0	8.8	15.1	21.1	6.7	2.7	6.9	2.5	16.9	7.0	4.6	3.1	2.8
Employees in Agric.	4.4	3.3	4.9	4.7	2.8	22.0	8.6	3.7	7.8	2.6	3.9	28.9	2.5
Employees in Industry	1.8	9.3	11.3	13.8	4.3	8.7	8.9	3.3	11.8	7.1	3.4	13.6	2.6
Employees in Tertiary	2.3	7.5	13.2	19.2	5.7	6.8	7.8	2.9	14.3	4.9	4.5	8.4	2.5
Population	2.4	7.2	11.7	15.7	4.6	9.4	7.5	3.2	13.8	5.3	5.5	11.4	2.3
Unemployment ratio	2.5	9.8	12.2	9.8	4.2	16.6	7.0	4.0	12.8	2.5	6.2	10.9	1.4
Female unemployment ratio	3.2	9.3	10.9	8.7	4.1	16.7	7.9	4.5	13.7	3.0	6.3	10.3	1.4
Long term unemployment rate	2.8	11.4	13.6	6.1	2.3	20.8	4.9	2.1	11.6	1.9	7.9	13.7	0.9
Gross value added Agriculture	5.0	4.5	9.7	8.6	5.5	6.1	9.3	6.5	20.2	5.9	7.4	8.5	2.8
Gross value added Industry	1.6	10.9	15.1	19.9	6.7	2.9	7.7	2.8	13.8	8.3	3.2	3.9	3.1
Gross value added Tertiary	2.0	8.1	15.1	22.5	6.4	2.4	6.5	2.3	18.1	6.4	5.0	2.5	2.7
Agricultural area	2.4	5.2	5.2	12.7	5.3	11.7	10.8	5.8	16.9	2.4	3.8	15.3	2.4
UAA of holdings l. t. 5 ha UAA	7.4	0.8	1.0	1.4	0.4	21.1	6.0	4.7	3.2	3.1	9.1	39.8	2.0
UAA of holdings >=50 ha UAA	0.6	5.9	5.8	15.6	5.9	5.5	12.4	6.2	21.8	1.7	2.1	15.0	1.5
Holdings l. t. 5 ha UAA	6.5	0.5	0.6	1.3	0.2	18.9	4.4	3.4	2.4	2.5	8.4	49.5	1.3
Holdings >=50 ha UAA	1.1	4.9	7.7	15.7	8.1	4.8	10.5	5.4	29.7	2.0	2.6	5.8	1.7
Farms with holder aged > 55	6.4	0.7	1.0	3.2	1.1	13.5	6.4	4.2	3.9	3.3	9.5	45.4	1.5
Agric. total labour forces	5.0	2.8	3.4	4.5	1.9	21.1	7.0	3.7	7.7	3.3	6.0	31.1	2.5
Arable land	2.1	6.0	5.7	7.8	7.7	14.2	8.0	4.6	18.5	2.6	3.0	18.1	1.5
Cereals	2.1	6.2	5.1	6.0	6.8	17.0	8.3	4.3	16.1	2.7	2.9	20.7	1.5
Industrial crops	4.0	8.0	5.4	6.9	4.2	8.5	2.3	4.5	21.6	1.5	0.4	31.5	1.2
Forage crops	1.2	5.2	6.3	13.1	12.7	10.0	5.1	0.6	26.5	3.3	4.9	9.5	1.7
Permanent crops	10.4	0.7	1.3	0.5	0.2	3.6	15.7	29.4	12.3	3.8	14.7	6.0	1.3
Vineyards	3.5	0.9	1.9	0.1	0.0	0.0	15.5	19.8	28.0	6.8	11.5	9.7	2.3
Permanent pastures	1.5	4.5	5.0	24.1	1.9	8.5	15.0	3.6	15.0	1.8	3.0	11.6	4.3
Woodlands	0.2	2.9	1.4	2.2	22.9	7.4	13.0	5.2	6.0	3.0	4.6	19.7	11.4
Bovine animals	0.9	7.2	10.2	22.5	5.9	7.9	6.9	1.1	21.4	4.4	2.0	6.7	2.9
Pigs	0.9	5.9	17.9	8.4	11.8	12.8	12.1	3.8	9.9	4.9	0.5	8.9	2.4
Sheep	8.8	1.3	2.1	39.6	1.0	0.5	15.0	6.0	9.2	0.2	5.4	10.3	0.5
Poultry	2.4	2.9	11.2	14.7	3.0	11.1	8.9	4.4	19.2	7.8	1.4	12.0	1.1
Total area	3.3	4.4	4.4	8.1	19.5	11.3	9.0	4.7	13.6	2.5	3.3	13.2	2.7

