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Chapter I

Introduction

In recent years, there has been growing interest for research directed to the study of the territorial differentiation of the agricultural development in the EU countries, with special concern for the long-term transformations. It has became more and more urgent to understand how the single situations are adjusting to the deep structural changes in progress. The forces within the primary sector, the relationships with the rest of the socio-economic system and the influence of the significant reforms of the EU policies, mainly the CAP reform (pillars I and II), all contributed to the aforementioned structural changes. In the recently enlarged Europe, this path increasingly implies the need to evaluate the mechanisms and the measures allowing to reach a territorial spatial equilibrium of the development.

It must be considered that the agricultural and rural scenarios in the EU are characterised by relevant differences in the natural resources availability, in the management methods, in the integration with the food chain, in the competitiveness and income levels and in the grade of environment preservation and safeguard.

This deliverable examines the impact of decoupling on structural change at farm and territorial level. The contractual obligations were:

- Identification of different territorial systems in relation to decoupling schemes.
- Estimation of micro model of farm households per different household types, relevant for Italian agriculture and the rural society and a macro-level general equilibrium model of the whole Italian economy.

The analysis was organised according to the following assumptions:

1) The institutional level of analysis. Based on the tools defined by the European Commission, the analysis refers to NUTS1 and NUTS2 regions. We start from the consideration that the situation of the European Union has radically changed. On the one hand, the Fischler reform has redefined the role of agricultural politics (CAP), indicating a clear line of discontinuity from the past; yet, at the same time, it has launched the policy for 2007-2013 for the programming of structural policies. The new European Agricultural Fund for Rural Development (EAFRD) and the guidelines for new rural development policies are of primary importance in this sphere. The decoupling is one of the

measures of the Middle Term Review of 2004 with the aim to contribute to the definition a competitive, multifunctional and sustainable agriculture, as defined in the strategic document Agenda 2000. The impact of decoupling must be therefore assessed in relation to socio -economic development process in act the territories; this implies that the analysis have to be based not only on the agricultural sector variables, but also on other relevant parameters of the economic, social and environmental background. The new European institutional framework ca n determine new comparative advantages, deeply changing the development dynamics at a territorial level, originating a new rural development and a further change in the geographical distribution of the producers and agricultural productions, but also intr oducing new weaknesses in some territorial systems. In order to prevent negative effects, specific interventions must be made according to each local situations.

2) The gap between the complexity degree reached by the theoretical analyses and the economi c policy needs. This gap emerges from the simplicity of the parameters indicated in the Reg. 1698/2005 which refers to the OCSE methodology, but also for those utilised the detection of the objectives ex5b and 2 (Agenda 2000) boundaries. In 1992, Copus and Crabtree had already listed a series of reasons why the statistical analysis is not valued in the "political" mapping of agriculture: scepticism on data representativeness, scarce awareness of multivariate statistic techniques, need for administrative simplification and – overall – need for flexibility towards the positions of the different interest groups. Thus, if the decision makers have generally favoured the selection on a limited and immediate number of indicators, now there is the need for tools abl e to understand the regional socio-economic situation as a whole. This leads to the research for the most appropriate analytical tools, that have to be relatively simple, able to utilise data easily available and reduce the influence of statistics not always reliable, but sufficiently exhaustive. On the contrary, there is the need to deepen the analysis with aim to assess the different impact of agricultural and rural policies. Starting from these assumptions, the deliverable includes a plurality of appro aches to territorial development with different levels of deepening. The aim is to highlight their potential to interpret the processes in action in the rural world in relation to decoupling schemes.

In particular, in C*hapter II* the attention is focused on indicators selection that represents a complex issue in light of both the different territorial situations and the different roles of agriculture. The number of indicators was limited based on the lack of available sources and the difficult interpretation of the available variables. In any case, the range of indicators has been adequate for an exhaustive understanding of the main rural aspects trends. Mainly *chapter V* underlines the most important issues concerning data availability and quality.

In REGIO Data Bank they can be summarised as follows:

- Lacking geographical breakdown;
- Unavailability of time series long enough for understanding the dynamic aspects;
- Lacking and poor quality data for the New Member States.

The main constraints of the Farm Accounts Data Network (FADN) are:

- The limitation of the field of observation to the "commercial farms";
- The differences in terms of sampling methods used in the Member States;
- The lack of information for the ten New Member States.

Finally, it should be underlined that the official sources do not provide data on the standard of living of rural and farm households. For this last reason, Chapter VI introduces the opportunities of the ISMEA survey that provides the data needed to better understand the agricultural household behaviour and to assess its welfare.

The objective of *Chapter III* is to identify the main territorial systems in the EU. We start from the assumption that the analytical tools must satisfy the following requirements: a) future repe atability, for monitoring the effectiveness and efficiency of the policy measures; b) comparison in the space, thus providing a reliable guide for the policy measures directed at the competitiveness or gaps between the single systems; c) flexibility, to ad apt to the mosaic of current situations and to the consequent agricultural policy demands; d) applicability to different territorial levels.

The Multivariate Statistical Analysis (MSA) utilised in this part represents a relatively simple appropriate analytical tool, which is able to utilise data easily available and reduce the influence of statistics not always reliable. However, it is sufficiently comprehensive for the detection of territorial systems at different level in the EU. This approach may overco me the limits of the Reg. 1698/2005 which refers to the OCSE methodology, where the simplicity of the parameters does not allow understanding the heterogeneity and complexity of the situations in the EU. Furthermore, this approach allows the analysis of ru ral territories not only in relation to the agricultural sector variables but also considering other relevant socio -economic and environmental parameters. Specifically, the analysis was conducted at a regional level in the EU -15 and in New Member States; in the latter part of the study, the attention was moved to a sub -regional level in an Italian region (Veneto) to understand to what extent concentration and specialization brought forth a strong impact on policies only in some areas.

Chapter IV aims at providing a tool for policy analysis in order to evaluate the implication of the strategies for the agricultural sector. We start from the consideration that the CAP reform provides the Member States and Regions with important instruments not only for the in troduction of

decoupling and especially for designing their strategic plans of rural development. The Multi-Criteria Analysis (MCA) allows policy makers at different levels: (a) to make different scenarios based on the variables or criterion previously defined according to specific requirements; (b) to consider the different alternatives within each scenario; (c) to justify their choices.

By means of the Multi-Criteria Analysis (MCA), the previous clusters (chapter 3) were classified into three scenarios (socio-economic context, land utilization, rural context) thanks to the targeted selection of specific variables. Then, through the Sensitivity Analysis (SA) we measured the sensitivity of each cluster to possible effects of changes in the variables that could depend on specific choices of interventions at the EU level. Specifically, in the first part, we evaluated how territorial systems change within the enlarged European scenario (EU 25). In the second part, the multi-criteria analysis and sensitivity analysis referred both the EU-15 and the EU-25 regions.

Chapter V is aimed at identifying the socio-economic factors that explain the regional disparities in the agricultural productivity and the intensity of their impact. The analysis developed in the previous chapters has highlighted the possible change in the territorial socio-economic systems connected to decoupling. In this context, the understanding of the impact of the change on the agricultural productivity, a key policy variable, becomes important. This chapter faces the issue also taking in to account the spatial dimension. The approach allows for the understanding of the socio-economic factors that more than other variables affect the agricultural productivity at the local level. Furthermore, the chapter provides a classification of regions aimed at estimating if the regional impact of the parameters' values is combined with their spatial proximity.

In light of these considerations, Chapter V is aimed at: (a) identifying, by a Geographically Weighted Regression (GWR) approach, the factors that influence the agricultural productivity and the intensity of this impact at the local level; (b) 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 refers to both the EU-15 and the EU-25 regions. It provides agricultural and rural development policymakers with useful insights in the field of territorial and decentralised interventions.

In C*hapter VI,* we recognise that in recent years there has been a progressive shift in the interest of policy makers from agricultural to rural policies. This change underlines the need for suitable data to: a) assess the socio-economic impact of the agricultural and rural policy programs; and b) monitor the living standard of rural population, which is the main objective of rural policies. The traditional agricultural surveys, such as the FADN, do not provide the information needed to capture the social impact of farm programs. The aim of this chapter is to explore the opportunities

the Institute for Services in Agricultural and Agrofood Markets (ISMEA) Survey. This survey was conducted first in 1995 and later updated in 2003 during the balancing process, as a prototype devoted to collect the information needed to monitor the living conditions of rural and farm population. This survey provides, in addition to the data on production practices and resource use in agriculture, all the information needed to model farm households' behavior both at the micro and macro levels. The impact of total decoupled CAP reform has been estimated: a) at the macro level using a regional CGE for the Italian economy; b) at the micro level on basis of a general equilibrium model for the farm households. This approach allows the policy analysts to obtain meaningful results both under an economic and agronomic perspective. The macro level of analysis points out interesting policy implications also related to both the land market and labor market.

Chapter II

The Scientific References for the Detection of the Main Agricultural and Rural Systems

2.1 Introduction

In the constantly fluctuating EU scenario we need to identify an analytical model that can be used for the interpretation of the territorial articulation of rural development, not only with respect to the dynamics existing in the single socio-economic contexts, but also to their susceptibility to the deep changes engendered by institutional reforms. This model must provide a key for the interpretation of the main territorial differences (at regional, national, EU level), in support of policy-makers' strategies during a phase of deep transformations of the rural world.

The analytical instruments must satisfy certain requirements:

A) the future repeatability of the research, for the *in itinere* and *ex post* monitoring of the effectiveness and efficiency of the adopted measures, as well as of the unfolding of processes that are independent from the public measures;

B) the comparison with other national and EU contexts, thus providing a reliable guide for the policy measures directed at the competitiveness or gaps within the single systems;

C) though scientifically rigorous, a sufficiently flexibility, so that they can be adapted to the mosaic of current situations and to the consequent agricultural policy demands;

D) the applicability to different territorial levels, so as to satisfy different agricultural policy demands.

The main objective is to obtain an adequate range of information for each level, to be integrated with the information available from the other levels, based not only on the significance of the results but also of the institutions involved. The accessibility of statistical information, the interpretability of the results and the possibility of rendering analysis dynamic will naturally be different.

The fulfilment of the above requirements has deep consequences on the path to be followed. On the one hand, it becomes necessary to put the analysis on an adequate information grid, which can

be integrated according to the aim of the research. On the other hand the statistical information is required to be the same at least at a first level, or with minimal adjustments, so that the above mentioned comparability across time and space. This leads to several issues, from the choice of the indicators to that of the methodologies to be adopted.

2.2 The choice of the indicators

As regards the indicators, the heterogeneity of the situations found in the rural world, as well as the new roles played by agriculture, make selecting the indicators a complex operation. Their number must be limited because of the scarcity of available sources and because of the difficulties connected with their interpretation, though the statistical techniques adopted can provide a valid instrument of selection and simplification. The range of indicators must in any case be adequate for an exhaustive reading of the main rural dynamics.

The need to analyse the agricultural and rural dynamics in progress implies that the analysis will have to be based not only on the agricultural sector variables but also on other relevant parameters of the economics social and environmental background.

The reasons of this integrated approach can therefore be summarized:

a) the differences in concentration and specialization levels of the agricultural and food productions vary considerably among the States members;

b) the territorial disparities are also determined by the commercials relationship among the Regions, they assume a different weight according to the commodity, and originate important effects on structure and competitiveness at territorial level;

c) the typologies of rural development are extremely differentiated in the European scenario, with different levels of protection of the environment;

d) the enlargement of the EU and the globalization in action in the world-wide markets represents elements that are decisive in determining new competitive advantages, with considerable changes in the geographic distribution of the producers and the productions typologies.

In order to identify in the considered regions groups of homogeneous systems, it is necessary to consider a wide range of indicators which can reflect different situations of rural and agricultural world that can be synthesised as follows:

(i) the agricultural specialisation and concentration areas, with or without local integration with the food chain;

(ii) the extended city areas, where the rural areas become important for their residential function;

(iii) the rural areas in territories with a relevant presence of small and medium enterprises (industrial districts);

(iv) other rural areas, subdivided according to the level of disadvantage-advantage, including the mountain areas.

Choosing proper indicators must take into account the main objectives pursued in dividing the territory into homogeneous areas.

In the present case the aim is to discover and understand the territorial differences with regard to the agricultural and rural situation. The actual complexity of the various regional settings highlights that a comprehensive grid of indicators, referred to the territorial unit level and satisfactory for the whole region, does not seem to be practical at a first glance, as the aspects to be investigated are very heterogeneous. The risk is to miss the specific characteristics of the single territories, especially with respect to the agricultural and rural perspective. Moreover, there is a relevant problem related to the possibility of acquiring the statistics necessary to derive the proper indicators. This issue becomes relevant especially when the aim is to compare the different regional situations at the EU level.

Table 2.1: Main groups of indicators considered in the analysis

Group	Indicators
Main social and demographic indicators and territorial morphology	% Change in population; female activity ratio; dependency ratio; ageing index; population density.
Economic structure	Employees per km^2: agriculture, industry, services; ratio of industry employees; ratio of services employees; per capita GDP; unemployment ratio.
Agricultural structure	Avg. UAA per farm; % UAA of farms under 2 ha; % UAA of farms above 50 ha; tractors per 100 ha UAA; AWU per 100 ha UAA; % UAA on total agricultural surface; % change in number of farms; % change in UAA.
Agricultural activities and land use Crops as UAA % *Animal production: heads/UAA*	Soft wheat; durum wheat; barley; maize; rice; dried leguminous vegetables; potatoes; beet; sunflower; soya beans; horticulture; grapes; oilseeds; apples; pears; peaches; kiwi; chestnuts; feeding crops; meat; milk; woods; pastures.
Productivity of agricolture	Standard gross margin per ha of UAA; marginal price of land; gross saleable production per ha (vegetables), GSP per ha (animal production); variable costs for saleable production per ha; variable costs for re-used production per ha; variable costs for animal production per ha.
Integration with food industry	% Food firms on total manufacturing firms; employees per food firm; employees in the food sector per km^2.

A more detailed discussion about the choice of indicators is reported in Mazzocchi and Montresor (1999) and in Montresor (2002). These indicators represent a suitable analytical basis, as they are capable of appraise (1) the level of agricultural development as well as other development characteristics; (2) the main demographic and social trends; (3) agricultural concentration and specialisation and finally (4) a tentative measurement of the degree of integration between farming and the food industry.

2.3 Data sources at different levels: limits and goals

2.3.1 The indicators and the regions at EU15 level

At European level through the use of the NUTS data of investigation, the purpose of the analysis is to understand the EU scenario affected by the national and regional strategies, as well as the overall context in view of the agricultural policies adopted in Fischler reform and also of the expansion towards the PECO and Southern Mediterranean Countries (Montresor, Mazzocchi, 2001).

In the EU15 case the information sources are the EU FADN and the REGIO data bank. The former enables us to select the indicators for the agricultural specializations, while the REGIO information is used to define the parameters for the socio-economic context, the business structures and agro-food integration. Limitations are revealed in the information sources: the limitation of the field of observation of EU-FADN to "commercial farms"; the differences in terms of sampling methods used in the member States; the lack of some information in REGIO data base (importations and exportations between Regions etc).

This investigation allows us to evaluate the foreseeable scenarios in the EU regions, since the historical series of information provided by the European FADN has a wider range, and also because it can be integrated with the models of agricultural offer, national or European.

In our analysis the year of reference considered for the construction of the data bank is 2002; in order to limit the number of omitted regions because of the lack of data, privileging therefore the existence of the data, some of them are reported to 2000 and in rare cases to previous years (1997), assuming that they have not suffered deep changes in the considered period. The indicators employed in the analysis can be subdivide in: a) demographic and social indicators; b) economic indicators; c) indicators related to the structure of the manufacturing industry; d) indicators on agricultural specialization; e) environmental indicators. That are (table 2.2a):

Table 2.2a: Indicators considered in the MSA analysis

Variable	Description	Source	Year range
	SOCIO-DEMOGRAPHICS		
Popden	Population density	REGIO	2002
Ageing	Ageing index	REGIO	2001_1998
Depend	Dependency ratio	REGIO	2001_1998
	ECONOMICS		
Female	Female unemployment ratio	REGIO	2003
Unempl	Unemployment ratio	REGIO	2003
Gdp	Per capita GDP	REGIO	2002
Empagr	Employees in Agric (% total)	REGIO	2001_2000
Empter	Employees in Tertiary (% total)	REGIO	2001_2000
Empine	Employees in Industry (% total)	REGIO	2001_2000
Ltunem	Long term unemployment rate	REGIO	2003
	INDUSTRY		
Firmemp	Number of employees per firm (local unit) - all manufacturing industry	REGIO	2002_2000
Firms	Number of manufacturing firms per km2	REGIO	2002_2000
	AGRICULTURE		
	Agriculture – structural		
Farmn	Number of farm holdings per Km2	REGIO	2000_1997
Uaa	UAA per farm	FADN	2002_2000
Small	% holdings with less than 8 EDU	REGIO	2000_1997
Big	% holdings with more than 40 EDU	REGIO	2000_1997
Hold55	% farms with holder aged more than 55	REGIO	2000_1997
	Land allocation		
Cereals	% UAA under cereals	FADN	2002_2000
Veget	% UAA under vegetable crops and flowers	FADN	2002_2000
Vine	% UAA under vineyards	FADN	2002_2000
Permcrop	% UAA under (other) permanent crops - EXCLUDING FRUIT	FADN	2002_2000
Orchards	% UAA under orchards	FADN	2002_2000
Forage	% UAA under forage crops	FADN	2002_2000
Othercr	Other crops - industrial crops (% UAA)	FADN	2002_2000
Fallows	% UAA non cultivated for various reasons	FADN	2002_2000
	Livestock		
Shegoa	Sheeps and goats per ha UAA	FADN	2002_2000
Pigs	Pigs per ha UAA	FADN	2002_2000
Poultr	Chickens per ha UAA	FADN	2002_2000
Milk	Milk cows per ha UAA	FADN	2002_2000
Beef	Beef cows per ha UAA	FADN	2002_2000
Beefor	Beef per ha of UAA under forage	FADN	2002_2000
Milkow	Diary cow on total cow		
	Productivity		
Valadd	Net value added per ha UAA	FADN	2002_2000
Sgm	Standard Gross Margin per ha UAA	REGIO	2000_1997
Vadawu	Net value added per working unit	FADN	2002_2000
Awureg	% AWU with reg. wage on total AWU	REGIO	2000
Awuint	AWU per 100 ha of UAA	FADN	2002_2000
	ENVIRONMENT		
Woods	Woodlands (% of total agric. Area)	FADN	2002_2000
Livint	Bovine heads, sheeps and goats per ha UAA	FADN	2002_2000

Table 2.2b: Statistical indicators considered in the analysis but not included in the MSA

Variable	Description	Source	Year range
	COMPETITIVENESS		
Invest	Investiment per person employed in manufac turing	REGIO	2002_1997
Patent	Patent application on IPC sector (total per inhabitant)	REGIO	2002
Patagi	Patent application in agriculture (A01)	REGIO	2002
Termia	University tertiary level per inhabitant	REGIO	2003
	SERVICES		
Hotel	Hotel bed-places per inhabitant	REGIO	2003

In our analysis 167 European regions are considered (table 2.3).

Table 2.3: Regions considered in the MSA analysis

Code	Region	Code	Region	Code	Region
be21	ANTWERPEN	gr41	VOREIO AIGAIO	itf1	ABRUZZO
be22	LIMBURG	gr42	NOTIO AIGAIO	itf2	MOLISE
be23	OOST-VLAANDEREN	gr43	KRITI	itf3	CAMPANIA
be24	VLAAMS BRABANT	es11	GALICIA	itf4	PUGLIA
be25	WEST-VLAANDEREN	es12	PRINCIPADO DE ASTURIAS	itf5	BASILICATA
be31	BRABANT WALLON	es13	CANTABRIA	itf6	CALABRIA
be32	HAINAUT	es21	PAIS VASCO	itg1	SICILIA
be33	LIEGE	es22	COMUNIDAD FORAL DE NAVARRA	itg2	SARDEGNA
be34	LUXEMBOURG	es23	LA RIOJA	nl11	GRONINGEN
be35	NAMUR	es24	ARAGON	nl12	FRIESLAND
dk00	DANMARK	es30	COMUNIDAD DE MADRID	nl13	DRENTHE
de11	STUTTGART	es41	CASTILLA Y LEON	nl21	OVERIJSSEL
de12	KARLSRUHE	es42	CASTILLA-LA MANCHA	nl22	GELDERLAND
de13	FREIBURG	es43	EXTREMADURA	nl23	FLEVOLAND
de14	TÜBINGEN	es51	CATALUNA	nl31	UTRECHT
de21	OBERBAYERN	es52	COMUNIDAD VALENCIANA	nl32	NOORD-HOLLAND
de22	NIEDERBAYERN	es53	ISLAS BALEARES	nl33	ZUID-HOLLAND
de23	OBERPFALZ	es61	ANDALUCIA	nl34	ZEELAND
de24	OBERFRANKEN	es62	REGION DE MURCIA	nl41	NOORD-BRABANT
de25	MITTELFRANKEN	es70	CANARIAS	nl42	LIMBURG
de26	UNTERFRANKEN	fr10	ILE DE France	at11	BURGENLAND
de27	SCHWABEN	fr21	CHAMPAGNE-ARDENNE	at12	NIEDERÍSTERREICH
de4	BRANDENBURG	fr22	PICARDIE	at21	KÄRNTEN
de71	DARMSTADT	fr23	HAUTE-NORMANDIE	at22	STEIERMARK
de72	GIESSEN	fr24	CENTRE	at31	OBERÍSTERREICH
de73	KASSEL	fr25	BASSE-NORMANDIE	at32	SALZBURG
de8	MECKLENBURG-VORPOMMERN	fr26	BOURGOGNE	at33	TIROL
de91	BRAUNSCHWEIG	fr30	NORD - PAS-DE-CALAIS	at34	VORARLBERG
de92	HANNOVER	fr41	LORRAINE	pt11	NORTE
de93	LÜNEBURG	fr42	ALSACE	pt16	CENTRO
de94	WESER-EMS	fr43	FRANCHE-COMTE	pt17	LISBOA E VALE DO TEJO
dea1	DÜSSELDORF	fr51	PAYS DE LA LOIRE	pt18	ALENTEJO

Table continues

Table 2.3: (continued)

Code	Region	Code	Region	Code	Region
dea2	KÍLN	fr52	BRETAGNE	pt15	ALGARVE
dea3	MÜNSTER	fr53	POITOU-CHARENTES	pt20	ACORES
dea4	DETMOLD	fr61	AQUITAINE	pt30	MADEIRA
dea5	ARNSBERG	fr62	MIDI PYRENEES	fi	FINLAND
deb1	KOBLENZ	fr63	LIMOUSIN	se01	STOCKHOLM
deb2	TRIER	fr71	RHONE-ALPES	se02	ÍSTRA MELLANSVERIGE
deb3	RHEINHESSEN-PFALZ	fr72	AUVERGNE	se04	SYDSVERIGE
dec	SAARLAND	fr81	LANGUEDOC-ROUSSILLON	se06	NORRA MELLANSVERIGE
ded	SACHSEN	fr82	PROVENCE-ALPES-COTE D'AZUR	se07	MELLERSTA NORRLAND
dee1	DESSAU	fr83	CORSE	se08	ÍVRE NORRLAND
dee2	HALLE	ie	IRELAND	se09	SMALAND MED ÍAMA
dee3	MAGDEBURG	itc1	PIEMONTE	se0a	VÄSTSVERIGE
def	SCHLESWIG-HOLSTEIN	itc2	VALLE D'AOSTA	ukc	NORTH-EAST UK
deg	THÜRINGEN	itc3	LIGURIA	ukd	NORTH-WEST UK
gr11	ANATOLIKI MAKEDONIA	itc4	LOMBARDIA	uke	YORKSHIRE - THE HUMBER
gr12	KENTRIKI MAKEDONIA	itd1	TRENTINO-ALTO-ADIGE	ukf	EAST MIDLANDS
gr13	DYTIKI MAKEDONIA	itd2	TRENTINO-ALTO-ADIGE	ukg	WEST MIDLANDS
gr14	THESSALIA	itd3	VENETO	ukh	EASTERN UK
gr21	IPEIROS	itd4	FRIULI-VENEZIA GIULIA	ukj	SOUTH-EAST UK
gr22	IONIA NISIA	itd5	EMILIA-ROMAGNA	ukk	SOUTH-WEST UK
gr23	DYTIKI ELLADA	ite1	TOSCANA	ukl	WALES
gr24	STEREA ELLADA	ite2	UMBRIA	ukm	SCOTLAND
gr25	PELOPONNISOS	ite3	MARCHE	ukn	NORTHERN IRELAND
gr30	ATTIKI	ite4	LAZIO		

2.3.2 The indicators and the regions in New Member States (NMS)

The territorial analysis at regional level (NUTS2) for 35 regions of the NM States (detailed list of the regions included in table 2.4) was carried out on a different set of indicators due to difficulties encountered during data collection.

