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Edited by
Danilo Tomić
Miladin M. Ševarlić

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RURAL DEVELOPMENT POLICY AND AGRICULTURAL PRODUCTIVITY IN THE ENLARGED EU[1]

Elisa Montresor[2], Francesco Pecci[3], Maria Sassi[4]

1. INTRODUCTION

The Common Agricultural Policy (CAP) reform of 2003 has represented an important step in the shift from price support to direct income support introduced by Agenda 2000. A key objective of the Mid Term Review has been to strengthen rural development policy in combination with decoupling. More EU funds have been directed to rural development also through "modulation". At the same time, a Special Pre-Accession Programme for Agriculture and Rural Development has prepared the entrant countries to the new CAP setting a strong emphasis on rural development measures.

In September 2005, a Rural Development regulation for the period 2007-2013 has been adopted. It has stated the following four strategic priorities: a. Fostering an enabling policy and institutional environment for broad-based and sustainable rural growth; b. Enhancing agricultural productivity and competitiveness; c. Encouraging non-farm economic growth; d. Improving social well-being, gender equity, managing risk, and reducing vulnerability; e. Enhancing sustainable management of natural resources. Within this framework the agricultural sector is called to strongly interact with local socio-economic and environmental factors for rural development and its competitiveness (one of the main objective of the CAP reform) is going to be affected by the policy action on policy sensitive socio-economic and environmental variables.

In this context, today there is the need for territorial analysis aimed at understanding the relationship between the local agricultural systems and the local socio-economic systems and in the light of this relationship it is relevant the understanding of the impact of policy sensitive socio-economic and environmental

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[2] Elisa Montresor, Dipartimento di Scienze Economiche-University of Verona-IT- elisa.montresor@univr.it

[3] Francesco Pecci, Dipartimento di Economie, Società e Istituzioni-University of Verona-IT- francesco.pecci@univr.it

[4] Maria Sassi, Dipartimento di Ricerche Aziendali-University of Pavia-IT- msassi@eco.unipv.it

variables on agriculture productivity. This is a key analysis for the policy making process required to both the old and new Member States by the new rural development policy and the modulation and cross-compliance introduced by the CAP reform. The empirical literature faces the issue mainly on the basis of a sector approach that, in the light of the role assumed by the Rural Development Policy, appears a limitation. The studies are mainly concentrated on the EU-15 partly due to limited data availability for CEECs. Furthermore, only few analysis consider the operational of spill-over the economic theory emphasises.

The paper faces these issues referring to a sample of 205 EU-25 regions and to the time period from 2000-2004. It is aimed at:

- Identifying the agricultural territorial systems within homogeneous socio-economic systems;
- Pointing out, by a Mixed Geographically Weighted Regression (MGWR) approach, the factors that locally influence the agricultural productivity and the intensity of this impact;
- Highlighting, through a cluster analysis, the existence of groups of regions within which the level of agricultural productivity is influenced by homogeneous values of the non-stationary parameters.

The analysis provides useful insights for territorial and decentralised intervention policymaking aimed at agricultural and rural development. In fact, it gives preliminary information on the variables sensitive from a policy point of view with a local impact on agricultural growth and on the intensity of this relationship.

2. METHODOLOGY

The empirical analysis has been articulated into two parts whose results have been compared in order to provide a better understanding of the possible role of the EU Rural Development Policy for agricultural growth.

From an initial dataset (see Montresor, 2002), the Principal Component Analysis (PCA) (Krzanowski, 1988) has allowed to identifying the agricultural territorial systems within homogeneous socio-economic systems for a sample of 205 EU-25 regions at NUTS2 level[1] (see note Figure 1).

This section has provided the descriptive framework within which the role of the Rural Development Policy for agricultural development has been analysed. To this purpose the selected EU-25 regions have been classified according to the

[1] Where data at NUTS2 level was not available, it has been substituted with NUTS1 information. However, these are only few cases.

relationship between the agricultural value added and the agricultural, economic, social and structural policy sensitive variables chosen according to the previously mentioned strategic priorities set out by the Rural Development reform. The parameters have made reference to a set of variables illustrated in Table 1 and have been estimated through a MGWR model that has allowed to understand the issue also keeping into account the spatial dimension.