Source: our elaborations and estimates

Table 5 - Mean of main indicators of clusters

Cluster	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
Programming Areas (n)	2	6	7	9	5	4	13	4	5	7	10	5	4
Per capita GDP (euro)	17812.7	27229.9	28679.9	29824.6	32271.0	6395.2	20597.1	17314.0	27293.4	29472.2	18810.3	5970.7	26980.6
Employees in Agric (% total)	11.8	2.7	2.5	1.7	3.3	16.3	6.5	7.5	3.6	3.0	5.8	16.1	6.2
Employees in Industry (% total)	22.6	33.2	25.5	22.8	23.3	29.2	30.3	30.3	24.6	36.6	22.7	34.0	29.2
Employees in Tertiary (% total)	65.6	64.1	70.5	75.3	73.2	54.4	63.2	62.2	71.5	60.5	71.5	49.9	64.5
Population density	83.8	182.8	300.5	218.4	26.8	93.1	93.0	76.1	114.2	239.8	187.9	96.7	94.9
Ageing index	120.3	133.8	108.4	88.6	94.5	81.7	125.3	97.1	93.7	143.2	100.8	95.4	100.2
Unemployment ratio	10.5	12.3	9.6	5.6	7.9	19.3	8.4	12.6	9.3	4.4	14.5	9.5	5.5
Gross value added Agric. (% total)	4.9	1.0	1.2	0.8	1.6	4.4	2.6	5.0	2.3	1.6	3.1	5.4	1.9
Gross value added Industry (% tot.)	22.1	32.7	26.3	24.3	27.3	29.4	29.6	29.8	21.3	31.4	18.6	34.5	29.5
Gross value added Tertiary (% tot.)	74.0	66.2	71.8	74.8	71.0	66.1	67.6	65.6	76.0	66.2	78.4	60.0	68.5
Agric. GVA per ha UAA (euro)	2257.9	926.4	2007.9	735.7	1113.8	563.8	929.2	1198.3	1285.0	2619.6	2110.6	595.1	1248.7
UAA per farm	4.7	42.5	37.1	45.8	42.5	7.0	22.7	17.4	40.4	10.2	5.8	4.7	14.2
Total labour forces per ha UAA	0.2	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.1
% UAA of holdings l. t. 5 ha UAA	26.6	1.4	1.6	0.9	0.7	15.5	4.8	6.9	1.6	11.2	20.7	22.4	7.3
% UAA of holdings >=50 ha UAA	16.2	69.7	68.2	75.5	68.5	29.1	70.7	65.4	79.1	42.7	34.2	60.0	37.8
% Holdings with l. t. 5 ha UAA	76.9	22.1	25.4	27.5	10.6	67.7	56.3	60.6	34.4	63.8	78.4	90.9	46.0
% Holdings with >=50 ha UAA	0.8	16.1	22.0	22.8	26.0	1.2	8.9	6.5	28.5	3.4	1.6	0.7	4.1
% farms with holder aged > 55	57.2	26.7	33.9	54.3	41.4	36.9	64.7	59.5	49.0	66.1	67.2	63.9	40.1
% UAA under arable land	52.4	70.6	67.1	37.7	87.9	73.9	45.2	48.1	66.6	65.6	48.9	72.0	38.2
% UAA under cereals	30.4	41.0	33.8	16.4	44.2	50.2	26.7	25.7	32.8	38.9	26.8	46.5	21.7
% UAA under industrial crops	9.6	8.9	6.0	3.1	4.5	4.2	1.2	4.5	7.4	3.5	0.6	11.9	3.0
% UAA under forage	5.5	10.7	12.8	11.0	25.3	9.1	5.1	1.1	16.6	14.6	13.8	6.6	7.4
% UAA under permanent crops	27.3	0.9	1.6	0.3	0.3	1.9	9.2	31.9	4.6	9.9	24.5	2.5	3.3
% UAA under vineyards	2.9	0.3	0.7	0.0	0.0	0.0	2.9	6.8	3.3	5.6	6.1	1.3	1.9
% UAA under permanent pastures	19.9	28.4	31.3	62.0	11.8	23.6	45.4	20.0	28.7	24.4	26.2	24.7	58.3
Woodlands (% of total agric. area)	1.2	9.1	4.5	3.0	40.6	9.3	16.6	12.2	5.9	16.7	17.0	18.2	41.2
Bovine > 1 year per ha UAA forage	0.50	1.30	1.49	0.94	1.05	0.80	0.46	0.33	1.06	1.75	0.54	0.55	0.68
Pigs per ha UAA	0.35	1.01	3.08	0.59	1.99	0.98	1.01	0.59	0.52	1.80	0.12	0.52	0.88
Sheeps per ha UAA	2.25	0.15	0.25	1.92	0.12	0.02	0.86	0.63	0.33	0.06	0.88	0.41	0.12
Poultry per ha UAA	0.01	0.00	0.02	0.01	0.00	0.01	0.01	0.01	0.01	0.03	0.00	0.01	0.00