This data set was prepared considering only the EUROSTAT/REGIO data because the FADN data base doesn't supply data for these new regions but only for the fifteen regions of the former EU.

The most important problem that we faced was the lack of data on the agricultural farms for Poland; a possible solution could be to drop this country from the analysis but, as we can see, it means to take off 17 regions, the 50% of the total. Even if doesn't consider information on agricultural holdings such as the number of farm or the dimension could lead to a less informative analysis, we choose to keep the polish regions and to limit the informativeness of the analysis.
The same problem affects the variables on productivity as shown in table 2.4 (in grey the variable not available for NMS, in yellow new indicators included) .

Some data not available in the REGIO data base were collected from the country National Statistical web site in order to keep these regions in the analysis.

As in the previous analysis the reference years was the 2002, but due to the lack of data in rare case we considered data of 2000

Table 2.4: Variables considered in the PCA of the NMS

Variable	Description	Source	Year range
	SOCIO-DEMOGRAPHICS		
Popden	Population density	REGIO	2002
Ageing	Ageing index	REGIO	2001
Depend	Dependency ratio	REGIO	2001
	ECONOMICS		
Female	Female unemployment ratio	REGIO	2003
Unempl	Unemployment ratio	REGIO	2003
Gdp	Per capita GDP	REGIO	2002
Empagr	Employees in Agric (% total)	REGIO	2001_2000
Empter	Employees in Tertiary (% total)	REGIO	2001_2000
Empine	Employees in Industry (% total)	REGIO	2001_2000
Ltunem	Long term unemployment rate	REGIO	2003
	INDUSTRY		
Firmemp	Number of employees per firm (local unit) – all manufacturing industry	REGIO	
Firms	Number ofmanufacturing firms per km2	REGIO	
	AGRICULTURE		
	Agriculture – structural		
Farmn	Number of farm holdings per Km2	REGIO	
Uaa	UAA per farm	FADN	
Uaatot	% Uaa on total area	REGIO	
Small	% holdings with less than 8 EDU	REGIO	
Big	% holdings with more than 40 EDU	REGIO	
Hold55	% farms with holder aged more than 55	REGIO	
	Land allocation		
Cereals	% UAA under cereals	REGIO	2002_2000
Vine	% UAA under vineyards	REGIO	2002_2000
Permcrop	% UAA under (other) permanent crops – EXCLUDING FRUIT	REGIO	2002_2000
Orchards	% UAA under orchards	REGIO	2002_2000
Greenfod	% UAA under greenfod	REGIO	2002_2000
Othercr	Other crops – industrial crops (% UAA)	REGIO	2002_2000
Fallows	% UAA non cultivated for various reasons	REGIO	2002_2000
	Livestock		
Shegoa	Sheeps and goats per ha UAA	REGIO	2002_2000
Pigs	Pigs per ha UAA	REGIO	2002_2000
Poultr	Chickens per ha UAA	REGIO	2002_2000
Milk	Milk cows per ha UAA	REGIO	2002_2000
Beef	Beef cows per ha UAA	REGIO	2002_2000
Beefor	Beef per ha of UAA under forage	REGIO	2002_2000
Milkow	Diary cow on total cow		

Table continues

Table 2.4: (continued)

Variable	Description	Source	Year range
	Productivity		
Valadd	Net value added per ha UAA	FADN	
Sgm	Standard Gross Margin per ha UAA	REGIO	
Vadawu	Net value added per working unit	FADN	
Awureg	% AWU with reg. wage on total AWU	REGIO	
InR&D	Investiment on Reserac and development	REGIO	
Awuint	AWU per 100 ha of UAA	REGIO	2002_2000
	ENVIRONMENT		
Woods	Woodlands (% of total agric. Area)	REGIO	2002_2000
Livint	Bovine heads, sheeps and goats per ha UAA	REGIO	2002_2000

Table 2.5: Regions considered in the MSA analysis

Code	Region	Code	Region
cy0	PRAHA	pl12	MAZOWIECKIE
cz01	CYPRUS	pl21	MALOPOLSKIE
cz02	STREDNÍ CECHY	pl22	SLASKIE
cz03	JIHOZÁPAD	pl31	LUBELSKIE
cz04	SEVEROZÁPAD	pl32	PODKARPACKIE
cz05	SEVEROVÝCHOD	pl33	SWIETOKRZYSKIE
cz06	JIHOVÝCHOD	pl34	PODLASKIE
cz07	STREDNÍ MORAVA	pl41	WIELKOPOLSKIE
cz08	MORAVSKOSLEZKO	pl42	ZACHODNIOPOMORSKIE
ee0	ESTONIA	pl43	LUBUSKIE
hu10	KÖZÉP-MAGYARORSZÁG	pl51	DOLNOSLASKIE
hu21	KÖZÉP-DUNÁNTÚL	pl52	OPOLSKIE
hu22	NYUGAT-DUNÁNTÚL	pl61	KUJAWSKO-POMORSKIE
hu23	DÉL-DUNÁNTÚL	pl62	WARMINSKO-MAZURSKIE
hu31	ÉSZAK-MAGYARORSZÁG	pl63	POMORSKIE
hu32	ÉSZAK-ALFÖLD	si0	SLOVENIA
hu33	DÉL-ALFÖLD	sk01	BRATISLAVSKÝ KRAJ
lt0	LITHUANIA	sk02	ZÁPADNÉ SLOVENSKO
lv0	LATRIA	sk03	STREDNÉ SLOVENSKO
mt0	MALTA	sk04	VÝCHODNÉ SLOVENSKO
pl11	LÓDZKIE		

2.3.3 Regional level through the use of municipal data (NUTS 3)

In this case the objective is to define the main territori al systems at sub-regional level, so as to understand their evolution with regard to the impact of the policies, the socio -economic dynamics and the integration with the food chain at the local level. The need for this investigation is therefore connected with the current need of the Regions to know their main strong points and

disadvantages; their objective is not to identify new institutional contexts in addition to the existing ones, but to define sufficiently homogeneous territorial systems from a rural viewpoint, to be placed at the centre of institutional planning at regional and local level (models of integrated endogenous development). This investigation highlights certain limitations. Certain parameters (per-capita GDP) need to be estimated, since they are not obtainable from statistical sources; besides there is the lack of statistical information, especially those from FADN.

The territorial analysis at sub-regional level was carried for Veneto, a region placed in the north part of Italy, with 582 communalities.

Table 2.6: Indicators considered in the MSA analysis

Group	Indicators
Socio-economic development	Per capita GDP , % employees agriculture, unemployment ratio, % employees industry, % employees services
Agricultural structure	avg. UAA per farm, % farms under 2 ha, % farms above 50 ha, % UAA of farms under 2 ha, % UAA of farms above 50 ha,
Agricultural activities *Crops: % of UAA* *Animal production: heads for hectare of UAA*	Cereals, feeding crops, pastures, horticulture, fruits, vines, CDO vines, bovines, pigs, chickens, bovine heads per ha of pastures, pigs per cow
Productivity of agriculture and integration	Workers per ha of UAA, SGM per ha of UAA, sgm per worker, workers per food firm, % employees in large food firms, woodlands (% agr. surface)
Social and demographic situation	Population density, pop. change (81-91), ageing index, ratio of female workers, dependence ratio, % employees industry, % employees services
Agricultural Structure dynamics (%)	UAA change (1990-2000), farms change (1990-2000), agr. surface change (1990-2000)

The most important sources at this level are from the National Statistical Institute (ISTAT) in particular we got data from:

- National Agricultural Census (2000): it supplies information on productivity and structure of agricultural sector such as land (UAA, AA) allocations, detailed information on farms (dimension, specialization, holders, etc.) and the more important changes that interests this sector.
- National Population Census (2001): it supplies information on population and territory, social and demographic situation such as the territorial density, ageing index, dependence ratio or information on gender employment.

- National Census of firms and services (2001): it supplies information on the integration o f agricultural sector and manufacturing firms such as the number of firms involved in food transformation and their dimension.

The set of indicators (table 2.6) are expected to represent the socio -economic structure, the farm structure, the level of agricu ltural specialisation and the agricultural profitability.

Despite the choice of indicators is based on the ease of retrievability, some of theme were still unavailable for recent years. Some of the missing variables, such as the, GDP or Net Value Added are our estimates expecting not to deeply influence the results, while it might be relevant the lack of the SGM per hectare.

2.4 The Multivariate Statistical Analysis to describe the territorial systems

2.4.1 The Principal Component Analysis

Through principal components analysis (PCA)[1], the initial set of p indicators observed on n statistical units can be transformed into a reduced set of variables able to explain a significant proportion of the original variability[2]. The variables obtained throu gh PCA are a linear combination of the original indicators and, in contrast to the initial variables, they are uncorrelated between each other. The PCA was applied to the correlation matrix, in order to avoid any problems of different scale and measurement unit among the indicators[3]. Operating on the correlation matrix leads to the following formulation of the principal components scores, that can be computed for each statistical unit (e.g. municipalities, NUTS3 or NUTS2 territorial units etc.):

$$y_{i,j} = \sum_{l=1}^{p} a_{l,j}\,\hat{x}_{i,l} \quad \text{with} \quad i: 1, 2, \ldots, N \ \text{and} \ j: 1, 2, \ldots, k \tag{1}$$

where $y_{i,j}$ is the j-th component score for territorial unit i

$\hat{x}_{i,l}$ is the standardised value of l-th indicator for territorial unit i

[1] For a more formalised description of the PCA see Krzanowski (1988) and Mignani and Montanari (1993). Fanfani and Mazzocchi (1999) analyse in detail the issues of the application to the territorial analysis of rural development.

[2] In the case study described hereafter, the method of Guttman -Kaiser was adopted to choose the number of principal components to be considered. The method advises to retain the components whose eigenvalue is equal or larger than 1. Generally this criterium led to the selection of a number of components explaining between 65% and 70% of the original data variance.

[3] Working on the correlation matrix means in practice standardising the original data matrix and avoiding that the indicators with larger variability exercise a distorting influence on the principal components extraction.

$a_{l,j}$ is the coefficient linking *l*-th indicator with *j-th* component

The scores for each territorial unit, contained in the vector $\mathbf{Y_i}=\{y_{i,j}\}$ with *j:1,…,k* are the values to be employed in the cluster analysis. Before implementing the CA and obtaining the final geographic subdivision of the territorial systems, the economic interpretation of the components and the comparison of the scores assumed by the single territorial units could also supply some helpful indications for interpreting the agricultural territorial development. The explanation of the components derives from the sign and magnitude of the coefficients $a_{l,j}$.

As the variables $\hat{x}_{i,j}$ are standardised, they all have variance equal to 1 and the weight of each variable on the component value is proportional to the absolute value of the coefficient. Hence, if one considers the squared coefficients, whose sum is constrained to be 1 by construction, these exactly represent the weight of each variable on the total component value. There are usually several problems in the interpretation of components: the number of indicators is often extremely large and the signs of the coefficients may return contradictory clues. Moreover, the interpretation is rarely univocal and it becomes more difficult when one tries to explain the last components, i.e. those with a lower proportion of explained variance.

Hence, a useful method for simplifying the analysis and eliminating the temptation of getting into arbitrary interpretation is to "filter" the variables through the weight on the component value as measured by each squared coefficient. There are no standard criteria for such an operation, that leaves again some room to the arbitrary choices of the researchers. In this work just the indicators whose squared coefficient was above or equal to 0.05 were considered, that is the ones whose impact on the component value was at least of 5%, defining such a proportion as:

$$s_{l,j} = a_{l,j}^2 \cdot 100 \qquad (2)$$

where $a_{l,j}$ (l=1,…, p) is the coefficient of the *l*–th indicator in the *j*-th component.

This allows to give a first quick interpretation to the components, which can then be tested or revised on the grounds of the sign and relevance of other coefficients. In general the $s_{i,j}$ is an indicator of the intensity of the impact of a single variable on the component value, whereas the direction of this impact is indicated by the signs of the coefficients $a_{l,j}$. Another indication which can be derived from the PCA concerns the comprehensive contribution of each indicator to the *k* selected principal components. In practice, if the $s_{l,j}$ are a measure of the weight of each variable

inside the single component, the simple average $\bar{s}_l$ returns a measure, although approximate, of the relevance of the variable on the principal components as a whole. Such an average assumes, however, that all the components are equally weighted, whereas a weighted average with respect to the proportion of variability explained by each component seems to be more appropriate:

$$w_l = \sum_{j=1}^{k} a_{l,j}^2 \cdot \frac{Var(Y_j)}{Var(Y)} \qquad (3)$$

where $Var(Y_j)$ is the variance of the j-th component (equal to the j-th eigenvalue) and $Var(Y)$ is the total variance of the first k components (equal to the sum of the first k eigenvalues).

Following (3) it is possible to rank the most representative indicators in the description of the phenomenon, although a strong limit in such a classification is that the correlation among the original variables has not been taken into consideration.

2.4.2 Cluster analysis

An accurate description of the methodological issues involved with cluster analysis is provided by Aldenderfer and Blashfield (1984) and Everitt (1974).

A key problem, not yet been solved in an univocal way, relates to the identification of the optimal number of clusters. Any technique considered statistically correct should always be confirmed by a satisfying results in terms of economic interpretation. As discussed below, this study exploits a range of criteria to identify the optimal number of cluster. Different numbers of clusters have been considered, retaining mappings that – besides being statistically acceptable – allowed a meaningful distinction across groups of regions without leading to an excessive fragmentation.

Cluster analysis can be based on hierarchical and non hierarchical methods depending on the capability of step by step modifiability of the classification. Hierarchical methods do not allow to change the classification, but have the advantage of exploring all potential numbers of clusters and supply several statistics to detect the optimal partition. On the other hand, non hierarchical methods require the preliminary choice of the number of clusters, introducing an inevitable element of subjectivity, but are more efficient in computational terms and allow reallocation of the units in order to achieve the optimal partition.

It is possible to compensate the rigidity of the results deriving from hierarchical techniques with the flexibility of non hierarchical methods. The so-called "tandem" approach consists in choosing the number of clusters according to a hierarchical approach and then apply the non hierarchical method to obtain the actual classification.

However, within the class of hierarchical methods, there is a variety of choices. For this analysis, the number of clusters was determined by comparing the results of three different clustering approaches:

1. The Ward hierarchical approach.
2. A nonparametric method based on probability density estimation implemented in the procedure CLUSTER of the SAS software. This method is based on the *k-th* nearest neighbour density estimate, but one may obtain different results by varying the value of *k*. Usually, *k* is set to be equal to 2 $log_2 N$, where *N* is the number of observations.
3. A repeated application of the non-hierarchical *k-means* method for different cluster numbers.

In order to actually determine the number of groups, three statistics are computed, the Pseudo F statistic, the Pseudo t^2 statistic and the Cubic Clustering Criterion.

The ideal number of clusters should correspond to a local maximum for the P seudo F and the CCC, together with a small value of the Pseudo t^2, but rarely these criteria are consistent among them, so that the researcher should rely also on meaningfulness (interpretability) criteria. Once the number of cluster has been decided, the actual segmentation was based on the *k*-means method.

Chapter III

Mapping of the Homogeneous Economic and Rural Systems at Different Territorial Levels

3.1 Introduction

The main objective of the research conducted and illustrated in this chapter is to understand how different territorial systems adapt to changes taking place in the markets and to the CAP reform. In this chapter, the focus has also been on the mechanisms which produce spatial adjustments that could imply a decline or crises in some cases or increase in other territorial systems.

The situation of the European Union has radically changed. For the most part, the actors are new; beyond the ten member states already included, Bulgaria and Romania (not considered in the conducted analysis) enter as of 2007. Although the scenario for Turkey and the remaining Balkan states has yet to be defined, and is not even certain for that matter, this still weighs upon the strategies adopted by the Union. On the one hand, the Fischler reform has redefined the role of agricultural politics (CAP), indicating a clear line of discontinuity from the past; yet, at the same time, it has launched the policy for 2007-2013 for the programming of structural politics. The new European Agricultural Fund for Rural Development (EAFRD) and the guidelines for new rural development policies are of primary importance in this sphere. The ultimate goal of these interventions is to ease the socio-economic differences or gaps that may exist between regions, thus favouring the convergence and economic cohesion between both new and old member states. On various levels, both for public decision makers and private actors, there is the need to understand the dynamics of the European territory.

Therefore the objective of this chapter is to identify the main territorial systems present in the EU. As described in Chapter II, this identification of territorial systems will bring into consideration not only variables in the agricultural sector but also other important parameters in economic, social, and environmental contexts. The reasons for this integrated approach can be summarized as: a) the level of concentration and specialization of agricultural and agro-food production at territorial level; b) the business relations between states and regions; (c) the

significant differences in rural typologies in the EU scenario with different levels of environmental protection; (d) the enlargement of the EU and the globalization in new global markets.

Specifically, the analysis was conducted at regional level in the EU-15 (par. 3.2) and in New Member States (par. 3.3); in the latter part of the study (par. 3.3), the attention was moved to a sub - regional level in an Italian region (Veneto) to understand to what extent concentration and specialization brought forth a strong impact on policies only in some areas. For the construction of indicators and for statistical information sources please see chapter 2, where the adopted methodology is explained (Multivariate Statistical Analysis). In this case, it could be useful to remember that in all levels of the research the same set of indicators was used apart from certain adjustments due to the lack of data. Ultimately, in order to make the analysis comparable, in the second stage of research (EU-15 and at the sub-regional level), specific indicators were used.

3.2 The analysis at regional level in the EU 15

As a first step, a PCA was carried out on the 39 indicators (table 3.1) for the fifteen EU regions. Nine principal components were retained. They explain more than the 70% of the total original variability.

Table 3.1: PRINCOMP procedure SAS output.

Eigenvalues of the Correlation Matrix

	Eigenvalue	Difference	Proportion	Cumulative
1	7.58008090	2.60604166	0.1944	0.1944
2	4.97403924	1.37125942	0.1275	0.3219
3	3.60277982	0.64606173	0.0924	0.4143
4	2.95671810	0.61985346	0.0758	0.4901
5	2.33686464	0.24165228	0.0599	0.5500
6	2.09521236	0.40510697	0.0537	0.6037
7	1.69010539	0.07244124	0.0433	0.6471
8	1.61766415	0.14140491	0.0415	0.6886
9	1.47625925	0.19019860	0.0379	0.7264
10	1.28606065	0.17395237	0.0330	0.7594
11	1.11210827	0.18354451	0.0285	0.7879
12	0.92856376	0.08716227	0.0238	0.8117
13	0.84140150	0.07531002	0.0216	0.8333
14	0.76609148	0.14221902	0.0196	0.8529
15	0.62387246	0.02707246	0.0160	0.8689
16	0.59679999	0.00504255	0.0153	0.8842
17	0.59175744	0.13324471	0.0152	0.8994
18	0.45851273	0.03175269	0.0118	0.9112
19	0.42676004	0.05743632	0.0109	0.9221
20	0.36932372	0.02528662	0.0095	0.9316
21	0.34403710	0.01703291	0.0088	0.9404
22	0.32700418	0.06412740	0.0084	0.9488
23	0.26287678	0.02041241	0.0067	0.9555

Table continues

Table 3.1: (continued)

	Eigenvalue	Difference	Proportion	Cumulative
24	0.24246437	0.03105671	0.0062	0.9617
25	0.21140766	0.01066945	0.0054	0.9671
26	0.20073821	0.02343059	0.0051	0.9723
27	0.17730762	0.01889734	0.0045	0.9768
28	0.15841028	0.01147727	0.0041	0.9809
29	0.14693301	0.01506526	0.0038	0.9847
30	0.13186775	0.01793531	0.0034	0.9881
31	0.11393243	0.01138347	0.0029	0.9910
32	0.10254897	0.01945909	0.0026	0.9936
33	0.08308987	0.01588743	0.0021	0.9957
34	0.06720244	0.01275719	0.0017	0.9975
35	0.05444525	0.02174182	0.0014	0.9989
36	0.03270343	0.02280865	0.0008	0.9997
37	0.00989479	0.00821421	0.0003	0.9999
38	0.00168058	0.00120121	0.0000	1.0000

Following the above explanation, it is possible to quantify the relevance of the original indicators in the extracted principal components pointing out which are the most relevant indicators in determining the difference between the considered region, once the correlation between the principal indicators and the scale differences have been eliminated through the PCA.