Table 1 Indicators

Variable	Description	Source	Year range
Dependent variables			
VALADD	Farm Net Value Added / UAA (€/UAA)	FADN	2000-2002
GVAUAA	Gross Value Added in primary sector / UAA (€/UAA)	REGIO	2002
Independent variables			
	FARM STRUCTURE		
HO3555	Age Structure in Agriculture ratio: farmers <35 / >= 55 years old (%)	REGIO	2003
HO5005	Physical Farm Size Distribution ratio of holdings <= 50 / >= 5 ha UAA (Portugal <=40 UDE/<=8 UDE) (%)	REGIO	2003
BOVUAA	Total cow + beef / UAA (index EU-25 = 100 or EU-15 = 100)	REGIO	2000-2002
CERUAA	Cereal surfaces / UAA (index EU-25 = 100 or EU-15 = 100)	REGIO	2000-2002
	AGRICULTURAL DIVERSIFICATION		
INSEPA	Agriculture inseparable output/ Agriculture total output (%)	REGIO	2000-2002
OTHGAI	Farmers with Other Gainful Activities: % holders with other gainful activity (%)	REGIO	2003
	HUMAN CAPITAL		
LEARRU	Life-Long Learning in Rural Areas: % of 25_64 y.o. participating in education and training	REGIO	2004
EDUTER	Students ISCED levels 5 and 6 / Total students (<= 29 y.o.) (%)	REGIO	2000-2002
	AGRICULTURAL INNOVATION CAPACITY		
IPCAGR	IPC agriculture / IPC total (%)	REGIO	2000-2002

	OVERALL INNOVATION CAPACITY		
KNOINT	Total knowledge-intensive services (% total employment)	REGIO	2000-2002
MHTECH	High and medium high technology manufacturing sector (as % total employment)	REGIO	2000-2002
	ENVIRONMENTAL SUSTAINABILITY		
SOIRIS	Areas at Risk of Soil Erosion Areas at risk of soil erosion (Ton/ha/year)	JRC	2004
WOODSL	Woodland / Total agricultural surface (%)	REGIO	2000-2002
	ECONOMIC DEVELOPMENT		
GDPIND	Economic Development GDP(in pps)/capita (index EU-25=100)	REGIO	2000-2002
	DEMOGRAPHIC CHARACTERS		
AGEING	Ageing index	REGIO	2001
POPDEN	Population density	REGIO	2002
	LABOUR MARKET		
UNEMPR	Unemployment rate (% active population)	REGIO	2004
EMPPER	Employment Rate Employed persons/total population (15_64 y.o.) (%)	REGIO	2004
EMPRUR	Employment in PR and IR rural areas (=ER) / Mean (ER)	REGIO	2002
EMPAGP	Employment in primary sector / Total employment (%)	REGIO	2001,2002
FEMALE	Female unemployment ratio (%)	REGIO	2003
PATIME	Part-time		
SELFSH	Self-employment / Total employment (%)	REGIO	2004
	REGIONAL ATTRACTION CAPACITY		
NETMIG	Net migration rate (%)	REGIO	2001,2002,2003
	INFRASTRUCTURES		
PUBTOT	Employment in public sector / Total employment (%)	REGIO	2000-2002
BERUPO	Tourism Infrastructure in Rural Areas: Total bed places / Total population	EUROSTAT	2004
VEIPOP	Vehicles / Total population (Vehicles per capita)	REGIO	2000-2002

On the basis of the MGWR, the spatially stationary (those with an impact in all the UE-25 regions) and non-stationary (those with and impact only in a specific

region) parameters have been distinguished. The latter have been the input of the classification based on the Kohonen Self Organizing Maps clustering algorithm (Kohonen, 1997) aimed at underlining sub-groups of regions with a level of agricultural productivity affected by homogeneous values of the non-stationary parameters. The results have been compared with those of the PCA for concluding remarks.