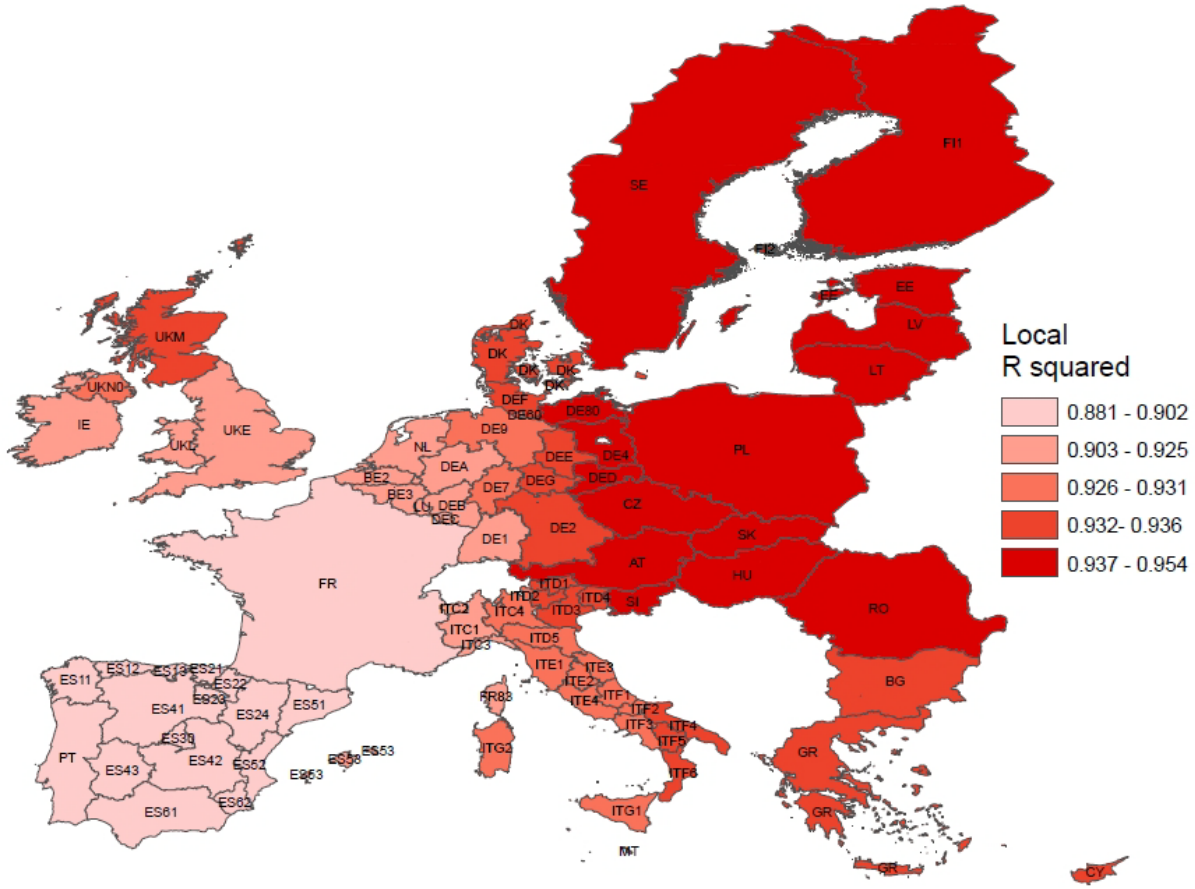
Source: our elaborations and estimates

Table 6 - Main measures applied for Axis 1 (Total public and private resources allocated in % of cluster total)

Cluster	*M 111*		*M 112*		*M 113*		*M 121*		*M 123*		*M 125*	
	Public	*Private*	*Public*	*Private*	*Public*	*Private*	*Public*	*Private*	*Public*	*Private*	*Public*	*Private*
1	1.19	0.00	13.15	0.00	11.90	0.00	21.54	54.40	15.61	40.51	29.26	0.01
2	0.84	0.15	0.00	0.00	0.69	0.00	39.24	68.29	12.34	26.32	27.09	3.80
3	2.93	1.08	0.16	0.16	0.00	0.00	33.80	71.13	10.28	21.73	42.17	4.01
4	11.07	1.64	9.38	14.46	16.36	0.00	34.51	57.92	16.21	21.42	2.14	0.72
5	15.24	1.64	14.47	19.05	4.09	0.00	33.95	57.93	16.70	18.35	3.13	0.73
6	0.78	0.00	5.69	0.09	26.30	0.00	29.45	47.37	14.84	49.06	7.97	0.84
7	1.34	0.22	9.94	3.23	7.01	0.00	20.10	25.20	23.86	59.89	27.79	4.13
8	0.59	0.00	11.00	4.04	2.23	0.00	16.86	16.57	37.82	71.66	24.06	3.88
9	3.19	0.63	26.15	0.00	1.07	0.00	31.39	56.34	13.41	34.67	3.81	1.48
10	3.64	0.27	15.50	0.00	0.63	0.00	40.57	57.14	17.81	33.94	5.89	1.91
11	3.14	0.16	11.60	0.00	1.06	0.00	36.07	55.97	19.10	31.89	13.60	1.69
12	4.09	0.15	5.75	0.00	0.65	0.00	41.65	54.37	20.42	37.48	10.77	3.24
13	5.35	0.53	9.64	0.00	2.32	0.00	39.63	65.32	17.28	23.98	9.68	4.00