At the first glance an interpretations of the factor loading of the nine extracted PC (table 3.2). Where considering the sign and relevance of the factor loadings (above 0.4 in absolute value), the extracted components can be interpreted as follows:

Table 3.2: Factor loadings for first-stage PCA

Variable	**Prin1**	**Prin2**	**Prin3**	**Prin4**	**Prin5**	**Prin6**	**Prin7**	**Prin8**	**Prin9**
Popden		4.45	4.26				5.95		
Ageing							4.29		
Depend				-4.48		6.64			-5.78
Female	4.88				5.73				
Unempl		-4.83	5.69		5.55				5.41
GDP	-4.02							-5.82	
Empagr	6.46								
Empter				-17.34					
Empind				23.35					
Ltunem			4.25		8.69				
Firmemp				4.49		-5.35	-6.36		
Firms		5.87					22.94	-6.93	
Farmn	5.64								
UAA		-5.70							
Small	8.91								
Big	-7.40		6.69						
Hold55	5.30						7.24		

Table continues

Table 3.2: (continued)

Variable	Prin1	Prin2	Prin3	Prin4	Prin5	Prin6	Prin7	Prin8	Prin9
Cereals		-7.30		7.16				-4.87	
Veget		6.98	7.87						
Vine					-4.42				7.14
Permcrop	5.19								-5.48
Orchards								15.46	
Forage			-9.86		5.18				4.60
Othercr			11.76						
Fallows					-4.81		8.81	11.00	
Shegoa								-5.81	-6.99
Pigs						4.11	4.93		-5.94
Poultry						7.43			-9.12
Milk	-4.96				9.79				
Beef	-4.73				6.07	4.74			
Valadd		10.42							
SGM		11.50							
VadAWU	-6.38		5.04						
AWUreg									
AWUint		6.97					-6.82		
Woods							4.03	19.22	
Livint				8.67		18.26			
Milkow					4.24	-8.01			
Beefor				7.05		16.21			10.57

1. *Rurality:* Relevance of the agricultural sector for the employment. Strong presence of small farms, holders are generally old (a very high percentage of farms with holders aged above 55). Low, in particular a very low Net Value Added per AWU and a consistent female unemployment rate. Strong presence of permanent crops but very low livestock in tensity.
2. *High level of socio-economic development:* Highly populated areas with a large percentage of small or medium size farms. Strong presence of manufacturing firms. Low unemployment rate. Even if agricultural sector is not important in the income creation process, it is highly productive.
3. *Intensive Agriculture:* Urban areas, with high long term unemployment rate, large farm. Cereals and industrial crops.
4. *Industrial component*. The industrial sector and manufacturing industry are important; young population, a large amount of population in working age. Relevance of cereal crops and bovine livestock.
5. *Bovine livestock (milk cow)*. High unemployment and long term unemployment rate. Prevalence of forage, and bovine and milk cow livestock.

6. *Livestock*. These regions are characterised by an high presence of livestock in general (bovine, pig and poultry). Populations with a high percentage of elderly people.
7. *Small and medium firms*. Highly populated areas with a strong presence of old people. Strong presence of manufacturing firms of small dimension. Agricultural sector is not relevant with a large percentage of farm holders aged more than 55 years old. Intensive pig livestock and wooded areas.
8. *Woodland.* Relevance of wooded areas, low GDP and low intensity of firm presence. Agriculture and livestock are not relevant. Permanent crops.
9. *Residual component*. High unemployment rate, agriculture is not important in the regions with an high score of this component. Presence of bovine livestock.

Cluster analysis led to the identification of 10 first-stage clusters (table 3.3). In order to obtain clusters that contain a significant (but not in statistic sense) number of regions, according to the output of the Sas routine (table 3.3), we decided to merge the cluster with a number of regions less than 3 to the statistically nearest cluster. According to that the cluster 4 (2 regions) has been joined to the cluster 2 (the nearest in statistical sense), the cluster number 6 (1 region) to the 3 and the cluster 9 (1 region) to the 3 too, leading in this way to 7 clusters of regions (table 3.4).

Table 3.3: Cluster Summary

Cluster	Frequency	RMS Std Deviation	Maximum Distance from Seed to Observation	Radius Exceeded	Nearest Cluster	Distance Between Cluster Centroids
1	12	1.2859	5.5312		10	6.0529
2	15	1.2081	4.7573		3	4.1951
3	21	1.3598	5.7056		2	4.1951
4	2	1.3364	2.8350		2	11.2425
5	8	0.7388	4.2311		10	5.5880
6	1	.	0		3	16.1891
7	51	1.0064	5.2154		10	3.2986
8	14	1.2166	5.9406		3	4.3882
9	1	.	0		3	12.7817
10	42	0.9907	6.3511		7	3.2986

A first definition of the groups of regions identified by the cluster analysis can be obtained from the analysis of the average values that the principal components assume in cluster in the following way (table 3.5):

Cluster 1 (12 regions): Non rural cluster, with an high level of socio-economic development, intensive presence of medium-small firms. Even if agriculture seems to be non relevant in the cluster in the income creation process it looks quite productive (bovine livestock);

Cluster 2 (17 regions): it is a rural cluster characterised by an high productivity (SGM), due to the presence of intensive agriculture. The regions of this cluster present a low industrial intensity;
Cluster 3 (23 regions): Clusters with an high degrees of rurality, high unemployment rate, but high employment in the industrial sector. Wooded areas;
Cluster 5 (8 regions): regions characterized by intensive agriculture, medium large firms but not productive, cluster medium poor. The livestock is relevant (milk cow) important. Wooded area.
Cluster 7 (51 regions): This is a large, non rural cluster. The agricultural sector is not intensive or productive. Relevance of milk cow livestock;
Cluster 8 (15 regions): high developed regions, particularly productive agriculture and medium dimension firms. Relevance of industrial and manufacturing sectors. Firms are small. Relevance of pig livestock;
Cluster 10 (42 regions): very populated areas with large farm. Bovine livestock is relevant particularly milk cow.

Important information could come from the analysis of the value of table 3.6 and table 3.7.

Table 3.4: Clusters

Code	Region	Cluster	Code	Region	Cluster	Code	Region	Cluster
be21	ANTWERPEN	**1**	ded	SACHSEN	**5**	es21	PAIS VASCO	**8**
be22	LIMBURG	**1**	dee1	DESSAU	**5**	es30	COMUNIDAD DE MADRID	**8**
be23	OOST-VLAANDEREN	**1**	dee2	HALLE	**5**	es53	ISLAS BALEARES	**8**
be25	WEST-VLAANDEREN	**1**	dee3	MAGDEBURG	**5**	itc1	PIEMONTE	**8**
nl12	FRIESLAND	**1**	deg0	THÜRINGEN	**5**	itc3	LIGURIA	**8**
nl21	OVERIJSSEL	**1**				itc4	LOMBARDIA	**8**
nl22	GELDERLAND	**1**	be34	LUXEMBOURG	**7**	itd2	TRENTINO-ALTO-ADIGE	**8**
nl31	UTRECHT	**1**	de11	STUTTGART	**7**	itd3	VENETO	**8**
nl32	NOORD-HOLLAND	**1**	de12	KARLSRUHE	**7**	itd4	FRIULI-VENEZIA GIULIA	**8**
nl33	ZUID-HOLLAND	**1**	de13	FREIBURG	**7**	itd5	EMILIA-ROMAGNA	**8**
nl41	NOORD-BRABANT	**1**	de14	TÜBINGEN	**7**	ite1	TOSCANA	**8**
nl42	LIMBURG	**1**	de21	OBERBAYERN	**7**	ite3	MARCHE	**8**
			de22	NIEDERBAYERN	**7**	ite4	LAZIO	**8**
gr14	THESSALIA	**2**	de23	OBERPFALZ	**7**	pt17	LISBOA E VALE DO TEJO	**8**
gr21	IPEIROS	**2**	de24	OBERFRANKEN	**7**			
gr22	IONIA NISIA	**2**	de25	MITTELFRANKEN	**7**	be24	VLAAMS BRABANT	**10**
gr23	DYTIKI ELLADA	**2**	de26	UNTERFRANKEN	**7**	be31	BRABANT WALLON	**10**
gr24	STEREA ELLADA	**2**	de27	SCHWABEN	**7**	be32	HAINAUT	**10**
gr25	PELOPONNISOS	**2**	de72	GIESSEN	**7**	be33	LIEGE	**10**
gr30	ATTIKI	**2**	de73	KASSEL	**7**	be35	NAMUR	**10**
gr41	VOREIO AIGAIO	**2**	de94	WESER-EMS	**7**	dk00	DANMARK	**10**
gr42	NOTIO AIGAIO	**2**	dea3	MÜNSTER	**7**	de71	DARMSTADT	**10**
gr43	KRITI	**2**	dea5	ARNSBERG	**7**	de92	HANNOVER	**10**
es61	ANDALUCIA	**2**	deb1	KOBLENZ	**7**	de93	LÜNEBURG	**10**
es70	CANARIAS	**2**	deb2	TRIER	**7**	dea1	DÜSSELDORF	**10**
itf3	CAMPANIA	**2**	dec0	SAARLAND	**7**	dea2	KÍLN	**10**
itf4	PUGLIA	**2**	es11	GALICIA	**7**	dea4	DETMOLD	**10**
itf6	CALABRIA	**2**	es12	PRINCIPADO DE ASTURIAS	**7**	deb3	RHEINHESSEN-PFALZ	**10**
itg1	SICILIA	**2**	es13	CANTABRIA	**7**	def0	SCHLESWIG-HOLSTEIN	**10**
pt30	MADEIRA	**2**	fr25	BASSE-NORMANDIE	**7**	fr10	ILE DE FRANCE	**10**
			fr43	FRANCHE-COMTE	**7**	fr21	CHAMPAGNE-ARDENNE	**10**
gr11	ANATOLIKI MAKEDONIA	**3**	fr63	LIMOUSIN	**7**	fr22	PICARDIE	**10**
gr12	KENTRIKI MAKEDONIA	**3**	fr71	RHONE-ALPES	**7**	fr23	HAUTE-NORMANDIE	**10**

Table continues

Table 3.4: (continued)

Code	Region	Cluster	Code	Region	Cluster	Code	Region	Cluster
gr13	DYTIKI MAKEDONIA	**3**	fr72	AUVERGNE	**7**	fr24	CENTRE	**10**
es22	COMUNIDAD FORAL DE N.	**3**	ie	IRELAND	**7**	fr26	BOURGOGNE	**10**
es23	LA RIOJA	**3**	itc2	VALLE D'AOSTA	**7**	fr30	NORD - PAS-DE-CALAIS	**10**
es24	ARAGON	**3**	itd1	TRENTINO-ALTO-ADIGE	**7**	fr41	LORRAINE	**10**
es41	CASTILLA Y LEON	**3**	at11	BURGENLAND	**7**	fr42	ALSACE	**10**
es42	CASTILLA-LA MANCHA	**3**	at12	NIEDERÍSTERREICH	**7**	fr51	PAYS DE LA LOIRE	**10**
es43	EXTREMADURA	**3**	at21	KÄRNTEN	**7**	fr52	BRETAGNE	**10**
es51	CATALUNA	**3**	at22	STEIERMARK	**7**	fr53	POITOU-CHARENTES	**10**
es52	COMUNIDAD VALENCIANA	**3**	at31	OBERÍSTERREICH	**7**	fr61	AQUITAINE	**10**
es62	REGION DE MURCIA	**3**	at32	SALZBURG	**7**	fr62	MIDI PYRENEES	**10**
fr81	LANGUEDOC-ROUSSILLON	**3**	at33	TIROL	**7**	fr82	PROVENCE-ALPES-COTE D'A.	**10**
fr83	CORSE	**3**	at34	VORARLBERG	**7**	nl11	GRONINGEN	**10**
ite2	UMBRIA	**3**	pt20	ACORES	**7**	nl13	DRENTHE	**10**
itf1	ABRUZZO	**3**	fi	FINLAND	**7**	nl23	FLEVOLAND	**10**
itf2	MOLISE	**3**	se06	NORRA MELLANSVERIGE	**7**	nl34	ZEELAND	**10**
itf5	BASILICATA	**3**	se07	MELLERSTA NORRLAND	**7**	se01	STOCKHOLM	**10**
itg2	SARDEGNA	**3**	se08	ÍVRE NORRLAND	**7**	se02	ÍSTRA MELLANSVERIGE	**10**
pt11	NORTE	**3**	se09	SMALAND MED ÍAMA	**7**	se04	SYDSVERIGE	**10**
pt16	CENTRO	**3**	se0a	VÄSTSVERIGE	**7**	ukc	NORTH-EAST UK	**10**
pt18	ALENTEJO	**3**	ukd	NORTH-WEST UK	**7**	uke	YORKSHIRE - THE HUMBER	**10**
pt15	ALGARVE	**3**	ukf	EAST MIDLANDS	**7**	ukg	WEST MIDLANDS	**10**
			ukk	SOUTH-WEST UK	**7**	ukh	EASTERN UK	**10**
de4	BRANDENBURG	**5**	ukl	WALES	**7**	ukj	SOUTH-EAST UK	**10**
de80	MECKLENBURG-VORPOMMERN	**5**	ukn	NORTHERN IRELAND	**7**	ukm	SCOTLAND	**10**
de91	BRAUNSCHWEIG	**5**						

Tables 3.6 and 3.7 demonstrate three large territorial systems within the EU with different characteristics of agricultural and rural development:

- *Systems with low rurality* (clusters 1, 7, 8, 10) in which agricultural employees are 1.5% of the total and that generally correspond to the regions with a high level of economic development (or at least a level higher than the European average). In these areas, the primary sector contributes in an irrelevant manner to the formation of income and employment. This low level of rurality, that takes up a large part of the European territory, with over 70% of the total surface and with a significant impact on income (92.4%), does not mean that the agriculture in these regions is of marginal importance. In fact, these territories supply a large part of the European agricultural production (72% of SGM). Of course, within this large group, there are deep differences, on both the productive and environmental sides. This implies a different use of resources and a demand for different policies.
- *Systems with a middle level rurality* (clusters 3 and 5) that take up over a fifth of the European territory, with 11% of the GDP and a major relevance of the primary sector both for the formation of income (over 16% SGM) as well as for employment (almost 21% of total workforce employed in agriculture). These territories require more interventions at

Table 3.5: Average PC values for first-stage clusters

Cluster	Principal component	Rurality	High economic development	Intensive Agricolture	Industry	Bovine Livestock (milk cows)	Livestock Component	Small and medium entreprises	Woodsent	Residual Component
1	**Mean**	**-3.98**	**3.70**	**1.19**	**0.13**	**1.48**	**1.67**	**0.95**	**0.50**	**-0.75**
	(std)	*0.946*	*1.509*	*1.596*	*1.374*	*1.301*	*1.383*	*0.950*	*0.925*	*1.383*
2	**Mean**	**5.26**	**1.32**	**1.49**	**-0.98**	**1.13**	**0.22**	**-0.90**	**-0.64**	**-0.65**
	(std)	*1.012*	*3.051*	*1.790*	*1.384*	*1.344*	*1.405*	*1.785*	*1.238*	*1.578*
3	**Mean**	**3.24**	**-0.59**	**-0.47**	**0.77**	**-0.73**	**0.54**	**0.72**	**0.83**	**0.11**
	(std)	*1.211*	*1.555*	*1.423*	*2.725*	*2.048*	*2.516*	*1.346*	*2.215*	*1.808*
5	**Mean**	**-0.39**	**-4.11**	**3.12**	**0.42**	**1.38**	**-1.34**	**0.63**	**0.89**	**1.37**
	(std)	*0.495*	*0.767*	*0.979*	*0.962*	*0.664*	*0.215*	*0.704*	*0.531*	*0.965*
7	**Mean**	**-1.13**	**-0.29**	**-1.63**	**0.09**	**0.36**	**-0.36**	**-0.73**	**0.21**	**0.21**
	(std)	*0.838*	*1.151*	*1.167*	*1.525*	*1.090*	*0.946*	*0.586*	*0.609*	*0.776*
8	**Mean**	**1.15**	**2.08**	**-0.74**	**1.21**	**-0.46**	**-1.01**	**1.60**	**-1.43**	**0.66**
	(std)	*1.059*	*1.926*	*1.068*	*1.594*	*0.934*	*0.335*	*1.512*	*0.904*	*0.848*
10	**Mean**	**-1.71**	**-0.82**	**0.94**	**-0.65**	**-1.02**	**0.17**	**-0.07**	**-0.29**	**-0.32**
	(std)	*0.971*	*1.094*	*1.277*	*1.104*	*1.057*	*0.885*	*0.809*	*0.837*	*0.768*

Figure 3.1: UE-15 map

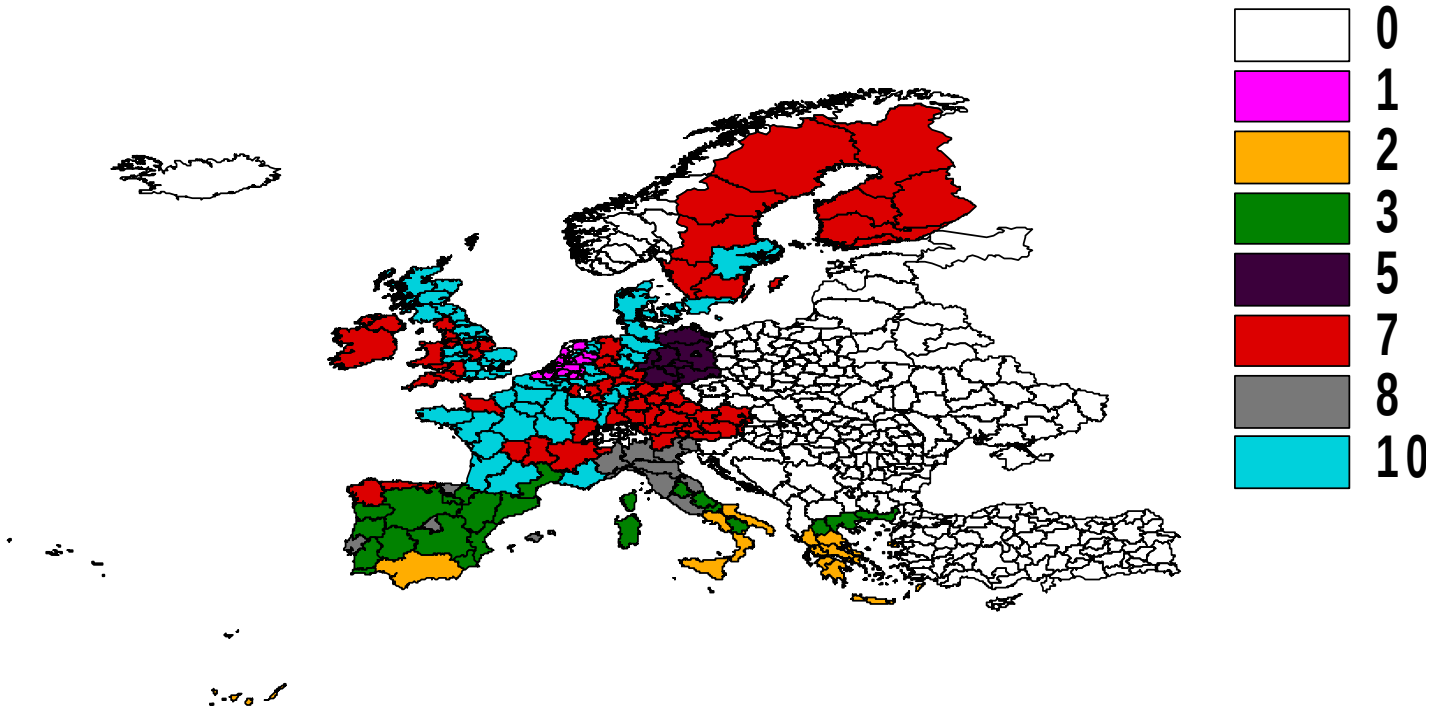


Table 3.6: Average clusters value

Cluster	**1**	**2**	**3**	**5**	**7**	**8**	**10**
Regions	**12**	**17**	**23**	**8**	**51**	**14**	**42**
			SOCIO DEMOGRAPHIC VARIABLE				
Popden	554.783	183.247	76.717	146.325	145.998	306.614	249.886
Ageing	82.267	106.544	126.932	135.628	101.814	151.064	90.510
Depend	48.789	49.723	50.532	43.922	51.387	47.411	52.683
			ECONOMIC VARIABLES				
Female	4.783	17.506	14.452	18.113	6.286	7.650	7.717
Unempl	4.408	11.806	9.913	17.725	6.078	5.614	7.369
GDP	24817.367	16201.753	17782.378	16121.263	22433.696	25969.057	22684.557
Empagr	1.491	7.773	4.172	3.216	1.491	1.265	1.537
Empter	70.837	67.151	62.889	68.498	68.525	66.924	73.907
Empind	27.671	25.104	32.935	27.385	29.973	31.811	24.540
Ltunem	30.219	50.772	42.079	59.910	32.613	35.045	35.324
			INDUSTRY				
Firmemp	18.011	26.848	13.425	93.775	62.258	9.437	39.956
Firms	1.732	0.535	0.528	0.080	0.305	2.455	0.667
			AGRICULTURE				
			Agriculture-structural				
Farmn	2.931	8.906	3.800	0.358	1.888	4.835	1.238
UAA	18.601	3.156	14.543	187.685	22.070	8.010	45.145
Small	15.704	79.715	70.587	35.322	50.374	73.895	29.839
Big	56.087	1.564	5.197	41.314	17.074	5.957	43.281
Hold55	42.292	58.090	54.236	26.155	34.044	61.738	35.083
			Agriculture-Land Allocation				
Cereals	10.121	21.659	33.186	50.081	24.140	30.886	37.118
Veget	5.857	5.360	1.698	0.182	0.259	3.745	2.307
Vine	0.000	7.723	8.414	0.032	0.752	5.893	1.475
Permcrop	0.706	29.003	3.943	0.130	0.062	3.047	0.076
Orchards	1.969	8.370	9.865	0.144	0.879	4.730	0.780
Forage	66.175	14.798	25.667	22.156	65.065	39.083	36.689
Othercr	12.392	9.519	6.553	20.541	5.491	6.509	15.820
Fallows	0.199	2.201	7.395	0.085	0.136	3.408	0.253
			Agriculture-Livestock				
Shegoa	0.048	0.421	0.152	0.011	0.052	0.070	0.046
Pigs	2.313	0.015	0.169	0.140	0.286	0.342	0.287
Poultry	0.844	0.152	0.055	0.017	0.037	0.058	0.122
Milk	0.846	0.037	0.044	0.160	0.383	0.188	0.206
Beef	0.758	0.066	0.114	0.148	0.468	0.232	0.337
Milkow	84.867	51.777	45.115	81.069	75.697	71.192	61.767
Beefor	1.201	0.423	2.881	0.709	0.735	0.663	0.954
			Agriculture-Productivity				
Valadd	3144.690	3174.273	962.440	533.043	858.837	2127.013	938.303
SGM	4.655	3.583	1.174	0.871	1.399	2.994	1.513
VadAWU	34447.781	11493.152	15181.936	28761.928	18949.955	19635.227	29658.228
AWUreg	93.788	85.322	85.853	93.603	94.597	93.703	88.947
AWUint	0.089	0.363	0.078	0.019	0.048	0.128	0.032