3. THE SPATIAL ANALYSIS

The geographically weighted regression analysis has first made reference to the following model: $\boldsymbol{Y} = \boldsymbol{X}\boldsymbol{f}(\boldsymbol{Z_E}, \boldsymbol{Z_N}) + \boldsymbol{\varepsilon}$ where Z_{Ei}, Z_{Ni}, $i = 1, \ldots, n$ (the number of observations) represent latitude and longitude coordinates (East direction and North direction) of each observation (Fortheringham, Brunsdon, Charlton, 2002). It is a form of locally weighted linear regression method for exploring spatial non-stationarity. Informally, a spatial process $\{Y(\boldsymbol{s}), \boldsymbol{s} \in \mathrm{R}\}$ is stationary, if its statistical propriety is independent of absolute location in R. In particular, this would imply that the mean, $E(Y(\boldsymbol{s}))$, and variance $VAR(Y(\boldsymbol{s}))$ are constant in R and therefore do not depend upon location, $\boldsymbol{s}$. If the mean, or variance, "drifts" over R the process exhibits spatial non-stationarity.

To identify potentially significant variables, GWR regression was performed first to test the relationship between the dependent variable and each of the independent variables. The variables with a correlation index greater or equal to 0.65 have not been included.

The parameter estimates of the factors affecting rural development in the EU-25 regions show different spatial variations indicating possible spatial non-stationarity. More precisely, IPCAGR, OTHGAI, POPDEN, MHTECH and BERUPO do not show significant spatial variation, while AGEING, WOODSL, PATIME, VEIPOP, HO5005, GDPIND, UNEMPR, LEARRU, HO3555, PUBTOT, BOVUAA and EMPRUR are significantly varying across the space.

In the light of the results achieved, the basic GWR model has been extended to allow some of the independent variables of the model to be fixed while the others are varied geographically. This is referred to as a mixed GWR model (Fortheringham, Brunsdon, Charlton, 2002).

The equation tested is the following:

$$GVAUAA_i = b0 + bf1POPDENi + bf_2MHTECH_i + bf_3BERUPO_i + bf_4OTHGAI_i + bf_5IPCAGR_i + b_1(i)AGEING + b_2(i)WOODSL_i + b_3(i)PATIME_i + b_4(i)VEIPOP_i + b_5(i)HO5005_i + b_6(i)\ GDPIND_i + b_7(i)UNEMPR_i + b_8(i)LEARRU_i + b_9(i)HO3555_i + b_{10}(i)PUBTOT_i + b_{11}(i)\ BOVUAA_i + b_{12}(i)EMPRUR_i$$

where b_0 is intercept term, $bf_{(1\ to\ 5)}$ are the global parameters of the independent variables not significantly varying across the space; $b_{(1\ to\ 12)}(i)$are the local (regional) parameters of the independent variables significantly varying across the space. The results are illustrated in Table 2.

Table 2 Parameters of EU-25 GWR model

Variable	Min.	Lwr Quart.	Median	Upr Quart.	Max.	Global	SP-test*
INTCPT	-	-	-	-	-	0.0004	-
POPDEN	-	-	-	-	-	0.1952	-
MHTECH	-	-	-	-	-	0.0783	-
BERUPO	-	-	-	-	-	-0.0210	-
OTHGAI	-	-	-	-	-	0.0301	-
IPCAGR	-	-	-	-	-	0.0283	-
AGEING	-0.1957	0.0639	0.1902	0.3114	0.7967	-	***
WOODSL	-0.3761	-0.0866	0.0293	0.1472	0.4926	-	***
PATIME	-0.2010	0.4532	0.5428	0.7641	1.1560	-	***
VEIPOP	-0.8146	0.0388	0.1229	0.2671	1.1410	-	***
HO0550	-1.4310	-0.4165	-0.1073	0.0511	0.1644	-	°°°
GDPIND	-0.2487	0.0652	0.1221	0.3236	0.7389	-	***
UNEMPR	-0.3578	-0.0691	0.0311	0.1741	0.4318	-	***
LEARRU	-0.6423	-0.3576	-0.2477	-0.1089	0.3530	-	°°°
HO3555	-0.3388	0.0320	0.2135	0.3666	0.7263	-	***
PUBTOT	-0.4156	-0.2069	-0.1118	-0.0109	0.7088	-	***
BOVUAA	-0.1862	-0.0627	0.0018	0.1474	0.6048	-	°°°
EMPRUR	-0.3822	-0.2858	-0.1720	-0.0419	0.3180	-	***