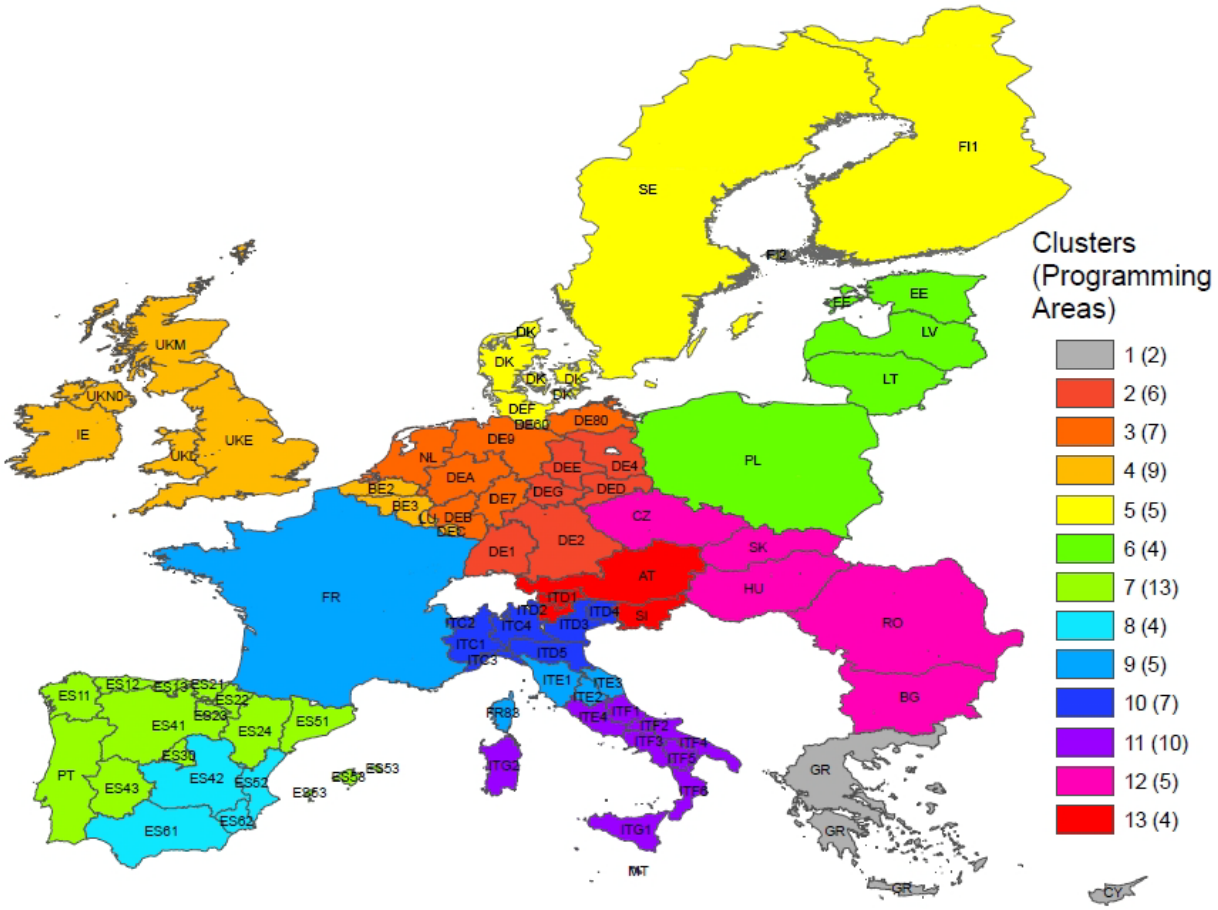
Source: our elaborations and estimates

Figure 1 - Map of local R squared



Source: our elaborations and estimates

Figure 2- Clusters' map



Cluster	*Programming areas*
1	CY, GR
2	DE4, DEG, DE1, DEE, DED, DE2
3	DE60, DE80, DEB, DEA, DE9, DE7, NL
4	DEC, LU, UKN0, BE3, IE, UKL, UKM, UK, BE2
5	DEF,DK, FI2, SE, FI1
6	EE, LT, LV, PL
7	ES11, ES12, ES13, ES21, ES22, ES23, ES24, ES30, ES41, ES43, ES51, ES53, PT
8	ES42, ES52, ES61, ES62
9	FR83, ITE1, ITE2, ITE3, FR
10	ITC1, ITC2, ITC3, ITC4, ITD3, ITD4, ITD5
11	ITE4, ITF1, ITF2, ITF3, ITF4, ITF5, ITF6, ITG1, ITG2, MT
12	RO, BG, SK, CZ, HU
13	ITD1, ITD2, SI, AT

Source: our elaborations and estimates