Table continues

Table 3.6: (continued)

Cluster	**1**	**2**	**3**	**5**	**7**	**8**	**10**
Regions	**12**	**17**	**23**	**8**	**51**	**14**	**42**
			ENVIRONMENT				
Woods	0.000	0.381	17.777	0.814	8.021	4.923	1.101
Livint	7.822	6.409	11.338	2.552	2.077	3.042	3.079

Table 3.7: Percentage clusters value

Cluster	**1**	**2**	**3**	**5**	**7**	**8**	**10**	**Total**
			SOCIO-DEMOGRAPHICS					
% Suptot	1.3	8.1	17.8	3.6	40.1	5.7	23.3	100
% Tot Pop	5.3	9.5	9.9	4.2	25.8	12.8	32.5	100
			ECONOMICS					
% Employees_Total	5.1	6.2	8.5	4.4	28.1	12.3	35.4	100
% Employees_Agric	3.8	24.7	13.7	7.2	18.4	7.5	24.7	100
% Employees_Industry	4.8	5.3	11.1	4.5	30.2	14.6	29.5	100
% Employees_Services	5.3	6.1	7.5	4.3	26.4	11.7	38.6	100
% GDP	6	6.5	8	3	26.3	15.1	35	100
			AGRICOLTURE					
			Agriculture-Structural					
% Farm	1.8	27.7	24.9	0.6	19.3	13.9	11.8	100
% UAA (Ha)	2	7.8	18.9	5.2	25.9	6	34.2	100
% Supagr	1.6	8.7	21.7	4.7	26.1	5.9	31.3	100
% Small	0.42	33.8	28.5	0.32	15.23	16	5.73	100
% Big	8.7	5.87	8.61	1.89	25.73	8	41.2	100
% Hold55	1.5	31.9	27.6	0.29	13.68	17.2	7.82	100
% Farm>50 UAA	0.64	5.56	20.7	7.18	22.36	4.04	39.6	100
			Agriculture-Land Allocation					
% Cereals_Ha	0.6	5.3	21.3	7.8	18	7.1	40	100
% Veget _Ha	11.6	15.3	18.2	1	6.1	12.2	35.5	100
% Vineyards_Ha	0	13.4	47	0	6.1	12.2	21.3	100
% Permcrop_Ha	0.8	52.9	33.1	0.3	2.4	7	3.5	100
% Orchards_Ha	1.3	19.7	52.9	0.3	6.1	11.2	8.5	100
% Forage_Ha	3.1	3.9	11.9	3	40.8	4.9	32.3	100
% Wood_Ha	0	1.1	31.8	1.2	46.6	8.8	10.5	100
% Other Field Crops-Ha	2.7	8.2	12.5	11.2	13.7	5.2	46.5	100
% Agric Fallows_Ha	0.3	10	79.9	0.3	2.3	3.2	4.1	100
% Set-Aside_Ha	1	3.7	26.2	7.9	16.9	4.2	40	100
			Agriculture-Livestock					
% Milk Cows_Lu	9.5	1.6	3.4	5.1	44	7.4	29.1	100
% Cow	6.2	2.6	7.5	3.9	42.6	5.5	31.7	100
% Other Cow	2.1	3.4	13.3	2.4	39.4	2.6	36.7	100
% Sheep&Goats_Lu	1.4	17.8	29.2	0.9	28.8	2.7	19.3	100
% Pigs_Lu	16.6	1.7	12.9	2.5	23.9	9.1	33.2	100

Table continues

Table 3.7: (continued)

Variable	1	2	3	5	7	8	10	Total
				Agriculture-Livestock (Continued)				
% Poultry_Lu	17.1	3.8	11.9	0.8	11.8	6.3	48.4	100
% Beef_Lu	4.8	1.4	6.5	2.9	43.9	5.7	34.9	100
% Livestock_Lu	10.0	3.4	10.5	2.8	33.5	6.7	33.1	100
				Agriculture-Productivity				
% AWU	4	22.3	21.4	2.2	20.7	10.3	19	100
% Farm Net Value Added	7.3	16.5	15.8	3.1	19.6	10.9	26.8	100
% SGM	7.62	11.1	12.7	3.76	22.08	9.59	33.2	100
% Compensatory Payments (Cereals_Ha)	0.5	4.8	19.0	7.9	19.2	3.6	44.9	100
% Compensatory Payments (Cereals_Cp)	0.6	2.3	9.6	9.4	20.4	3.3	54.4	100
% Payments to Dairy Outgoers	0.0	0.0	2.9	0.0	76.5	0.0	20.5	100
% Compensatory Payments	1.2	5.6	12.9	8.9	18.0	7.5	46.0	100
% Set-Aside Premiums	0.9	2.0	12.3	11.8	17.3	4.6	51.1	100
% Subsidies on Livestock	2.4	3.9	12.9	1.7	46.0	2.4	30.7	100

sectorial level, but also the structural and economic differences rema in to a substantial extent.

- *Systems with a high level of rurality* (cluster 2), that take up slightly more than 8% of the land, but in which almost one-fourth of the farmers live and work. These regions require urgent structural interventions and integration of the primary sector with the food chain.

In-depth information emerging from the analysis of the individual clusters (figure 3.1):

Cluster 1. Continental urban systems with a high level of socio-economic development and with a highly specialized agriculture. This cluster consists of some regions in continental Europe (Belgium and Holland) where there are large urban centers, with slightly mo re than 1% of total surface, but 6% of the GDP and almost 8% of the agricultural income. In medium and large sized enterprises, primarily pork, almost 17% of the total) and aviculture (over 17%). The most evident feature of these areas is the consistent us e of all of the resources, given that it is focused on both the population as well as the industrial and tertiary activities and the agricultural specialization, barely dependent upon the agricultural policies adopted. The application of environmental meas ures based upon the second pillar of the CAP is of utmost importance.

Cluster 2. Mediterranean Systems with gaps in socio-economic development. Regions in the south of Italy and Spain, as well as Greece belong to this cluster, which is characterized by a strong role

of agriculture for both domestic (almost 8% of employed) and European levels (almost one fourth of total work force). These areas also have a very high rate of unemployment, especially in the long term and the primary sector could play an important role in the research of new competitiveness. Agriculture presents significant structural problems (the average being 3.1 hectares) and large population of ageing (59% of holders are older than 55); prevailing systems - fruit growing, horticulture, and sheep farms - allow for a high productivity per hectare but the integration with the rest of the food chain is limited. Overall, agricultural politics have been implemented, yet there remains a noteworthy need for structural and regional policies.

Cluster 3. Mediterranean systems with an average level of socio-economic development and with both extensive and intensive agriculture. Included in this cluster are some of the regions in central Italy, Spain, Portugal and Greece. Taking up almost 18% of the European territory these regions are also characterized by a GDP per capita slightly less than the average. The primary sector has an important role (4% of farm workers and almost 14% of European agricultural employees). These regions are unique because of the old age of the population, especially the farmers. Most farm structures are medium sized, but the smallest are particularly relevant since they make up over 70%. There is a variety of agricultural systems including cereals (21% of the European total); fruit farming (33%), vegetable growing and horticulture; sheep farming (almost 30% of the total). In these areas, the CAP has played a relatively important role with almost 13% of compensatory payments in the EU, 12% of premium for the set aside and almost 13% of subsidies for livestock.

Cluster 5. Continental systems with a low level of socio-economic development. This cluster (some regions in Germany) is characterized by a per capita GDP less than the European average along with a population of elderly people that is higher than the EU's average. Agriculture holds a significant role, with large farms and a prevalence of young conductors. Profitability is less than the average even though the most prevalent system is cereal growing. Even in these regions, the impact of the CAP has been fairly strong due to the compensation for cereals (19% of the total).

Cluster 7. Systems in the mountains and hills. A broad range of European regions belong to this group that includes over 40% of the total surface, but the population residing here is low (less than 26% of the total). Mountainous and hilly regions in most Member States (France, Spain, Italy, Germany, and Austria) and regions in the north (Sweden) are included in this cluster. Socio-economic indicators do not clearly demonstrate the unique nature of the situation: the per capita GDP corresponds with the EU average. Nonetheless the minimal relevance of agriculture around these areas, there is a high number of agricultural workers (over 18%) as well as agricultural lands (almost 26%). The majority of systems are livestock (milk cows, pigs, and sheep) and the farms are

medium sized. There are also a considerable number of small farms. Even though providing the significant contribution to European agricultural income (over one fifth) these areas are encountering problems with over 76% of premiums for milk quotas outgoers. Also other CAP measures affect significantly the agricultural profitability: 46% of livestock support and 18% of compensations.

Cluster 8. Systems with a high level of development and a highly productive agricultural sector . It includes Italian and Spanish regions characterized by high demographic density and high levels of GDP per capita even though there is a large elderly population. Farms are mainly small with a high number of very small units (less than 1 hectare) and with a large number of elderly farmers. Under an agricultural profile, these areas can be considered like a link between continental agriculture and that of the Mediterranean. Other than cereals farming, prevalent systems include fruit growing, viniculture, and vegetable growing/horticulture. Of utmost relevance, is the integration of the food chain of high quality. The subsidies of the CAP have influenced agricultural productivity minimally.

Cluster 10. Continental Systems with extensive agriculture and a high level of socio -economic development. In this region, that includes a wide range of regions in Germany, France, England, and Belgium, (almost ¼ of European surface) agriculture is not an important sector for the employment with only 1.5% of workers, but a significant share on the European total (almost 25%). These regions are densely populated with a relatively young population and a low unemployment rate. Farms are fairly large (an average of 45 hectares), the majority of farm owners are young, and the main systems are cereal growing (40% of European total), livestock (31% cows, 33.2% pigs, 48% poultry). In these regions, the measures of the CAP have had a particularly relevant role on agricultural production with 54% of compensations, 51% of premiums for the “set aside” and almost 31% of subsidies for breeding/raising/growing. As a result, the reforms can have a major impact.

3.2.1 The Two-stage Cluster analysis

Due to the big dimension of clusters 3, 7 and 10 (where we can find 83% of the compensatory payments for cereals, 88.9% of subsidies for livestock and 81% of set aside premiums) we decided to perform a second stage MSA analysis in order to capture and understand more important features of the clusters’ regions that seems to be so different from each others (figure 3.2).

Cluster 10 (Continental Systems with extensive agriculture) consists in 42 regions, in order to identify homogeneous groups of regions in this big m acro cluster we adopt a small set of indicators aiming to highlight the differences among the regions that are (table 3.8):

Table 3.8: Variables of the second stage cluster 10

% Employees Agric
Population Density
GDP
Patent Agricolture (Mio Pop)
% Set Aside

The PCA carried out two principal component that explain more than the 74% of the whole variability and the hierarchical cluster analysis according to the Pseudo F, Pseudo t^2 and CCC statistics identifies 3 clusters (table 3.9).

In this way the cluster 10 is divided in 3 smallest clusters (table 3.9).

Table 3.9: Cluster Summary (second stage cluster 10)

Cluster	Frequency	RMS Std Deviation	Maximum Distance from Seed to Observation	Radius Exceeded	Nearest Cluster	Distan ce Between Cluster Centroids
101	7	1.0266	2.1018		2	3.1439
102	19	0.7247	1.8838		3	2.0958
103	16	0.6083	1.5564		2	2.0958

Cluster 7 (Systems in the mountains and hills) is the biggest cluster with 51 regions. We decided to carry the second stage of MSA analysis only on 6 indi cators (table 3.10).

The CAP points out three principal components that explain more than the 80% of the variability. The hierarchical cluster analysis produces 3 second stage groups in the cluster 7 (table 3.11).

In the cluster number 3 (Mediterranean systems) there are 23 regions, we decided to run the PCA analysis on a set of indicators that are shown in table 3.12.

Table 3.10: Variables of second stage cluster 7

% Employees Agric
% Employees Industry
Investments in Manufacturing (X Person)
% Small Firm
% Dairy Outgoers
% Pigs

Table 3.11: Cluster Summary (second stage cluster 7)

Cluster	Frequency	RMS Std Deviation	Maximum Distance from Seed to Observation	Radius Exceeded	Nearest Cluster	Distance Between Cluster Centroids
71	7	1.0392	1.9519		2	2.8434
72	28	0.6316	2.0742		3	2.3867
73	16	0.8641	3.3551		2	2.3867

Table 3.12: Variables of second stage cluster 3

% Employees Agric
SGM
Population Density
Ageing Index
% Holders Aged more than 55

We get 3 principal components that explain more than the 80% of the whole variability. 3 smallest clusters comes from the cluster 3 (table 3.13).

Table 3.13: Cluster Summary (second stage cluster 3)

Cluster	Frequency	RMS Std Deviation	Maximum Distance from Seed to Observation	Radius Exceeded	Nearest Cluster	Distance Between Cluster Centroids
31	7	0.7381	1.9598		3	2.1077
32	9	0.9674	2.4553		1	2.3743
33	7	0.9737	2.7029		1	2.1077

Table 3.14 shows the regional EU segmentation coming from the second stage analysis. The analysis of individual under-systems territorial systems (tables 3.15, 3.16 a, b, c) highlights:

- A large amount of CAP measures is directed towards two territorial systems (clusters 102 and 103). Here we can find 35 regions (covering more than 21.4% of the SAU of the EU),

with a large amount of compensatory payments (43.3%) and premiums for the "set aside" (48.3%), but also with 30% of the subsidies for livestock;

- In hill and mountain systems (cluster 7) there is a territorial system (cluster 72), with subsidies for livestock (almost 21% of the total), compensatory payments (12.9%) and the premiums set aside (12.6%), while the subsidies for the dairy outgoers is found in cluster 71;
- The CAP measures are not relevant in any of the secondary territorial systems of the Mediterranean systems with different levels of socio-economic development (cluster 3). In these areas, the majority of the workforce works in agriculture, thus showing the need for rural development measures.

Table 3.14: Regional European UE-15 segmentation

Code	Region	Cluster	Code	Region	Cluster	Code	Region	Cluster
be21	ANTWERPEN	**1**	gr12	KENTRIKI MAKEDONIA	**32**	se07	MELLERSTA NORRLAND	**73**
be22	LIMBURG	**1**	es23	LA RIOJA	**32**	se08	ÍVRE NORRLAND	**73**
be23	OOST-VLAANDEREN	**1**	es51	CATALUNA	**32**	ukl	WALES	**73**
be25	WEST-VLAANDEREN	**1**	es52	COMUNIDAD VALENCIANA	**32**	ukn	NORTHERN IRELAND	**73**
nl12	FRIESLAND	**1**	es62	REGION DE MURCIA	**32**	fr25	BASSE-NORMANDIE	**73**
nl21	OVERIJSSEL	**1**	fr81	LANGUEDOC-ROUSSILLON	**32**	itc2	VALLE D'AOSTA	**73**
nl22	GELDERLAND	**1**	itf1	ABRUZZO	**32**	itd1	TRENTINO-ALTO-ADIGE	**73**
nl31	UTRECHT	**1**	pt11	NORTE	**32**	itd2	TRENTINO-ALTO-ADIGE	**73**
nl32	NOORD-HOLLAND	**1**	pt15	ALGARVE	**32**	at11	BURGENLAND	**73**
nl33	ZUID-HOLLAND	**1**				at21	KÄRNTEN	**73**
nl41	NOORD-BRABANT	**1**	es22	COMUNIDAD FORAL DE NAVARRA	**33**	at32	SALZBURG	**73**
nl42	LIMBURG	**1**	es24	ARAGON	**33**	at33	TIROL	**73**
			es41	CASTILLA Y LEON	**33**	pt20	ACORES	**73**
gr14	THESSALIA	**2**	fr83	CORSE	**33**	se06	NORRA MELLANSVERIGE	**73**
gr21	IPEIROS	**2**	ite2	UMBRIA	**33**	se07	MELLERSTA NORRLAND	**73**
gr22	IONIA NISIA	**2**	itf2	MOLISE	**33**	se08	ÍVRE NORRLAND	**73**
gr23	DYTIKI ELLADA	**2**	pt16	CENTRO	**33**	ukl	WALES	**73**
gr24	STEREA ELLADA	**2**				ukn	NORTHERN IRELAND	**73**
gr25	PELOPONNISOS	**2**	be34	LUXEMBOURG	**71**			
gr30	ATTIKI	**2**	de21	OBERBAYERN	**71**	be24	VLAAMS BRABANT	**102**
gr41	VOREIO AIGAIO	**2**	fr71	RHONE-ALPES	**71**	be31	BRABANT WALLON	**102**
gr42	NOTIO AIGAIO	**2**	Ie	IRELAND	**71**	be32	HAINAUT	**102**
gr43	KRITI	**2**	Ukd	NORTH-WEST UK	**71**	be33	LIEGE	**102**
es61	ANDALUCIA	**2**	Ukf	EAST MIDLANDS	**71**	be35	NAMUR	**102**
es70	CANARIAS	**2**	Ukk	SOUTH-WEST UK	**71**	dk00	DANMARK	**102**
itf3	CAMPANIA	**2**				de92	HANNOVER	**102**
itf4	PUGLIA	**2**	de11	STUTTGART	**72**	dea4	DETMOLD	**102**
itf6	CALABRIA	**2**	de12	KARLSRUHE	**72**	fr22	PICARDIE	**102**
itg1	SICILIA	**2**	de13	FREIBURG	**72**	fr23	HAUTE-NORMANDIE	**102**
pt30	MADEIRA	**2**	de14	TÜBINGEN	**72**	fr30	NORD - PAS-DE-CALAIS	**102**
			de22	NIEDERBAYERN	**72**	fr41	LORRAINE	**102**
de4	BRANDENBURG	**5**	de23	OBERPFALZ	**72**	fr42	ALSACE	**102**
de80	MECKLENBURG-VORPOMMERN	**5**	de24	OBERFRANKEN	**72**	fr82	PROVENCE-ALPES-COTE D'AZUR	**102**
de91	BRAUNSCHWEIG	**5**	de25	MITTELFRANKEN	**72**	nl11	GRONINGEN	**102**
ded	SACHSEN	**5**	de26	UNTERFRANKEN	**72**	ukc	NORTH-EAST UK	**102**
dee1	DESSAU	**5**	de27	SCHWABEN	**72**	uke	YORKSHIRE AND THE HUMBER	**102**
dee2	HALLE	**5**	de72	GIESSEN	**72**	ukg	WEST MIDLANDS	**102**

Table continues

Table 3.14: (continued)

Code	Region	Cluster	Code	Region	Cluster	Code	Region	Cluster
dee3	MAGDEBURG	**5**	de73	KASSEL	**72**	ukh	EASTERN UK	**102**
deg0	THÜRINGEN	**5**	de94	WESER-EMS	**72**			
			dea3	MÜNSTER	**72**	de93	LÜNEBURG	**103**
es21	PAIS VASCO	**8**	dea5	ARNSBERG	**72**	def0	SCHLESWIG-HOLSTEIN	**103**
es30	COMUNIDAD DE MADRID	**8**	deb1	KOBLENZ	**72**	fr21	CHAMPAGNE-ARDENNE	**103**
es53	ISLAS BALEARES	**8**	deb2	TRIER	**72**	fr24	CENTRE	**103**
itc1	PIEMONTE	**8**	dec0	SAARLAND	**72**	fr26	BOURGOGNE	**103**
itc3	LIGURIA	**8**	fr43	FRANCHE-COMTE	**72**	fr51	PAYS DE LA LOIRE	**103**
itc4	LOMBARDIA	**8**	fr63	LIMOUSIN	**72**	fr52	BRETAGNE	**103**
itd3	VENETO	**8**	fr72	AUVERGNE	**72**	fr53	POITOU-CHARENTES	**103**
itd4	FRIULI-VENEZIA GIULIA	**8**	at12	NIEDERÍSTERREICH	**72**	fr61	AQUITAINE	**103**
itd5	EMILIA-ROMAGNA	**8**	at22	STEIERMARK	**72**	fr62	MIDI PYRENEES	**103**
ite1	TOSCANA	**8**	at31	OBERÍSTERREICH	**72**	nl13	DRENTHE	**103**
ite3	MARCHE	**8**	at34	VORARLBERG	**72**	nl23	FLEVOLAND	**103**
ite4	LAZIO	**8**	fi	FINLAND	**72**	nl34	ZEELAND	**103**
pt17	LISBOA E VALE DO TEJO	**8**	se09	SMALAND MED ÍAMA	**72**	se02	ÍSTRA MELLANSVERIGE	**103**
			se0a	VÄSTSVERIGE	**72**	se04	SYDSVERIGE	**103**
gr11	ANATOLIKI MAKEDONIA	**31**	es11			ukm	SCOTLAND	**103**
gr13	DYTIKI MAKEDONIA	**31**	es12	GALICIA	**73**			
es42	CASTILLA-LA MANCHA	**31**	es13	PRINCIPADO DE ASTURIAS	**73**			
es43	EXTREMADURA	**31**	fr25	CANTABRIA	**73**			
itf5	BASILICATA	**31**	itc2	BASSE-NORMANDIE	**73**			
itg2	SARDEGNA	**31**	itd1	VALLE D'AOSTA	**73**			
pt18	ALENTEJO	**31**	itd2	TRENTINO-ALTO-ADIGE	**73**			
			at11	TRENTINO-ALTO-ADIGE	**73**			
de71	DARMSTADT	**101**	at21	BURGENLAND	**73**			
dea1	DÜSSELDORF	**101**	at32	KÄRNTEN	**73**			
dea2	KÍLN	**101**	at33	SALZBURG	**73**			
deb3	RHEINHESSEN-PFALZ	**101**	pt20	TIROL	**73**			
fr10	ILE DE FRANCE	**101**	se06	ACORES	**73**			
se01	STOCKHOLM	**101**		NORRA MELLANSVERIGE	**73**			
ukj	SOUTH-EAST UK	**101**						