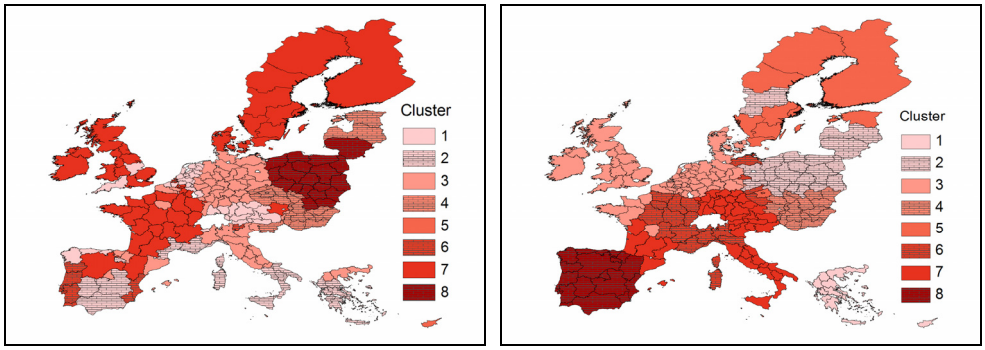
(*)Spatial variability test of local variables: ***, signif.; °°° not signif.

GWR shows a significant improvement, in term of residual sum of square (RSS), 25.0, with respect to ordinary least square (OLS), 95.1, while the F value of the ANOVA test value, as proposed by Fortheringham, Brunsdon, Charlton (2002, pp. 91-2), is 3.8114 (p-value = 0.000). Spatial non-stationarity involves several indicators: AGEING, WOODSL, PATIME, VEIPOP, GDPIND, UNEMPR, HO3555, PUBTOT and EMPRUR. These shows like significant socio-economic variables that explain the variability of the agriculture gross value added per hectare have remarkable local characteristics also in enlarged EU.

4. THE CLUSTER ANALYSIS

Figure 1 shows the cartographic presentation of the PCA and SOM clustering analysis. The Ward method and the R2 statistics have suggested eight clusters as optimal for both the approaches.

Concerning the spatial analysis based on the MGWR, the agricultural and socio-economic variables with spatial non-stationary parameters have resulted representative of the areas of economic development, demographic structure, overall and rural labour market, infrastructure, farmer age structure and agricultural environmental sustainability. A part from two indicators, PATIME and WOODSL, all the others have resulted important to the formation of the cluster even if with a different intensity. This means that the regional impact of these parameters on the agricultural productivity is combined with their spatial proximity.



a. PCA b. SOMs

Figure 1 - Cartographic presentation of the classifications result

Note: The regions in the sample are: AT11, AT12, AT21, AT22, AT31, AT32, AT33, AT34, BE21, BE22, BE23, BE24, BE25, BE31, BE32, BE33, BE34, BE35, CY00, CZ01, CZ02, CZ03, CZ04, CZ05, CZ06, CZ07, CZ08, DE11, DE12, DE13, DE14, DE21, DE22, DE23, DE24, DE25, DE26, DE27, DE40, DE71, DE72, DE73, DE80, DE91, DE92, DE93, DE94, DEA1, DEA2, DEA3, DEA4, DEA5, DEB1, DEB2, DEB3, DEC0, DED0, DEE1, DEE2, DEE3, DEF0, DEG0, DK00, EE00, ES11, ES12, ES13, ES21, ES22, ES23, ES24, ES30, ES41, ES42, ES43, ES51, ES52, ES53, ES61, ES62, FI00, FR10, FR21, FR22, FR23, FR24, FR25, FR26, FR30, FR41, FR42, FR43, FR51, FR52, FR53, FR61, FR62, FR63, FR71, FR72, FR81, FR82, FR83, GR11, GR12, GR13, GR14, GR21, GR22, GR23, GR24, GR25, GR30, GR41, GR42, GR43, HU10, HU21, HU22, HU23, HU31, HU32, HU33, IE00, ITC1, ITC2, ITC3, ITC4, ITD1, ITD2, ITD3, ITD4, ITD5, ITE1, ITE2, ITE3, ITE4, ITF1, ITF2, ITF3, ITF4, ITF5, ITF6, ITG1, ITG2, LT00, LV00, MT00, NL11, NL12, NL13, NL21, NL22, NL23, NL31, NL32, NL33, NL34, NL41, NL42, PL11, PL12, PL21, PL22, PL31, PL32, PL33, PL34, PL41, PL42, PL43, PL51, PL52, PL61, PL62,