Table 3.15: Average clusters values total

Cluster	**1**	**2**	**5**	**8**	**31**	**32**	**33**	**71**	**72**	**73**	**101**	**102**	**103**
Regions	**12**	**17**	**8**	**13**	**7**	**9**	**7**	**7**	**28**	**17**	**7**	**19**	**16**
						SOCIO DEMOGRAPHIC							
Popden	554.8	183.2	146.3	324.2	39.1	122.5	55.4	205.4	174.8	70.0	572.5	252.5	105.6
Ageing	82.3	106.5	135.6	153.4	119.9	114.1	150.5	83.0	101.7	110.9	93.8	86.3	94.1
Depend	48.8	49.7	43.9	47.2	51.3	48.6	52.2	52.7	51.2	51.2	48.7	52.9	54.2
						ECONOMIC							
Female	4.8	17.5	18.1	7.9	20.5	11.6	12.1	5.3	6.2	6.7	6.3	8.4	7.6
Unempl	4.4	11.8	17.7	5.8	13.5	8.6	8.0	5.2	6.4	5.7	6.9	8.0	6.8
Gdp	24817.4	16201.8	16121.3	25867.0	15176.5	18492.9	19474.8	24290.1	22476.7	21884.5	28927.9	21783.6	21022.9
Empagr	1.5	7.8	3.2	1.2	7.0	3.8	1.8	1.1	1.1	2.3	0.8	1.1	2.4
Empter	70.8	67.2	68.5	66.8	61.8	62.0	65.0	73.9	65.8	70.8	77.7	74.1	72.0
Empind	27.7	25.1	27.4	32.0	31.1	34.2	33.1	25.1	33.1	26.8	21.5	24.8	25.5
Ltunem	30.2	50.8	59.9	36.3	45.0	38.8	43.4	28.9	37.1	26.0	36.0	37.0	33.1
						INDUSTRY							
Firmemp	18.0	26.8	93.8	9.6	16.2	13.6	10.4	47.6	92.4	15.4	93.0	31.6	26.7
Firms	1.7	0.5	0.1	2.6	0.2	0.8	0.4	0.6	0.2	0.3	1.2	0.8	0.3
						AGRICULTURE							
						***Agriculture**-Structural*							
Farmn	2.9	8.9	0.4	4.8	3.4	4.5	3.3	1.4	1.7	2.5	1.1	1.3	1.2
UAA	18.6	3.2	187.7	8.5	14.9	7.4	23.3	30.0	23.9	14.5	31.4	43.4	53.3
Small	15.7	79.7	35.3	73.8	76.7	69.2	66.2	40.4	43.5	67.2	34.0	30.9	26.8
Big	56.1	1.6	41.3	6.0	2.4	6.3	6.6	27.9	19.4	8.1	38.4	42.7	46.1
Hold55	42.3	58.1	26.2	62.2	55.6	54.5	52.5	40.4	27.7	43.2	33.3	37.8	32.6
						***Agriculture**-Land allocations*							
Cereals	10.1	21.7	50.1	33.3	40.7	24.4	37.0	15.3	33.9	10.4	40.7	39.3	33.0
Veget	5.9	5.4	0.2	4.0	1.0	2.9	0.9	0.2	0.4	0.2	2.7	1.7	2.9
Vine	0.0	7.7	0.0	5.2	3.3	12.4	8.4	0.6	0.7	1.7	2.4	1.2	1.5
Permcrop	0.7	29.0	0.1	3.3	3.2	5.3	2.9	0.0	0.1	0.0	0.1	0.1	0.1
Orchards	2.0	8.4	0.1	3.1	1.6	22.0	2.5	0.5	0.5	3.1	0.8	0.6	0.9
Forage	66.2	14.8	22.2	37.9	32.2	17.3	29.8	77.3	52.4	80.2	32.2	35.7	39.8
Othercr	12.4	9.5	20.5	7.0	6.9	6.6	6.2	4.1	7.7	2.1	14.7	16.0	16.1
Fallows	0.2	2.2	0.1	3.4	7.0	7.7	7.4	0.2	0.1	0.3	0.1	0.3	0.2

Table continues

Table 3.15: (continued)

Cluster	**1**	**2**	**5**	**8**	**31**	**32**	**33**	**71**	**72**	**73**	**101**	**102**	**103**
Regions	**12**	**17**	**8**	**13**	**7**	**9**	**7**	**7**	**28**	**17**	**7**	**19**	**16**
							***Agriculture**-Livestock*						
Shegoa	0.0	0.4	0.0	0.1	0.2	0.1	0.1	0.2	0.0	0.1	0.0	0.1	0.0
Pigs	2.3	0.0	0.1	0.4	0.0	0.3	0.2	0.1	0.5	0.1	0.3	0.3	0.2
Poultry	0.8	0.2	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.2
Milk	0.8	0.0	0.2	0.2	0.0	0.0	0.1	0.3	0.3	0.5	0.2	0.2	0.2
Beef	0.8	0.1	0.1	0.2	0.1	0.1	0.1	0.7	0.4	0.5	0.3	0.4	0.3
Milkow	84.9	51.8	81.1	69.1	38.2	51.2	44.1	63.2	79.0	76.7	70.1	62.0	57.8
Beefor	1.2	0.4	0.7	0.7	1.1	6.1	0.5	0.8	0.8	0.6	0.8	1.1	0.8
							***Agriculture**-Productivity*						
Valadd	3144.7	3174.3	533.0	1869.0	692.7	1296.0	803.4	653.4	798.3	1315.1	1075.4	904.7	918.2
SGM	4.7	3.6	0.9	2.8	0.8	1.7	0.8	2.6	1.2	1.4	2.0	1.5	1.3
VadAWU	34447.8	11493.2	28761.9	19594.1	15460.8	12407.6	18470.1	21103.3	20050.1	16323.1	26036.0	31917.8	28559.7
AWUreg	93.8	85.3	93.6	93.8	85.4	81.9	91.4	94.0	93.5	96.6	88.6	91.1	86.5
AWUint	0.1	0.4	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0
							ENVIRONEMENT						
Woods	0.0	0.4	0.8	5.3	2.6	37.8	7.2	2.6	8.7	8.6	1.4	0.9	1.3
Livint	7.8	6.4	2.6	3.2	12.1	17.6	2.4	1.7	2.6	1.4	2.3	3.8	2.6
							COMPETITIVENESS						
Patent	218.7	6.3	95.8	77.2	4.2	27.8	23.4	221.4	269.5	77.8	360.8	147.2	125.4
Patagr	4.5	0.3	2.9	1.7	0.0	0.8	1.0	2.0	3.3	0.7	8.4	3.1	2.3
Patter	264.2	180.3	359.5	359.9	78.0	304.2	140.2	652.3	236.5	117.9	952.1	368.1	289.7
Invest	9.6	8.7	12.3	6.7	6.5	6.2	7.7	12.2	7.7	8.2	9.4	8.3	8.1

Table 3.16a: Percentage value of clusters 31, 32, 33 with respect to cluster 3

Cluster	31	32	33	Cluster 3
SOCIO-DEMOGRAPHICS				
% Suptot	6.6	4.9	6.3	17.8
% Tot Pop	1.9	5.9	2.2	9.9
ECONOMICS				
% Employees_Total	1.3	5.3	1.9	8.5
% Employees_Agric	4.4	7.3	2.1	13.7
% Employees_Industry	1.3	7.3	2.5	11.1
% Employees_Services	1.2	4.6	1.7	7.5
% GDP	1.3	5	1.8	8
AGRICULTURE				
Agriculture-Structural				
% Farm	8.1	10.1	6.8	24.9
% UAA (Ha)	8	4.2	6.8	18.9
% Supagr	9.3	4.3	8.1	21.7
% Small	9.5	11.5	7.5	28.5
% Big	2.2	3.8	2.6	8.61
% Hold55	8.9	11	7.6	27.6
Agriculture-Land Allocation				
% Cereals_Ha	7.5	3.6	10.1	21.3
% Vegetables_Flowers_Ha	7.8	8.3	2.1	18.2
% Vineyards_Ha	18.7	18.8	9.5	47
% Permcrop_Ha	8.8	19.9	4.5	33.1
% Orchards_Ha	3.5	41.9	7.5	52.9
% Pastures Ggi_Ha	6.7	2	3.3	11.9
% Wood_Ha	9.2	15.5	7.2	31.8
% Other Field Crops-Ha	4.5	2.8	5.1	12.5
% Set-Aside_Ha	11.3	1.5	13.4	26.2
Agriculture-Livestock				
% Milk Cows_Lu	0.5	1.4	1.5	3.4
% Cow	2.8	2	2.8	7.5
% Other Cow	6	2.3	5	13.3
% Sheep&Goats_Lu	12.4	5.3	11.4	29.2
% Pigs_Lu	0.9	7	5.1	12.9
% Poultry_Lu	1.1	5.5	5.3	11.9
% Beef_Lu	2.4	1.8	2.3	6.5
% Livestock_Lu	2.5	3.9	4.2	10.5
Agriculture-Productivity				
% AWU	5.6	10.6	5.2	21.4
% Farm Net Value Added	4.7	6	5	15.8
% SGM	3.8	5.3	3.6	12.7
% Compensatory Payments (Cereals_Ha)	6.7	2.9	9.4	19
% Compensatory Payments (Cereals_Cp)	2.9	1.7	5	9.6
% Payments to Dairy Outgoers	0	3.5	0	2.9
% Compensatory Payments	4.5	3	5.4	12.9
% Set-Aside Premiums	4.6	1	6.7	12.3
% Subsidies on Livestock	4.9	2.7	5.4	12.9

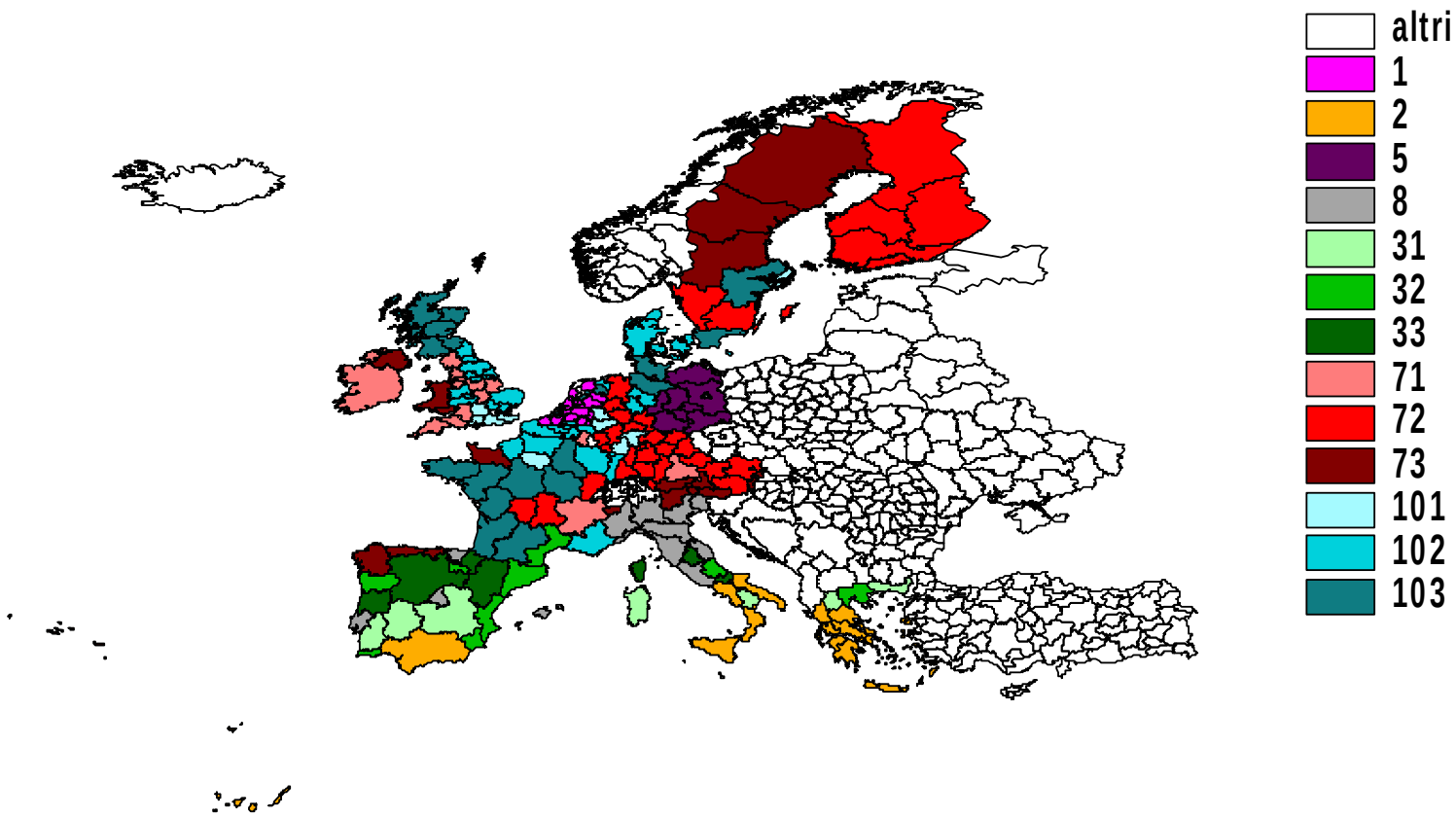
Table 3.16b: Percentage value of clusters 71, 72, 73 with respect to cluster 7

Variable	71	72	73	Cluster 7
SOCIO-DEMOGRAPHICS				
% Suptot	6	20.6	13.7	40.1
% Tot Pop	8.3	13.4	4.3	25.8
ECONOMICS				
% Employees_Total	9.2	14.9	4.1	28.1
% Employees_Agric	5.3	8.8	4.5	18.4
% Employees_Industry	8.4	17.9	4	30.2
% Employees_Services	9.8	12.5	4.2	26.4
% GDP	9.1	13.6	3.8	26.3
AGRICULTURE				
Agriculture-Structural				
% Farm	4.6	9	6.2	19.3
% UAA (Ha)	8	12.6	5.3	25.9
% Supagr	8.3	12	5.9	26.1
% Small	3.1	6	6.7	15.2
% Big	8.1	13.9	4	25.7
% Hold55	3.5	4.8	5.8	13.7
Agriculture-Land Allocation				
% Cereals_Ha	2.7	13.6	1.7	18
% Vegetables_Flowers_Ha	1.3	4.1	0.8	6.1
% Vineyards_Ha	2.2	2.8	1.3	6.1
% Permcrop_Ha	0.9	0.9	0.8	2.4
% Orchards_Ha	2.5	2.2	2.1	6.1
% Pastures_Ha	15.5	15	10.4	40.8
% Wood_Ha	6.3	28.5	11.8	46.6
% Other Field Crops-Ha	2	10.3	1.4	13.7
% Set-Aside_Ha	2.2	12.7	1.9	16.9
Agriculture-Livestock				
% Milk Cows_Lu	12.4	19.9	11.8	44
% Cow	15	16.8	10.9	42.6
% Other Cow	15.9	12.8	10.7	39.4
% Sheep&Goats_Lu	14.4	2.7	11.7	28.8
% Pigs_Lu	1.9	20.5	1.6	23.9
% Poultry_Lu	4.1	5.2	2.4	11.8
% Beef_Lu	16.9	17.1	9.9	43.9
% Livestock_Lu	10.2	15.9	7.3	33.5
Agriculture-Productivity				
% AWU	5.6	10.2	5.2	20.7
% Farm Net Value Added	5.3	10.4	4.3	19.6
% SGM	7.1	11.3	3.9	22.1
% Compensatory Payments (Cereals_Ha)	2.9	14	2.3	19.2
% Compensatory Payments (Cereals_Cp)	3.6	14.3	2.6	20.4
% Payments to Dairy Outgoers	71.7	0	0.3	76.5
% Compensatory Payments	2.9	12.9	2.1	18
% Set-Aside Premiums	2.7	12.6	2	17.3
% Subsidies on Livestock	14.4	20.8	10.2	46

Table 3.16c: Percentage value of clusters 101, 102, 103 with respect to cluster 10

Variable	101	102	103	Cluster 10
SOCIO-DEMOGRAPHICS				
% Suptot	2	7.5	13.8	23.3
% Tot Pop	10	13.5	8.9	32.5
ECONOMICS				
% Employees_Total	12.2	14.1	9.1	35.4
% Employees_Agric	4.6	8.9	11.2	24.7
% Employees_Industry	8.8	12.5	8.2	29.5
% Employees_Services	14	15.1	9.5	38.6
% GDP	13.4	13.1	8.5	35
AGRICULTURE				
Agriculture-Structural				
% Farm	1	4.1	6.6	11.8
% UAA (Ha)	1.8	11.1	21.3	34.2
% Supagr	2.2	10.5	18.6	31.3
% Small	0.6	2	3.1	5.73
% Big	3.3	14.4	23.6	41.2
% Hold55	0.7	3.1	4	7.82
Agriculture-Land Allocation				
% Cereals_Ha	2.4	15.7	21.9	40
% Vegetables_Flowers_Ha	3.7	12.9	18.9	35.5
% Vineyards_Ha	1.7	4.6	15	21.3
% Permcrop_Ha	0.4	1.1	2	3.5
% Orchards_Ha	1	2.4	5	8.5
% Pastures_Ha	1.1	7.7	23.4	32.3
% Wood_Ha	1.2	2.2	7.1	10.5
% Other Field Crops-Ha	3.2	18.5	24.7	46.5
% Set-Aside_Ha	2.3	13.8	23.9	40
Agriculture-Livestock				
% Milk Cows_Lu	1.5	11.1	16.5	29.1
% Cow	1.6	10.7	19.4	31.7
% Other Cow	1.2	9.2	26.3	36.7
% Sheep&Goats_Lu	1.3	5	12.9	19.3
% Pigs_Lu	1.2	16.5	15.5	33.2
% Poultry_Lu	0.5	10.5	37.3	48.4
% Beef_Lu	1.2	10.6	23	34.9
% Livestock_Lu	1.2	11.8	20.1	33.1
Agriculture-Productivity				
% AWU	1.6	6.1	11.3	19
% Farm Net Value Added	2.1	9.6	15.1	26.8
% SGM	3	12.5	17.7	33.2
% Compensatory Payments (Cereals_Ha)	2.5	17	25.4	44.9
% Compensatory Payments (Cereals_Cp)	3	20.6	30.7	54.4
% Payments to Dairy Outgoers	5.4	9.9	9.1	20.5
% Compensatory Payments	2.7	17.1	26.2	46
% Set-Aside Premiums	2.9	18.4	29.7	51.1
% Subsidies on Livestock	0.9	9.2	20.9	30.7

Figure 3.2: UE-15 second stage map.



3.3 The analysis at regional level in the New Member States

3.3.1 The CAP and the New Member States

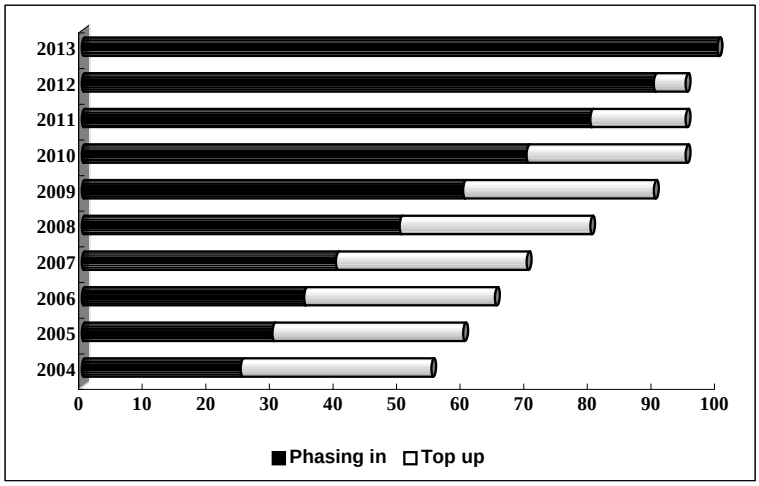
In light of the socio-economic conditions characterizing new Member States and creating difficulties applying the CAP, the European Union put forth a reform in October 2003 that integrated the results of negotiations with new aspects within the CAP.

The extension of direct payments was one of the most important issues in dealing with agricultural policy. There were two possibilities:

- *Total allocation of direct aid.* This option would provide agricultural producers with direct aid using the same measures that applied to the EU-15 countries. Strongly backing this proposal, Poland, agriculturally speaking the most influential of the 10 new Member States, emphasized how the application of the CAP should be equal for all Member States. Other applicant countries supported Poland and this option.
- *Gradual allocation of direct aid*. The Commission proposed an alternative solution including payments of various sorts between the old and new Member States until 2013. Based on the premise that a total allotment of direct aid would have a negative effect upon the modernization and restructuring of businesses thus leading to a low productivity, low production standards, and a rise in the unemployment rate, the Commission opted to gradually distribute direct aid over a period of time. Not only would the direct application cause these problems, but also it could have brought about a rise in social inequality and raise the necessary sectors to bridge the gaps between the two groups.

In the end, the Commission opted for the second option regarding direct payments and these were introduced in a gradual manner *(phasing in)* starting from 25% of the total sum in 2004 and arriving at 100% in 2013, when the payment level will reach the same amount provided in Member States (figure 3.3). Each new Member State, however, will be able to increase its remunerations by 30% during this transitional period by means of national funding, under the condition that the sum of both the EU and the national payments does not exceed 10% of the aid received before joining the EU and that the sum does not exceed the actual level of payments in existing in the Community (*top-up*).

Figure 3.3: Phasing in and top-up of direct payments in NMS



Source: EU Commission

The application of direct payments however requires organized, effi cient, and administrative structures working well; however, these are difficult to find in the new Member States. As a result, the EU has offered a transitory system of payment to the NMS that is valid for five years (at max) that can allow new Member States both to pay this type of funding to producers and to be able to organize themselves and prepare their structures for the concession of direct payments according to the foreseen modalities of the CAP.

In the new Member States, a uniform amount was calcu lated and supplied based upon the number of agricultural hectares in possession. The main condition was such that the surfaces were kept in good productive condition in the considered time period. Each farmer is thus given a subsidy based on the number of hectares declared at the time of the application. Given the number of NMS (including those also with fairly insignificant farms), in which production is divided between both self-consumption and sales, an added loan up to 1000 Euros geared towards making these farms totally commercial. Until 2013, the application of this modulation, a decrease, and of a *cross-compliance* in the NMS is not foreseen; while at the same time compromises and transitional measures regarding food security were not granted. Relating to the adoption of these measures, with the exception of Malta (where the reform will brought about starting in 2007 and the model of payment will be *phasing in* on the regional model) all of the NMS have adopted the transitory payment method, with a fixed amount per hectare.

3.3.2 The agricultural and rural systems in the NMS

In this part we applied the MSA methodology (PCA and Cluster analysis) described in section 2 on the regions of the NMS.

As explained the analysis on this ten countries (Malta, Cyprus, Estonia, Latvia, Lithuania, Poland, Hungary, Czech Republic, Slovenia, Slovakia) is affected by the lack of data discussed previously. Here we can remember the lack of FADN data base; the lack of da ta at regional level for Poland (about 50% of total surface), mainly for agriculture structures; the lack of information for agricultural productivity for about all NMS. In order to keep the Polish regions, our choice is to limit the informativeness of the analysis at structural level for all the NMS.

The Principal Component Analysis (PCA), explained in the previous section aims to reduce the number of variables and to drop the correlation among their producing component that are latent variable determining the disparity among data.

The PCA applied at the data in table 2.4 gives 5 latent variable that explained the 78% of the whole variability (table 3.17)

Table 3.17: PRINCOMP procedure SAS output

Eigenvalues of the Correlation Matrix

	Eigenvalue	Difference	Proportion	Cumulative
1	8.22075657	2.25734163	0.2936	0.2936
2	5.96341493	2.65644449	0.2130	0.5066
3	3.30697044	0.92800402	0.1181	0.6247
4	2.37896642	0.22250691	0.0850	0.7096
5	2.15645951	0.67282155	0.0770	0.7867
6	1.48363797	0.60405571	0.0530	0.8397
7	0.87958226	0.09630303	0.0314	0.8711
8	0.78327922	0.11885626	0.0280	0.8990
9	0.66442297	0.11128753	0.0237	0.9228
10	0.55313544	0.06317592	0.0198	0.9425
11	0.48995952	0.21277686	0.0175	0.9600
12	0.27718266	0.04325784	0.0099	0.9699
13	0.23392482	0.06692218	0.0084	0.9783
14	0.16700264	0.03452812	0.0060	0.9842
15	0.13247452	0.04179057	0.0047	0.9890
16	0.09068395	0.02330738	0.0032	0.9922
17	0.06737656	0.01548315	0.0024	0.9946
18	0.05189341	0.02154890	0.0019	0.9965
19	0.03034451	0.00834901	0.0011	0.9976
20	0.02199550	0.00350408	0.0008	0.9983
21	0.01849142	0.00490420	0.0007	0.9990
22	0.01358722	0.00263100	0.0005	0.9995
23	0.01095622	0.00854571	0.0004	0.9999
24	0.00241051	0.00158279	0.0001	1.0000
25	0.00082773	0.00062520	0.0000	1.0000
26	0.00020253	0.00014202	0.0000	1.0000
27	0.00006052	0.00006048	0.0000	1.0000

The result of PCA can be summarized and e xplained in the following way (t able 3.18):

Table 3.18: Factor loading

Variable	Prin1	Prin2	Prin3	Prin4	Prin5
Popden				18.27	7.96
Ageing		-7.41		9.38	
Depend		5.13			
Female					7.86
Unempl		5.61			7.64
GDP		-5.54			7.01
Empagr		10.00			
Empter			6.26		-9.42
Empind		-6.85			
Ltunem					
UAA tot					-15.19
Cereals			-13.10		
Forest			7.39	-5.60	
Fallow					11.46
Permcrop	8.51				
Grenfod	5.57		11.69		
Vine	7.55			-6.66	
Orchards	6.32		-6.35		
Shegoa	7.67			-6.74	
Pigs	6.40				
Poultr	6.76		5.45		
Milk		6.29	5.36		
Cow		5.12	7.02		
Beefor		6.37			
Milkow		6.66			-7.09
AWUint		6.29		8.23	
Liveint	9.29				
Inrd					

Where considering the sign and relevance of the factor loadings (above 0.5 in absolute value), the extracted components can be interpreted as follows:

- *First Principal Component*: high value for all the cultivation, and livestock presence. Intensive livestock.
- *Second Principal Component*: small value of the ageing index, low per capita GDP and high unemployment and agricultural employment rate. Relevance of bovine livestock, in particular milk cow.
- *Third Principal Component*: relevance of the services for employment. Presence of woodlands and livestock (not intensive).

- *Fourth Principal Component:* Densely populated areas and strong presence of elderly people. Livestock and agriculture in general are not important.
- *Fifth Principal component*: Densely populated areas and high unemployment rate, mainly for the women, despite the medium socio-economic development (GDP) per capita is medium. The agricultural sector is not important .

Table 3.19: Average value of the principal component in the clusters

Cluster		Prin1	Prin2	Prin3	Prin4	Prin5
2	**Mean**	**-2.31**	**1.02**	**0.31**	**-0.57**	**1.34**
	Std	*0.48*	*0.55*	*0.71*	*0.56*	*0.96*
3	**Mean**	**0.16**	**-1.48**	**-2.01**	**0.07**	**-1.42**
	Std	*0.62*	*0.86*	*0.59*	*0.73*	*0.92*
4	**Mean**	**-0.53**	**-0.94**	**1.59**	**-1.14**	**0.24**
	Std	*0.69*	*0.86*	*0.84*	*0.65*	*0.67*
6	**Mean**	**11.25**	**3.42**	**0.28**	**-0.95**	**0.54**
	Std	*0.02*	*1.46*	*7.22*	*5.32*	*2.77*
7	**Mean**	**0.90**	**-2.78**	**0.66**	**0.55**	**-0.24**
	Std	*1.04*	*1.87*	*0.99*	*1.97*	*2.19*
8	**Mean**	**-1.17**	**2.91**	**-0.73**	**1.13**	**-0.06**
	Std	*0.54*	*1.06*	*0.85*	*0.63*	*0.64*

Table 3.20: Summary of the clusters

Cluster	Frequency	RMS Std Deviation	Maximum Distance from Seed to Observation	Radius Exceeded	Nearest Cluster	Distance Between Cluster Centroids
1	1	.	0		7	9.5139
2	7	0.6726	2.0664		4	3.1919
3	7	0.7558	2.9821		7	3.1078
4	8	0.7472	2.0665		7	2.4197
5	1	.	0		6	13.4330
6	1	.	0		5	13.4330
7	7	0.8252	2.6782		4	2.4197
8	9	0.7688	1.9656		2	3.2921

Cluster analysis led to the identification of 8 clusters (table 3.20). As in the EU -15 analysis in order to obtain clusters with a significant dimension, according to the output of the Sas routine we decided to merge the cluster with a number of regions less than 3 to the statistically nearest cluster. According to that the cluster 1 (1 region) has been joined to cluster 7, clusters number 5 and 6 (1 region) has been joined together (Cyprus and Malta), leading in this way to 6 clusters of regions .

The analysis of the NMS considers only a first stage MSA analysis due to the lack of data and the relative small number of countries.

A first definition of the groups of regions identified by the cluster analysis can be obtained considering the average values pointed out by each cluster in the following way:

Cluster 2 (7 regions). This cluster presents high value for the fifth principal component and small for the first one. Therefore, although there are many problems with unemployment, the areas are not particularly poor. The agricultural sector as also underlined by the first principal component is not relevant in itself; however, it is important for employment.

Cluster 3 (7 regions). This group of regions has relatively low importance in all of the main components, especially components 2, 3, and 5. These regions are characterized by a fairly high elderly population, relatively low unemployment rates, and employment in the agricultural sector fairly important.

Cluster 4 (8 regions). This group of regions has high levels in the 3rd component and medium low levels for the fourth. These are therefore characterized by service sector of minimal importance for employment; more important for agriculture. Therefore, these results have multiple meanings.

Cluster 6 (Cyprus and Malta). These two regions have fairly high values for the first main component. They are characterized by a high density of population, primarily young, high rates of unemployment both in the long term and for females. Nonetheless, the GDP per capita is high. The agricultural sector is important.

Cluster 7 (8 regions). These regions have high values for the first main component and relatively low values for the second. These regions are characterized by agricultural cultivation (although agriculture is not important in terms of employment) and for livestock that is intensive in some cases. Demographics include a moderately old population. The industrial sector is important for employment and a high GDP.

*Cluster 8 (9 regions)***.** Polish regions make up this cluster distinguished by high values in the second and fourth main components, and low values for the first. These regions are characterized by a young population, high rates of unemployment, and a relatively low per capita GDP. Agriculture is important for employment and the cow farming is particularly important.

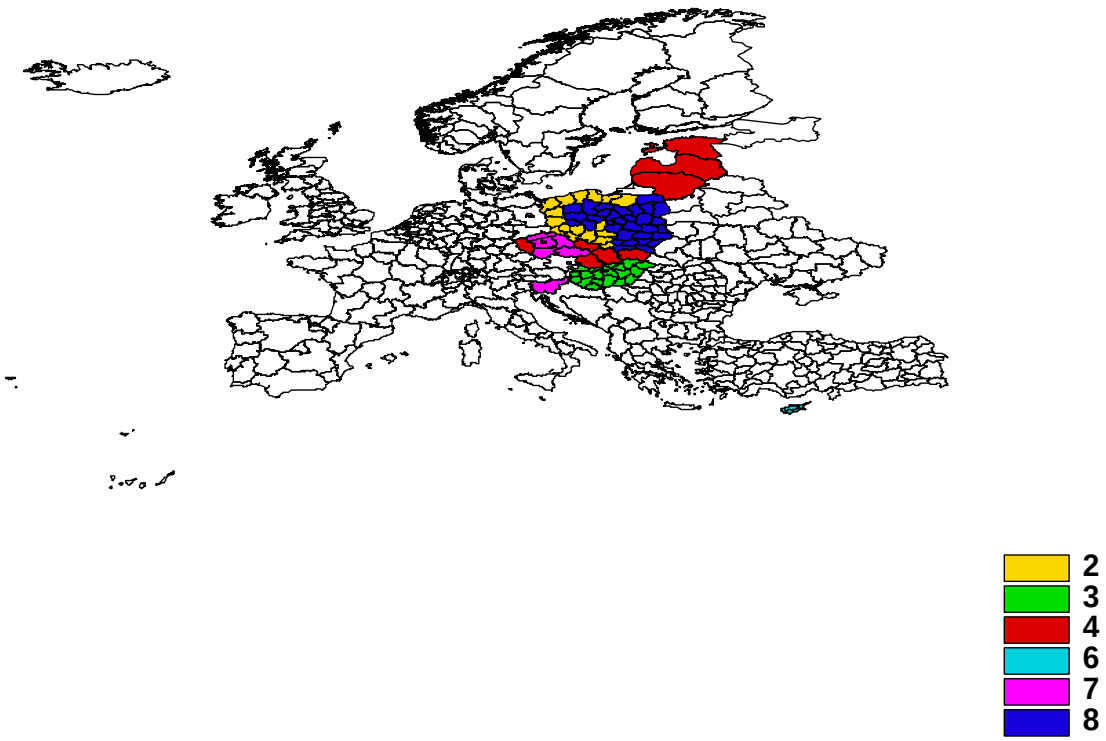
The characteristics of agricultural and rural systems in the New Member States (table 3.21, 3.22 , 3.23 and figure 3.4) include:

1. *Agricultural systems in densely populated areas with an average level of development (Cluster 2).* Included in this group are seven Polish regions covering over 16% of the total NMS surface and including over 20% of the population. There is a high unemployment rate and the agricultural sector is very important for employment (more than 16% of total

agricultural employees in these areas). Both the CAP measures and rural development measures have significant meaning in this context.

2. *Intensive and extensive systems with an average level of socio economic development (Cluster 3).* Seven Hungarian regions make up this group in which agriculture is not of particular importance for employment (only 8% of workers). In this system, there are both intensive and extensive (59% of viticulture lands in the NMS) and extensive (grains, pigs, poultry).

Figure 3.4: NMS Regions Map



3. *Areas with different gaps in development (Cluster 4).* A broad area in Slovakia, Czech Republic, Lithuania and Estonia characterized by a below average socio-economic level falls into this group. 40% of the land is covered in forests. CAP measures have a strong impact and there is a need for rural development measures to bridge inequalities.

4. *Mediterranean Systems (Cluster 6).* Cyprus and Malta make up only 1% of the surface of the NMS.
5. *Systems surrounding urban areas with a high level of development.* In this group, there are 7 Czech regions and only 12% of the total area of the NMS. These areas are densely populated and agriculture is not relevant for employment or for income. The main system is grain production (almost 10% of land).

Table 3.21: NMS Regions in the identified clusters

Code	Region	Cluster	Code	Region	Cluster
pl22	SLASKIE	**2**	cz01	PRAHA	**7**
pl42	ZACHODNIOPOMORSKIE	**2**	cz02	STREDNÍ CECHY	**7**
pl43	LUBUSKIE	**2**	cz03	JIHOZÁPAD	**7**
pl51	DOLNOSLASKIE	**2**	cz05	SEVEROVÝCHOD	**7**
pl52	OPOLSKIE	**2**	cz06	JIHOVÝCHOD	**7**
pl62	WARMINSKO-MAZURSKIE	**2**	cz07	STREDNÍ MORAVA	**7**
pl63	POMORSKIE	**2**	si0	SLOVENIA	**7**
			sk01	BRATISLAVSKÝ KRAJ	**7**
hu10	KÖZÉP-MAGYARORSZÁG	**3**			
hu21	KÖZÉP-DUNÁNTÚL	**3**	pl11	LÓDZKIE	**8**
hu22	NYUGAT-DUNÁNTÚL	**3**	pl12	MAZOWIECKIE	**8**
hu23	DÉL-DUNÁNTÚL	**3**	pl21	MALOPOLSKIE	**8**
hu31	ÉSZAK-MAGYARORSZÁG	**3**	pl31	LUBELSKIE	**8**
hu32	ÉSZAK-ALFÖLD	**3**	pl32	PODKARPACKIE	**8**
hu33	DÉL-ALFÖLD	**3**	pl33	SWIETOKRZYSKIE	**8**
			pl34	PODLASKIE	**8**
cz04	SEVEROZÁPAD	**4**	pl41	WIELKOPOLSKIE	**8**
cz08	MORAVSKOSLEZKO	**4**	pl61	KUJAWSKO-POMORSKIE	**8**
ee0	ESTONIA	**4**			
lt	LITHUANIA	**4**	cy0	CYPRUS	**6**
lv0	LATVIA	**4**	mt0	MALTA	**6**
sk02	ZÁPADNÉ SLOVENSKO	**4**			
sk03	STREDNÉ SLOVENSKO	**4**			
sk04	VÝCHODNÉ SLOVENSKO	**4**			

6. *Systems with a low level of socio-economic development and intensive/extensive agriculture.* Over one-fourth of the land in the NMS (9 Polish regions) and one-third of the population with the lowest income is included in these systems. Agriculture is the most important sector for employment (35% in the cluster and almost 60% of agricultural workers in NMS) also for the presence of high rates of unemployment especially in the

long term. In these territories, CAP measures have a strong impact. Prevalent systems include cereal growing (over 36%) and livestock (49% cows, 44% pigs).

Table 3.22: Average value of the identified clusters

Cluster	**2**	**3**	**4**	**6**	**7**	**8**
Regions	**7**	**7**	**8**	**2**	**8**	**9**
			SOCIO DEMOGRAPHIC VARIABLE			
Popden	138.38	129.42	98.14	662.57	408.75	122.71
Ageing	635.09	922.98	728.86	598.33	915.90	700.97
Depend	427.79	463.43	449.28	481.76	420.22	472.59
			ECONOMIC VARIABLES			
Female	24.00	6.00	15.38	6.65	7.90	18.59
Unempl	22.70	6.30	14.64	5.85	6.36	18.17
GDP	9068.89	11095.64	9679.76	16528.15	16759.15	8805.20
Empagr	18.10	8.05	8.37	5.57	5.55	34.91
Empter	30.26	33.77	34.80	27.65	36.72	23.33
Empind	51.65	58.18	56.83	66.78	57.73	41.76
Ltunem	53.22	39.72	55.96	32.71	44.65	57.15
			AGRICULTURE			
			Agriculture-Land Allocation			
UAA tot	46.31	61.36	36.83	24.44	41.50	54.41
Cereals	48.44	48.67	33.14	21.14	40.73	49.71
Fallow	15.03	3.68	3.48	5.70	3.73	9.51
Permcrop	0.42	3.32	1.03	18.66	2.09	2.09
Grenfod	2.96	2.05	13.42	32.16	12.77	4.42
Vine	0.00	1.64	0.23	8.54	1.03	0.00
Orchards	0.40	1.68	0.68	6.50	1.04	2.05
			Agriculture-Livestock			
Shegoa	0.03	0.18	0.09	3.45	0.05	0.04
Pigs	0.86	0.80	0.58	5.43	0.84	1.23
Poultr	3.54	6.41	5.29	84.02	9.03	3.52
Milk	0.10	0.06	0.12	0.47	0.13	0.23
Cow	0.10	0.06	0.14	0.47	0.16	0.23
Beefor	7.25	6.78	2.48	3.13	3.43	9.33
Milkow	96.79	91.97	83.10	100.00	74.09	99.29
			Agriculture-Productivity			
AWUint	7.82	9.01	5.87	32.67	7.77	18.63
Inrd	0.28	0.66	0.50	0.30	1.38	0.51
			ENVIRONMENT			
Forest	34.39	20.11	39.69	3.41	34.42	26.46
Liveint	0.23	0.32	0.39	4.53	0.46	0.44

Table 3.23: Percentage value of the identified clusters

Cluster	**2**	**3**	**4**	**6**	**7**	**8**
Regions	**7**	**7**	**8**	**2**	**8**	**9**
% Total_Area	16.4	12.6	32.0	1.3	11.8	25.9
% Totpop	20.2	13.7	19.3	1.5	14.0	31.2
% UAA	16.8	17.6	22.5	0.4	11.1	31.6
% Forest	17.3	7.4	39.9	0.2	14.6	20.6
% Fallow	34.6	7.8	13.3	0.3	6.1	37.9
% Permcrop	3.7	30.5	13.1	6.0	10.0	36.7
% Greenfod	7.2	4.9	43.2	1.2	22.7	20.8
% Orchards	5.1	22.2	11.6	2.9	6.9	51.3
% Vineyard	0.0	59.6	9.1	11.9	19.4	0.1
% Cereal (Inc Rice)	17.9	19.2	16.6	0.4	9.4	36.5
% Cereal	17.9	19.2	16.6	0.4	9.4	36.5
% GDP (Mio_Pps)	17.7	15.5	16.6	2.3	20.3	27.6
% Totemp	17.7	13.0	18.9	1.4	16.8	32.1
% Emp Agri	16.5	5.3	11.7	0.6	5.9	60.1
% Emp Indus	18.9	13.8	20.4	1.2	20.4	25.3
% Emp Ter	17.4	15.1	20.4	1.9	18.3	27.0
% Labour Force (AWU)	11.0	14.9	15.2	1.0	6.9	51.0
% Partecipation_In_Long_Life_Learn	19.8	14.1	19.3	1.5	14.5	30.7
% Hotelbed	7.7	20.3	17.3	16.7	28.5	9.5
% Total_Intramural_R%D_Expenditure	7.1	18.1	12.1	0.9	36.6	25.2
% Cattle	11.2	7.5	21.3	0.8	17.5	41.8
% Calf	11.8	8.1	22.1	1.0	20.9	36.0
% Cow	10.8	7.0	21.1	0.7	13.8	46.6
% Cow Diary	11.1	6.9	20.9	0.7	11.7	48.8
% Other Cow	5.0	9.4	25.1	0.0	53.2	7.3
% Pig	14.4	15.8	11.7	1.8	11.6	44.7
% Sheep	3.2	47.5	17.9	12.3	8.0	11.1
% Goats	7.0	10.2	9.6	53.3	3.9	15.9
% Poultry	11.0	23.3	18.0	3.2	22.0	22.5

3.4 The analysis at sub-regional level. The Veneto case

3.4.1 Introduction

During this part of the study, the aim of the analysis is to measure the deep territorial differences existing at the sub-regional level in a region (Veneto), which is characterized by a high level of socio-economic development and high agricultural production. The scope of the case study was to highlight the territorial specialization and concentration, thus implying the different impact

of the reform at a territorial level. Following this query, the attention is moved to the Rural Development Plan prepared by the region for the period of 2007-2013 to measure the extent to which interventions geared specifically to territories will have and most of all the coherence with other policies, especially the CAP.