PL63, PT11, PT15, PT16, PT17, PT18, SE01, SE02, SE04, SE06, SE07, SE08, SE09, SE0A, SI00, SK01, SK02, SK03, SK04, UKC0, UKD0, UKE0, UKF0, UKG0, UKH0, UKJ0, UKK0, UKL0, UKM0, UKN0

As far as the clusters profile is concerned, the SOM approach has allowed to underline the variables with parameters greater than the overall means. They are of specific importance because they can be understood as policy sensitive areas for the agricultural development not only at the level of a specific region but also of the sub-group of territorial units included in a specific cluster.

Through the PCA, the clusters obtained by the SOM approach have been interpreted within specific socio-economic systems. In the eight clusters base on the SOM approach the agricultural productivity is strongly sensitive to following distinctive variables:

- Cluster 1 – labour market and infrastructures. The PCA has suggested that in these regions the prevailing territorial system is Mediterranean with an average level of development and an intensive agriculture (Figure 1.a –cluster 6);
- Cluster 2 – economic development, demographic characters, infrastructures included the social, rural labour market and agricultural environmental sustainability. These regions shows the largest gaps in socio-economic development (Figure 1.a –cluster 4);
- Cluster 3 – farmers age structure. In this area two territorial systems are widespread. They are both Continental but one shows an average level of development and primarily extensive agriculture (UK) and the other a high level of development and both intensive and extensive agriculture (BE, DE, NL) (Figure 1.a – cluster 7 and 3 respectively);
- Cluster 4 - infrastructures included the social, rural labour market and agricultural environmental sustainability. These regions are characterised by a large gap in socio-economic development as those in Cluster 2 (Figure 1.a – cluster 8);
- Cluster 5 - economic development, demographic characters, social infrastructures, rural labour market. The prevailing territorial system is Continental with a high level of development and both intensive and extensive agriculture (Figure 1.a –cluster 3);
- Cluster 6 – part-time labour and farmers age structure. In these group of regions the dominant territorial system is Continental with an average level of development and a primarily extensive agriculture (Figure 1.a – cluster 7);
- Cluster 7 – labour market. These territorial units are characterised by a mixture of territorial systems. In the France regions a Continental systems with an average level of development and primarily extensive agriculture is dominant, in the Austrian a territorial system with the highest levels of development and

in the Italian a Continental with high level of development and both intensive and extensive agriculture (Figure 1.a – cluster 7, 1 and 3);

- Cluster 8 – economic development, labour market and agricultural environmental sustainability. The prevailing system is Mediterranean with a low level of development and with agriculture playing an important role (Figure 1.a – cluster 2).

Figure 1 underlines that in general the New Member States represent distinct separate groups from the EU-15. Furthermore, the results achieved through the spatial analysis show a certain degree of spatial coherence across the regions in the sub-groups. Some time it is coincident with the reference Member States' borders that might, in part, depend on the fact that some of the selected variables reflect historical, social, physical and geographic conditions that are strongly related to the national or sub-national level (Montresor, Pecci, Sassi, 2007),.

5. CONCLUSIONS

The MGWR analysis has pointed out that at the local level the agricultural productivity is significantly affected by policy sensitive socio-economic variables pointing out the role that the Rural Development Policy can play in supporting the sector growth. This also underlines the need for evaluating the impact of the agricultural interventions keeping into account the relationship between the local agricultural and local socio-economic systems.

Although a certain degree of spatial coherence among groups of regions sharing geographic borders, a great diversity exists between clusters in terms of profile.

This suggest that regionalization can be an important component of the new agricultural policy but it has to be even more understood as an integrated multi-sector policy for agricultural development at the Regional and State level.

However, it should be noticed that for promoting rural development one of the critical points is of financial nature. The Middle Term Review has modified substantially the mechanisms of CAP support, but the rural development measures still remain of scarce importance in terms of total CAP resources also including the modulation. Besides, there is the issue related to the financial sustainability of the new CAP. The enlarged EU, in accordance to expectations after 2009, will likely go beyond the budget limits and then a new budget negotiation process might be necessary with the possibility of a further reduction in the rural development resources.

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