In the analysis, it is necessary to state first a brief description of the Veneto region under an agricultural and rural profile. The agricultural sector of Veneto has an important role in the national context (9.7% of Agricultural Gross Value Added), but at regional level confirming the agricultural sector's decline in income over recent years (3.3% of regional GVA). In the past 5 years, employment in the agricultural sector has fallen (-15%) and the increased rate of females managing farms (40% higher than the national average).

Regional agricultural production is above all cantered on grass production, almost 55% of the total production. During the period of 2000-2006, the composition of agricultural production has not changed significantly, thus showing that the adopted measures in previous rural development programs have not brought about important reorientation especially in cereal production (already approached in the measures of Agenda 2000 and now an objective of the Fischler Reform). In fact, cereals production is continuously growing in regards to other national trends, especially corn (almost 20% of national production) and wheat, not to mention bovine cow meat (40% of national production). At the same time, there are other important crops in the Veneto agro-food system showing a reduction in production in fruits and a less reduction in viticulture.

Structurally, the Veneto region is characterized by small and medium sized farms. Even with a strong decrease in smallholdings registered in recent years, they continue to make up the majority. Almost 87% of farms are less than 10 hectares with almost 37% of UAA. The data from farms smaller than 2 hectares (41% and 8% of UAA) is also noteworthy. At the same time, there is an increase in the large farms that take up a substantial amount of land in the Veneto. Following in line with the national trends of Italian agriculture, most farmers are aging (50% are over 60 years old) and only 2% of farms are run by farmers under the age of 30. Moreover, for the most part, farms run by elderly managers do not seem to be making the necessary generational changes within their family. According to a study conducted by the Region, these farm units concern almost 20% of the regional agricultural land.

The food industry as well, representing 8% of the national total, shows some critical factors. Almost 94% of units have less than 15 employees and approximately two-thirds have less than six.

Between 1990 and 2000, units grew by about 8% contrasting the reduction in workers with a fall in workers per unit.

3.4.2 The principal agricultural and rural systems

From 29 original indicators we have extracted 5 principal components (latent variables) able to explain 78% of the whole variability oh the data. Cluster analysis led to the identification of 14 first stage clusters (table 3.24).We have decided to aggregate those inferior or equal to 3.

Table 3.24: Cluster Summary

Cluster	Frequency	RMS Std Deviation	Maximum Distance from Seed to Observation	Radius Exceeded	Nearest Cluster	Distance Between Cluster Centroids
1	1	.	0		4	27.6846
2	160	1.1334	18.3227		9	4.4859
3	145	1.0332	18.1722		9	4.2710
4	3	2.6519	11.9653		3	16.5120
5	2	2.7937	9.2658		4	23.4726
6	3	2.5715	12.1349		2	23.3490
7	1	.	0		1	29.7320
8	83	1.3186	14.1745		2	6.2369
9	148	1.2054	17.6644		3	4.2710
10	23	2.0093	17.5334		2	9.8796
11	2	1.8414	6.1074		2	15.7594
12	3	2.0654	9.8701		9	13.4056
13	6	2.0828	13.5266		3	12.4906
14	1	.	0		2	31.7881

The territorial systems can be grouped into 3 main areas (table 3.25 and figure 3.5):

1. *Metropolitan areas characterized by a high level of socio-economic development and high population density (Cluster 3)*. Public actions should aim to maintain and increase competitiveness; however, here there is also the problem of environmental protection given the noteworthy tensions in the use of resources. It is necessary to unite measures geared towards modernization of agricultural and transformation structures and the necessary adoption of agro-environmental measures, taking into consideration how and to what extent the constraints of the productive processes will be compatible with the maintenance and development of new territorial, sectorial and farm competitiveness. The large metropolitan areas in Veneto (covering 25% of the total area) continue to grow with urbanization and settlement. Massive suburban development took place during the 1980s leading to a reduction in the importance of agriculture. Nonetheless, it is still contributing

Table 3.25: The clusters (average values)

Cluster	**2**	**3**	**8**	**9**	**10**	**13**	**Veneto**
Municipalities	**166**	**152**	**83**	**151**	**23**	**6**	**581**
			SOCIO-ECONOMICS				
Population Density	184.0	497.3	50.4	240.8	183.9	264.1	262.5
Gross Value Added (Millions)	78.2	399.4	37.9	104.7	386.3	269.9	177.5
Ageing Index	135.8	136.7	160.8	112.8	158.7	134.9	135.2
Dependency Ratio	46.9	46.4	52.8	46.2	46.1	44.7	46.6
% Agriculture Employees	1.1	0.5	0.5	1.2	4.2	1.4	1.0
% Industry Employees	57.9	54.8	45.7	61.0	38.0	50.2	55.3
% Tertiary Employees	41.0	44.7	53.8	37.8	57.8	48.4	43.7
Unemployment Ratio	4.3	3.4	4.5	3.1	6.1	3.9	3.8
Young Unemployment Ratio	11.7	9.1	11.7	7.8	16.2	9.9	10.2
Female Activity Ratio	64.5	67.5	60.5	65.5	65.9	65.6	65.7
			AGRICULTURAL STRUCTURES				
% Woodlands On Total Area	1.4	2.9	29.5	13.2	4.4	11.8	9.1
UAA	7.4	2.9	20.5	3.3	13.6	3.7	7.3
% Small Farm 2ha	43.3	64.8	39.4	59.1	41.9	58.6	52.6
% Big Farm 50ha	1.8	0.4	6.7	0.4	4.6	0.7	1.8
% UAA Small 2ha	6.5	22.0	4.9	19.8	4.8	18.4	13.8
% UAA Big 50ha	20.6	10.2	54.6	9.1	49.6	16.6	20.9
			LAND ALLOCATION				
% Var. UAA % (1990 2000)	-1.0	-3.7	12.8	-9.6	6.7	-3.1	-1.7
% UAA *Cereals*	53.9	52.9	0.6	17.4	44.5	36.9	36.0
% UAA Forage Crops	6.8	7.6	0.9	4.4	7.4	7.4	5.6
% UAA *Pastures*	4.4	12.2	93.6	42.0	8.5	25.0	29.3
% UAA *Horticulture*	2.1	2.4	0.1	0.3	3.6	3.2	1.5
% UAA *Fruits*	4.4	1.5	0.6	3.5	2.3	0.9	2.7
% UAA *Vineyards*	3.7	7.6	0.1	23.5	2.3	9.5	9.4
% UAA *Olive*	0.1	0.2	0.4	2.4	0.0	0.0	0.8
% UAA CDO On Vineyards	12.5	9.4	2.0	36.0	13.9	14.2	16.4
Bovines / Ha UAA Pastures	27.5	13.0	0.7	3.0	5.9	7.3	5.8
Pigs/ Ha UAA	7.7	4.3	5.7	3.6	10.5	6.4	4.7
Chickens/ Ha UAA	87.3	44.7	8.6	72.4	20.5	5.6	57.6
ULA/ UAA	0.1	0.2	0.1	0.2	0.1	0.2	0.1
			INTEGRATION				
Food Industry: Local Units	4.9	17.1	2.7	6.8	23.2	18.8	9.1
Food Industry: Employees/Local Units	9.5	8.0	3.0	7.1	6.0	33.1	7.7
Food Industry: % Employees Big Firm 100	6.2	3.5	0.0	5.9	2.6	71.6	5.1

significantly to productivity on the regional agricultural level. The main characteristic of this system is that it is represented by small and very small farm structures. The large diffusion of residential farms is seen by the high number of farms smaller than 2 hectares (49% and 28% of UAA) and the moderate reduction in the number of these smallholdings. The most widespread systems are cereals (almost 35% of the total cereals), cattle, mainly poultry (35% of total); horticulture.

2. *Agricultural areas with average level of economic development.* Agriculture contributes to socio-economic development in a major way. In this case, agriculture, with a key productive function, requires valuable sectoral interventions and an integration into the food supply chain; especially the CAP measures can have a strong impact including the integrated rural development measures where necessary. In these territories we can find: (a) Areas with both intensive and extensive agriculture (cluster 2 and 13); (b) Areas characterized by specialized agriculture (cluster 9), in particular, vineyards and fruit growing; (c) Areas with extensive agriculture (cluster 10).
3. *Areas with different gaps in socio-economic development*. These territories only influence slightly sectorial and regional profitability yet taking on a fundamental importance from an environmental perspective. The main need for agricultural policies coming in this area concerns rural development even if the productive function should not be undervalued since it is fundamental for the maintenance of environmental protection.

Table 3.26: Some percentages

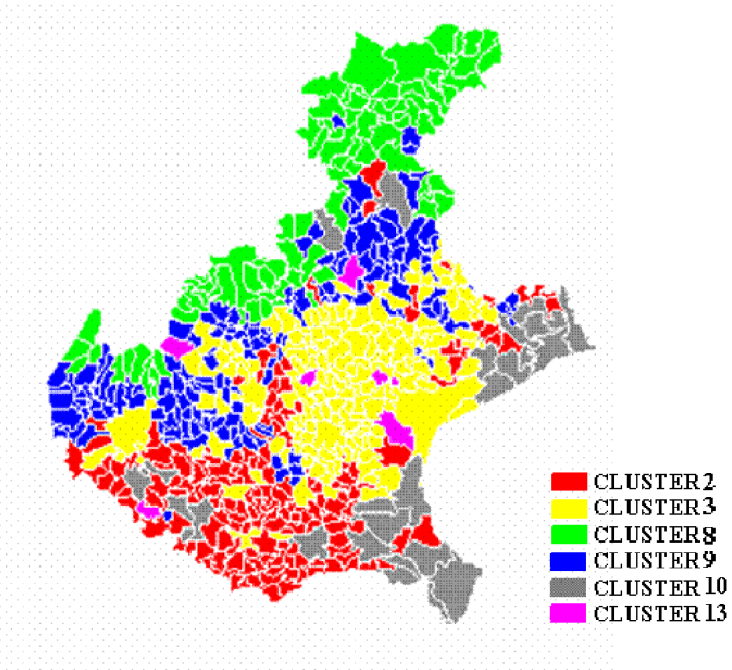
Cluster	**2**	**3**	**8**	**9**	**10**	**13**	**Veneto**
Municipalities	**28.6**	**26.2**	**14.3**	**26.0**	**4.0**	**1.0**	**100.0**
Population 2001	14.2	55.6	3.4	15.4	9.5	1.9	100.0
Value Added	12.6	58.9	3.0	15.3	8.6	1.6	100.0
Agriculture Employees	12.1	25.4	1.3	18.3	40.6	2.2	100.0
Industry Employees	15.5	53.2	3.3	20.1	6.2	1.7	100.0
Tertiary Employees	9.1	66.5	2.6	10.6	10.0	1.2	100.0
Woods	2.3	7.2	60.5	22.9	5.0	2.1	100.0
UAA	30.5	28.2	7.6	15.4	16.8	1.6	100.0
Small Farm 2ha	15.9	49.1	2.7	22.7	6.7	2.9	100.0
Big Farm 50ha	34.8	17.5	12.5	8.2	25.8	1.2	100.0
UAA Small 2ha	16.2	50.5	2.2	21.6	6.9	2.6	100.0
UAA Big 50ha	27.7	13.9	18.3	7.0	32.0	1.0	100.0
UAA Cereals	38.6	34.7	0.1	6.6	18.5	1.5	100.0
UAA Forage Crops	34.1	33.3	0.7	11.0	19.0	2.0	100.0

Table continues

Table 3.26: (continued)

Cluster	**2**	**3**	**8**	**9**	**10**	**13**	**Veneto**
Municipalities	**28.6**	**26.2**	**14.3**	**26.0**	**4.0**	**1.0**	**100.0**
UAA Pastures	6.5	17.5	38.4	27.5	8.4	1.6	100.0
UAA Horticulture	34.6	31.8	0.1	2.4	28.4	2.7	100.0
UAA Fruits	46.7	19.9	2.1	20.4	10.5	0.4	100.0
UAA Vineyards	13.0	27.8	0.1	52.9	4.0	2.2	100.0
UAA Cdo	8.6	12.0	0.0	72.6	3.2	3.6	100.0
Bovines	31.2	39.3	4.8	14.1	8.6	2.1	100.0
Pigs	42.1	27.8	4.1	14.6	10.0	1.5	100.0
Chickens	47.0	21.6	2.2	23.8	5.3	0.2	100.0
Food Firm	15.4	48.9	4.2	19.4	10.1	2.1	100.0
Employees Food Firm	23.9	41.9	2.0	20.2	6.5	5.5	100.0

Figure 3.5: The map of Veneto (first stage)



3.4.3 The second stage

In this part, the two stage analysis changed, taking into consideration some of the most significant variables in the individual clusters. In particular, in Cluster 2, (systems with both intensive and extensive agriculture) the choice of the variables was made to highlight individual sub zones in which the impact of decoupling could bring about significant changes at a territorial level. The variables can be found in table 3.27.

The second stage analysis shows how the impact of the Fischler reform wil l be mainly in the cluster 20, where we can find nearly a fifth of the cereals Venetian prod uction, but where there is also a strong presence of livestock. The structural analysis highlights as by to large farms exists still little farms, where the appli cation of the cross compliance will be able to change in meaningful manner the farm profitability.

In second stage analysis in cluster 3 (metropolitan areas we adopt a small set of indicators aiming to highlight the territorial differences. The variables ca n be found in table 3.31.

Table 3.27: Variables second stage cluster 2

Variable	Group	Stage
Population Density	Socio-Economics	Second
% Var. Population (1991-2001)	Socio-Economics	Second
% Tertiary Employees	Socio-Economics	Second
% Industry Employees	Socio-Economics	Second
Food Industry: Employees/Local Units	Integration	Second
% UAA Small 2ha	Agricultural structures	Second
% UAA Big 50ha	Agricultural structures	Second

Table 3.28: Cluster summary (second stage cluster 2)

Cluster	Frequency	RMS Std Deviation	Maximum Distance from Seed to Observation	Radius Exceeded	Nearest Cluster	Distance Between Cluster Centroids
20	66	0.7134	5.4342		22	2.4804
21	35	0.8005	5.0462		20	2.5460
22	20	0.9800	4.6998		20	2.4804
23	10	1.2066	5.2497		20	4.2595
24	5	1.1961	3.2269		25	4.7809
25	30	0.8447	3.7772		22	2.8549

Table 3.29: Average value cluster 2 (second stage)

Cluster	**20**	**21**	**25**
Municipalities	**96**	**35**	**35**
SOCIO-ECONOMICS			
Population Density	167.7	155.4	257.3
Gross Value Added (Millions)	62.4	80.0	119.7
Ageing Index	158.0	144.7	99.2
Dependency Ratio	48.7	46.2	44.5
% Agriculture Employees	1.3	0.8	0.7
% Industry Employees	55.7	60.7	61.1
% Tertiary Employees	43.0	38.5	38.2
Unemployment Ratio	4.7	4.4	3.2
Young Unemployment Ratio	12.9	11.8	8.0
Female Activity Ratio	63.8	65.9	67.1
AGRICULTURAL STRUCTURES			
% Woodlands On Total Area	1.4	1.4	1.6
UAA	6.6	10.1	7.2
% Small Farm 2ha	44.5	45.6	37.6
% Big Farm 50ha	1.1	3.8	1.5
% UAA Small 2ha	7.5	4.5	5.7
% UAA Big 50ha	13.7	43.4	17.0
LAND ALLOCATION			
% Var. UAA % (1990 2000)	-3.1	-2.0	-0.6
% UAA Cereals	60.0	49.9	41.2
% UAA Forage Crops	4.2	4.5	16.2
% UAA Pastures	1.4	2.8	14.4
% UAA Horticulture	2.1	1.8	2.6
% UAA Fruits	5.0	3.2	3.8
% UAA Vineyards	3.9	2.8	4.2
% UAA Olive	0.1	0.0	0.1
% UAA CDO on Vineyards	7.8	20.1	17.7
Bovines / Ha UAA Pastures	45.0	30.4	21.4
Pigs/ Ha UAA	5.1	5.2	22.4
Chickens/ Ha UAA	99.8	28.2	112.1
ULA/ UAA	0.1	0.1	0.1
INTEGRATION			
Food Industry: Local Units	4.2	5.3	6.6
Food Industry: Employees/Local Units	10.9	7.5	7.6
Food Industry: % Employees Big Firm 100	9.3	3.3	0.9

Cluster 16 stands out with almost 16% of the UAA and the characteristics of high demographic density (over 340 inhabitants per km), very small farms (slightly over 3 hectares in average), over 20% of the Veneto cereals and 25% of cows (table 3.33 and 3.34).

Table 3.30: Percentage clusters value (cluster 2)

Cluster	**20**	**21**	**25**	**Cluster 2**
Municipalities	**57.8**	**21.1**	**21.1**	**100.0**
Population 2001	49.6	21.4	29.0	100.0
Value Added	46.1	21.6	32.3	100.0
Agriculture Employees	61.9	15.0	23.1	100.0
Industry Employees	45.6	22.5	31.9	100.0
Tertiary Employees	47.7	18.5	33.8	100.0
Woods	53.0	23.3	23.7	100.0
UAA	52.3	26.0	21.7	100.0
Small Farm 2ha	61.1	21.3	17.6	100.0
Big Farm 50ha	39.6	41.8	18.6	100.0
UAA Small 2ha	60.7	20.1	19.2	100.0
UAA Big 50ha	35.3	48.0	16.7	100.0
UAA Cereals	58.7	24.7	16.5	100.0
UAA Forage Crops	33.5	18.0	48.5	100.0
UAA Pastures	20.2	14.9	64.9	100.0
UAA Horticulture	51.4	22.4	26.2	100.0
UAA Fruits	61.5	13.2	25.3	100.0
UAA Vineyards	50.6	18.5	30.9	100.0
UAA Cdo	34.3	14.3	51.4	100.0
Bovines	33.1	16.5	50.4	100.0
Pigs	34.3	13.8	51.9	100.0
Chickens	58.0	7.1	34.9	100.0
Food Firm	49.2	22.5	28.3	100.0
Employees Food Firm	68.3	13.8	17.9	100.0

Table 3.31: Variables second stage cluster 3

Variable	**Group**	**Stage**
Population Density	Socio-Economics	Second
% Var. Population (1991-2001)	Socio-Economics	Second
% Tertiary Employees	Socio-Economics	Second
% Industry Employees	Socio-Economics	Second
Food Industry: Employees/Local Units	Integration	Second
% UAA Small 2ha	Agricultural structures	Second
% UAA Big 50ha	Agricultural structures	Second

Cluster 14 is also exemplary with a high popu lation density in which smallholdings (average 2 hectares), high number of cows and poultry. The full application of the reform could bring about noteworthy changes at a territorial level but even more changes at the passage to the full market at

the end of the reform. One cannot ignore the fact that the majority of residential and multifunctional farms are run by older farmers for the most part.

Table 3.32: Clusters summary (second stage cluster 3)

Cluster	Frequency	RMS Std Deviation	Maximum Distance from Seed to Observation	Radius Exceeded	Nearest Cluster	Distance Between Cluster Centroids
14	31	0.6641	2.4592		19	2.2165
15	1	.	0		16	11.8158
16	22	0.7653	2.9028		18	2.0200
17	11	0.8086	2.7625		14	2.9735
18	52	0.5941	2.8981		16	2.0200
19	35	0.5418	1.6664		14	2.0737

Figure 3.6: The Map of Veneto (total)

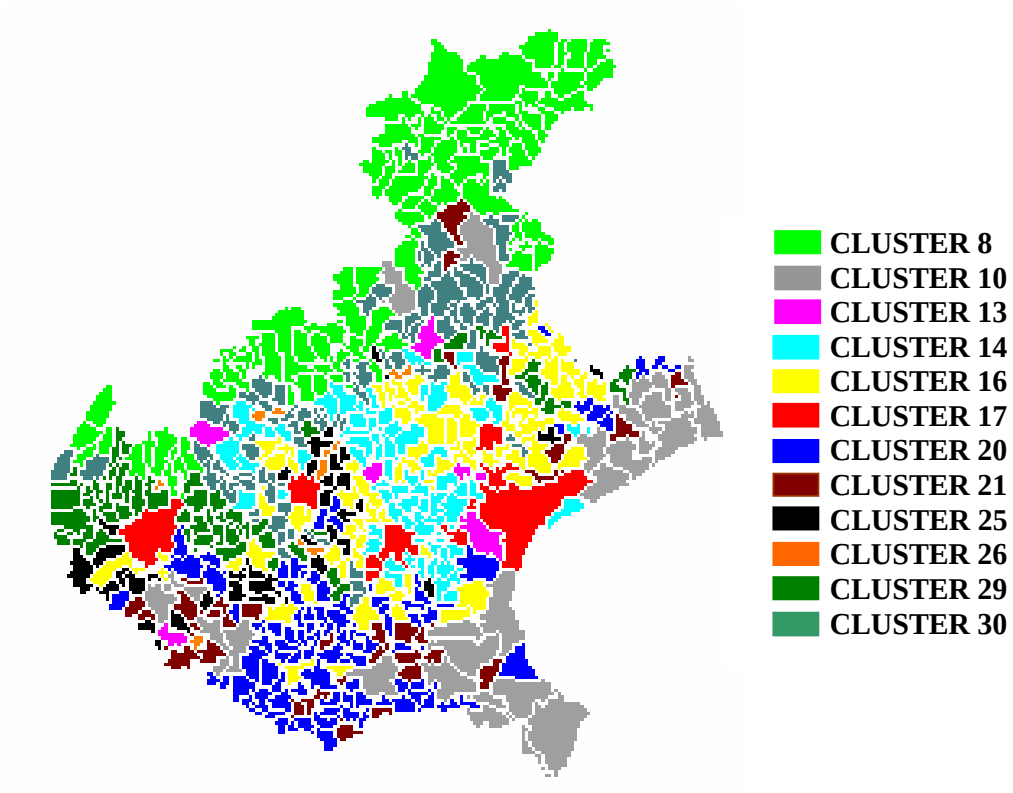


Table 3.33: Average value cluster 3 (second stage)

Cluster	**14**	**16**	**17**
Municipalities	**66**	**75**	**11**
	SOCIO-ECONOMICS		
Population Density	574.2	340.4	1105.4
Gross Value Added (Millions)	294.2	193.4	2436.1
Ageing Index	108.0	104.0	168.2
Dependency Ratio	43.2	43.7	47.4
% Agriculture Employees	0.4	0.6	0.2
% Industry Employees	55.5	59.1	21.3
% Tertiary Employees	44.1	40.2	78.5
Unemployment Ratio	3.6	3.1	4.5
Young Unemployment Ratio	9.4	8.2	14.2
Female Activity Ratio	67.9	67.5	65.5
	AGRICULTURAL STRUCTURES		
% Woodlands on Total Area	2.8	3.0	2.7
UAA	2.0	3.6	3.1
% Small Farm 2ha	73.6	56.9	65.6
% Big Farm 50ha	0.2	0.5	0.5
% UAA Small 2ha	30.1	15.5	17.5
% UAA Big 50ha	6.1	13.2	13.8
	LAND ALLOCATION		
% Var. UAA % (1990 2000)	-5.4	-1.2	-8.2
% UAA Cereals	55.7	51.3	47.1
% UAA Forage Crops	7.0	8.4	6.4
% UAA Pastures	15.5	9.9	7.6
% UAA Horticulture	2.6	2.4	2.1
% UAA Fruits	0.9	2.0	2.7
% UAA Vineyards	4.9	9.8	9.7
% UAA Olive	0.2	0.1	0.6
% UAA CDO On Vineyards	6.1	10.8	20.3
Bovines / Ha UAA Pastures	8.7	17.6	9.1
Pigs/ Ha UAA	1.1	2.8	1.7
Chickens/ Ha UAA	30.6	60.1	23.5
ULA/ UAA	0.2	0.2	0.2
	INTEGRATION		
Food Industry: Local Units	13.1	10.4	86.6
Food Industry: Employees/Local Units	6.0	10.1	5.4
Food Industry: % Employees Big Firm 100	0.0	6.4	5.6

Table 3.34: Percentage clusters values

Cluster	**14**	**16**	**17**	**Cluster 3**
Municipalities	**43.4**	**49.4**	**7.2**	**100.0**
Population 2001	32.5	26.0	41.5	100.0
Value Added	32.0	23.9	44.1	100.0
Agriculture Employees	25.2	33.6	41.2	100.0
Industry Employees	41.3	33.8	24.9	100.0
Tertiary Employees	24.7	15.9	59.3	100.0
Woods	43.5	47.0	9.5	100.0
UAA	31.2	57.3	11.5	100.0
Small Farm 2ha	50.3	40.5	9.2	100.0
Big Farm 50ha	20.3	66.3	13.4	100.0
UAA Small 2ha	48.3	42.7	9.0	100.0
UAA Big 50ha	15.6	71.6	12.8	100.0
UAA Cereals	34.3	56.2	9.5	100.0
UAA Forage Crops	29.6	60.0	10.4	100.0
UAA Pastures	43.5	47.0	9.5	100.0
UAA Horticulture	25.8	60.7	13.5	100.0
UAA Fruits	12.7	59.4	27.9	100.0
UAA Vineyards	17.6	70.7	11.7	100.0
UAA CDO	10.8	62.7	26.5	100.0
Bovines	29.4	64.0	6.6	100.0
Pigs	25.6	67.1	7.2	100.0
Chickens	22.8	66.3	10.9	100.0
Food firm	33.3	30.0	36.7	100.0
Employees food firm	25.1	45.5	29.4	100.0

3.4.4 The Rural Development Plan for Veneto

In May 2006, a Regional Strategic Paper was presented for the programming of rural development for the period of 2007-2013. The designing of the new plan falls in a period characterized by important institutional and market changes. On the one hand, decoupling has taken effect since 2005 when the Fischler Reform was launched; on the other hand, the prices of many agricultural products suffered price drops, thus bringing about extraordinary interventions at the national level.

As one can see, the new process of programming comes into a new EU scenario:

- The Reg. 2005/1290 relative to the financing of the Community Agricultural Policy (CAP), instituting the FEAGA (European Agricultural Fund of Garancy) and the FEASR (Agricultural Fund for Rural Development);
- The Reg 2005/1698 for funding of rural support from FEASR ;

- The Community Strategic Guidelines (CSG) that have defined a range of priorit y options of which Member States can make use of while processing their national strategic plans and their national rural development plans;

The Community Guidelines have identified 4 priorities (Axes) the must be fol lowed through specific measures:

- Improvement of competitiveness in the agricultural and forestry sector ;
- Improvement of the Environment and Rural Areas (countryside) ;
- Improvement of the quality of life in rural areas and diversification of the rural economy ;
- Local employment capacity (Leader) ;

One the programming for 2000 -2006 was also articulated in axes. In the distribution of incentives, seeking to respond to the structural problems of its agro -food system, Veneto, with respect to the other regions outside of Objective 1, sent a higher percen tage to modernization of structures (almost 39% as opposed to 30.6%), as well as to handicap/disadvantaged areas (7% as opposed to 5.7%), while a smaller amount was directed towards agro -food measures (40.5% as opposed to almost 50%). In line with the tren ds of the other regions was the funding of rural land (12.7%) and the formation of human capital (0.9%).

The Veneto Strategic Regional Paper for 2007 -2013 is divided into 2 parts; the first is dedicated to the analysis of the regional socio -economic situation, pointing out both strong and weak points, while the second identifies strategic guidelines for the implementation of rural development policies.

Veneto, like the other regions outside of objective 1, could choose between two options for its rural and agro-food systems:

- A tendency to maintain the same situation and intervention approaches as in the past assuming that the crisis is overall rel ating to the economic situation;
- A promotion of its agro -food system, through a diffused requalification and reo rganization, with a repositioning of the supply (both individual chains, territories, individual enterprises), not to mention a strong response to the demand of the entire Veneto socie ty asks the sector, especially its environmental and landscape function. Important instruments for this shift are the forms of governance to adopt and the promotion of partnerships as an instrument for territorial plans.

From reading the Strategic Document, the chosen path is unclear. Both options present strong and weak aspects thus making the decision difficult to make.

In the first place, the list of axes and measures proposed do not present any new revelations in regards to those already set forth in previous EU regulations. They highlight the basic philosophy of the Veneto region to keep intervention options open at this stage in the chains and territories. Loans available to individual interventions will make the difference; however, as of yet, there is no outline for these. Anyway, competitiveness emerges as an important concern (especially important with regards to technological information) as does the improvement of environmental services on the side of agriculture but also the role given to women, youth, as well as strengthening local partnerships.

The analysis that follows examines some main points (both positive and negative). In regards to the reform, the most interesting points are:

A) The regionalization of interventions. To identify single territorial systems, the methodology OCSE[4] is not applicable since of the majority of the area is urban. For this reason, the analysis was disaggregated, singling out rural areas (35% of communes, 17% of the population, 44% of the areas), urbanized rural areas (46% of communes, 33% of the population, and 39% of the areas) and urban areas (almost 19% of the communes, 49.5% of the population, and almost 17% of the areas). At the same time, the Region took the following for the Axis 1:

- Preferential intervention areas, in which there is the possibility to develop integrated programming, a strong participatory value involving both public and private actors th at can be seen as districts;
- Areas that are in the stage of adapting themselves to the law within which more restrictive measures for adjustment and/or within which structural interventions are required (for example in vulnerable and sensitive areas);
- Mountain zones in need of specific policies.

A regionalization of interventions is foreseen also for Axis 2 in order to avoid a waste of public resources and general and barely measurable setbacks. Eligible areas include those already outlined in the regional territorial plan (mountain areas, Nature 2000 areas, etc .) and others that are in the process of being determined. The indicated criteria can bring up some risks. In the firs t place, there is the possibility of giving priority to the territories with a higher amount of public and private institutions, not only agricultural, and to not allow territories with different handicap levels to participate in the new programming that f oreseen plans and partnerships in all rural areas.

[4] This methodology created in Reg. 1698/05 is based upon the population at the municipality level and refers only to rural municipalities with populations o f less than 150 inhabitants/km.

Secondly, the non-overlapping of the different maps of axes 1 and 2 risk not to take into account characteristics of the Veneto model of development. The large quota of Veneto planes is an example of that. It extends from the east of the Province of Verona to Treviso and Venice, characterized by a very large number of small and very small farms (multifunctional, residential, and old) in which only in part systems are geared towards quality production but th ey are also geared to commodities production largely supported by CAP measures with a large presence of on behalf of a third party. Here it would have been useful to reflect upon the potential impact of the Fischler Reform that foresees the necessary cross compliance in a highly fragmented agricultural system.

B. *Coherence with the CAP*. In a region like Veneto, where production is largely supported by community subsidies and the impact of the Fischler reform could be significant, almost no calculation has been introduced regarding the coherence with other EU policies, especially decoupling, that could have a different impact on the middle and long term in farming structures. The only responses, even though relevant, are related to bio -energetic productions.

Chapter IV

The New Scenario in the Enlarged European Union

4.1 The main territorial systems in EU-25

The aim of this last analysis was to evaluate how territorial systems change within the European scenario based on the profound reforms of structural and agricultural policies introduced in recent years. This analysis considered all the regions at NUTS2 level within the EU since the fifth enlargement (2004). During this enlargement, 10 new states became members and eight of these New Member States (NMS) are located in Central and Eastern Europe (table 4.1).

The same analysis was conducted for the regions in the EU-15 and the NMS; nonetheless, the variables considered were not the same (see par. 3.3.2). In this part the analysis, as performed in the previous analyses, the PCA was applied to the initially values of the variables, allowing these initial variables to be reduced to a smaller set of new variables, defined as principal components, uncorrelated between them. After having provided a brief description of the identified components, highlighting the important variables among them, the CA was applied. This allowed regions to be grouped based on their most homogeneous characteristics.

As a first step, a PCA was carried out on the 26 indicators (table 4.2) for the EU regions. Eight principal components were retained. They explain more than 70% of the total original variability (table 4.3).

Based on the above explanation, it is possible to quantify the relevance of the original indicators in the extracted principal components. This points out which are the most relevant indicators in determining the difference between the regions in the sample, once the correlation between the principal components and the scale differences have been eliminated through the PCA.

Table 4.1: Regions considered in the MSA analysis

Code	Region	Code	Region	Code	Region
at11	BURGENLAND	es24	ARAGON	itf3	CAMPANIA
at12	NIEDERÍSTERREICH	es30	COMUNIDAD DE MADRID	itf4	PUGLIA
at21	KÄRNTEN	es41	CASTILLA Y LEON	itf5	BASILICATA
at22	STEIERMARK	es42	CASTILLA-LA MANCHA	itf6	CALABRIA
at31	OBERÍSTERREICH	es43	EXTREMADURA	itg1	SICILIA
at32	SALZBURG	es51	CATALUNA	itg2	SARDEGNA
at33	TIROL	es52	COMUNIDAD VALENCIANA	lt0	LITHUANIA
at34	VORARLBERG	es53	ISLAS BALEARES	lv0	LATRIA
be21	ANTWERPEN	es61	ANDALUCIA	mt0	MALTA
be22	LIMBURG	es62	REGION DE MURCIA	nl11	GRONINGEN
be23	OOST-VLAANDEREN	es70	CANARIAS	nl12	FRIESLAND
be24	VLAAMS BRABANT	fi	FINLAND	nl13	DRENTHE
be25	WEST-VLAANDEREN	fr10	ILE DE France	nl21	OVERIJSSEL
be31	BRABANT WALLON	fr21	CHAMPAGNE-ARDENNE	nl22	GELDERLAND
be32	HAINAUT	fr22	PICARDIE	nl23	FLEVOLAND
be33	LIEGE	fr23	HAUTE-NORMANDIE	nl31	UTRECHT
be34	LUXEMBOURG	fr24	CENTRE	nl32	NOORD-HOLLAND
be35	NAMUR	fr25	BASSE-NORMANDIE	nl33	ZUID-HOLLAND
cy0	CYPRUS	fr26	BOURGOGNE	nl34	ZEELAND
cz01	PRAHA	fr30	NORD - PAS-DE-CALAIS	nl41	NOORD-BRABANT
cz02	STREDNÍ CECHY	fr41	LORRAINE	nl42	LIMBURG
cz03	JIHOZÁPAD	fr42	ALSACE	pl11	LÓDZKIE
cz04	SEVEROZÁPAD	fr43	FRANCHE-COMTE	pl12	MAZOWIECKIE
cz05	SEVEROVÝCHOD	fr51	PAYS DE LA LOIRE	pl21	MALOPOLSKIE
cz06	JIHOVÝCHOD	fr52	BRETAGNE	pl22	SLASKIE
cz07	STREDNÍ MORAVA	fr53	POITOU-CHARENTES	pl31	LUBELSKIE
cz08	MORAVSKOSLEZKO	fr61	AQUITAINE	pl32	PODKARPACKIE
dk00	DANMARK	fr62	MIDI PYRENEES	pl33	SWIETOKRZYSKIE
de11	STUTTGART	fr63	LIMOUSIN	pl34	PODLASKIE
de12	KARLSRUHE	fr71	RHONE-ALPES	pl41	WIELKOPOLSKIE
de13	FREIBURG	fr72	AUVERGNE	pl42	ZACHODNIOPOMORSKIE
de14	TÜBINGEN	fr81	LANGUEDOC-ROUSSILLON	pl43	LUBUSKIE
de21	OBERBAYERN	fr82	PROVENCE-ALPES-COTE D'AZUR	pl51	DOLNOSLASKIE
de22	NIEDERBAYERN	fr83	CORSE	pl52	OPOLSKIE
de23	OBERPFALZ	gr11	ANATOLIKI MAKEDONIA	pl61	KUJAWSKO-POMORSKIE
de24	OBERFRANKEN	gr12	KENTRIKI MAKEDONIA	pl62	WARMINSKO-MAZURSKIE
de25	MITTELFRANKEN	gr13	DYTIKI MAKEDONIA	pl63	POMORSKIE
de26	UNTERFRANKEN	gr14	THESSALIA	pt11	NORTE
de27	SCHWABEN	gr21	IPEIROS	pt16	CENTRO
de4	BRANDENBURG	gr22	IONIA NISIA	pt17	LISBOA E VALE DO TEJO
de71	DARMSTADT	gr23	DYTIKI ELLADA	pt18	ALENTEJO
de72	GIESSEN	gr24	STEREA ELLADA	pt15	ALGARVE
de73	KASSEL	gr25	PELOPONNISOS	pt20	ACORES
de8	MECKLENBURG-VORPOMMERN	gr30	ATTIKI	pt30	MADEIRA
de91	BRAUNSCHWEIG	gr41	VOREIO AIGAIO	se01	STOCKHOLM
de92	HANNOVER	gr42	NOTIO AIGAIO	se02	ÍSTRA MELLANSVERIGE
de93	LÜNEBURG	gr43	KRITI	se04	SYDSVERIGE
de94	WESER-EMS	hu10	KÖZÉP-MAGYARORSZÁG	se06	NORRA MELLANSVERIGE
dea1	DÜSSELDORF	hu21	KÖZÉP-DUNÁNTÚL	se07	MELLERSTA NORRLAND
dea2	KÍLN	hu22	NYUGAT-DUNÁNTÚL	se08	ÍVRE NORRLAND
dea3	MÜNSTER	hu23	DÉL-DUNÁNTÚL	se09	SMALAND MED ÍAMA
dea4	DETMOLD	hu31	ÉSZAK-MAGYARORSZÁG	se0a	VÄSTSVERIGE
dea5	ARNSBERG	hu32	ÉSZAK-ALFÖLD	si0	SLOVENIA
deb1	KOBLENZ	hu33	DÉL-ALFÖLD	sk01	BRATISLAVSKÝ KRAJ
deb2	TRIER	ie	IRELAND	sk02	ZÁPADNÉ SLOVENSKO
deb3	RHEINHESSEN-PFALZ	itc1	PIEMONTE	sk03	STREDNÉ SLOVENSKO
Dec	SAARLAND	itc2	VALLE D'AOSTA	sk04	VÝCHODNÉ SLOVENSKO
Ded	SACHSEN	itc3	LIGURIA	ukc	NORTH-EAST UK
dee1	DESSAU	itc4	LOMBARDIA	ukd	NORTH-WEST UK
dee2	HALLE	itd1	ALTO-ADIGE	uke	YORKSHIRE AND THE HUMBER
dee3	MAGDEBURG	itd2	TRENTINO	ukf	EAST MIDLANDS
Def	SCHLESWIG-HOLSTEIN	itd3	VENETO	ukg	WEST MIDLANDS
Deg	THÜRINGEN	itd4	FRIULI-VENEZIA GIULIA	ukh	EASTERN UK
ee0	ESTONIA	itd5	EMILIA-ROMAGNA	ukj	SOUTH-EAST UK
es11	GALICIA	ite1	TOSCANA	ukk	SOUTH-WEST UK
es12	PRINCIPADO DE ASTURIAS	ite2	UMBRIA	ukl	WALES
es13	CANTABRIA	ite3	MARCHE	ukm	SCOTLAND
es21	PAIS VASCO	ite4	LAZIO	ukn	NORTHERN IRELAND
es22	COMUNIDAD FORAL DE NAVARRA	itf1	ABRUZZO		
es23	LA RIOJA	itf2	MOLISE		

Table 4.2 Variables considered in the PCA of the EU -25 regions

Variable	Description	Source	Year range
	SOCIO-DEMOGRAPHICS		
Popden	Population density	REGIO	2002
Ageing	Ageing index	REGIO	2001
Depend	Dependency ratio	REGIO	2001
	ECONOMICS		
Female	Female unemployment ratio	REGIO	2003
Unempl	Unemployment ratio	REGIO	2003
GDP	Per capita GDP	REGIO	2002
Empagr	Employees in Agric (% total)	REGIO	2001_2000
Empter	Employees in Tertiary (% total)	REGIO	2001_2000
Empine	Employees in Industry (% total)	REGIO	2001_2000
Ltunem	Long term unemployment rate	REGIO	2003
	AGRICULTURE		
Agriculture – structural			
UAAtot	Uaa	REGIO	
Land allocation			
Cereals	% UAA under cereals	REGIO	2002_2000
Vine	% UAA under vineyards	REGIO	2002_2000
Permcrops	% UAA under (other) permanent crops - EXCLUDING FRUIT	REGIO	2002_2000
Orchards	% UAA under orchards	REGIO	2002_2000
Fallows	% UAA non cultivated for various reasons	REGIO	2002_2000
Livestock			
Shegoa	Sheeps and goats per ha UAA	REGIO	2002_2000
Pigs	Pigs per ha UAA	REGIO	2002_2000
Poultr	Chickens per ha UAA	REGIO	2002_2000
Milk	Milk cows per ha UAA	REGIO	2002_2000
Cow	Cows per ha UAA	REGIO	2002_2000
Beefor	Beef per ha of UAA under forage	REGIO	2002_2000
Milkow	Diary cow on total cow		
Productivity			
Awuint	AWU per 100 ha of UAA	REGIO	2002_2000
	ENVIRONMENT		
Woods	Woodlands (% of total agric. Area)	REGIO	2002_2000
Livint	Bovine heads, sheeps and goats per ha UAA	REGIO	2002_2000

Table 4.3: PRINCOMP procedure SAS output

Eigenvalues of the Correlation Matrix

	Eigenvalue	Difference	Proportion	Cumulative
1	6.23125729	2.72859960	0.2397	0.2397
2	3.50265769	1.11818811	0.1347	0.3744
3	2.38446958	0.66036600	0.0917	0.4661
4	1.72410358	0.16045054	0.0663	0.5324
5	1.56365303	0.07628410	0.0601	0.5925
6	1.48736893	0.10587246	0.0572	0.6498
7	1.38149648	0.32128975	0.0531	0.7029
8	1.06020672	0.11243720	0.0408	0.7437
9	0.94776953	0.13985519	0.0365	0.7801
10	0.80791434	0.11237857	0.0311	0.8112
11	0.69553577	0.04771443	0.0268	0.8379
12	0.64782134	0.08757199	0.0249	0.8629
13	0.56024934	0.05204223	0.0215	0.8844
14	0.50820711	0.02876643	0.0195	0.9040
15	0.47944068	0.09353937	0.0184	0.9224
16	0.38590132	0.06008997	0.0148	0.9372
17	0.32581135	0.01760950	0.0125	0.9498
18	0.30820185	0.05988679	0.0119	0.9616
19	0.24831506	0.03488381	0.0096	0.9712
20	0.21343125	0.03353296	0.0082	0.9794
21	0.17989829	0.04414259	0.0069	0.9863
22	0.13575570	0.01944831	0.0052	0.9915
23	0.11630739	0.04007299	0.0045	0.9960
24	0.07623440	0.04833387	0.0029	0.9989
25	0.02790053	0.02780908	0.0011	1.0000
26	0.00009145		0.0000	1.0000

At first glance, an interpretation of the factor loading of the eight extracted PC (table 4.4). Where considering the sign and relevance of the factor loadings (above 0.5 in absolute value), the extracted components can be interpreted as follows:

Table 4.4: Factor loadings for first-stage PCA

Variables	Prin1	Prin2	Prin3	Prin4	Prin5	Prin6	Prin7	Prin8
Popden		5.50				14.57	-6.62	20.36
Ageing								-8.12
Depend							16.34	
Female	6.07	6.36		9.09				
Unempl	7.76			7.04				
GDP	-10.09							
Empagr	9.60							
Empter	-12.92							
Empind	7.83			-6.60				
Ltunem	5.17					15.47		
UAA					-5.46		12.24	16.31
Cereals				-12.15		13.09		
Vine			18.79					
Permcrops			10.79	9.52				-8.98
Orchards			7.03		5.20	-7.23	-13.35	
Fallows						-11.79	-6.89	8.42
Shegoa					-10.29			-6.16
Pigs		12.64						
Poultry		7.19	7.22		-5.75			
Cow		8.34			8.81			
Milk		14.02			7.97			
Awuint	8.15							
Livint			11.87	-12.40	14.24		6.17	
Milkow		10.44						
Beefor				-14.59	11.00		8.49	
Woods	6.67					-7.10		

1. *Low Socio-Economic Level,* characterized by low levels of GDP, which are linked to structural problems such as the unemployment rate (both general and over long term). Significant female employment rates working as well as substantial percentage of employees in agricultural and industrial sectors at the expense of the tertiary sector.
2. *Livestock,* wraps up the main variables tied to cow, pig, and poultry. Significant values tied to population density and the female employment rates.
3. *Vineyard,* presents important values linked to agricultural areas reserved for vineyard production; fruits, permanent crops, and cattle/hectare.

4. Permanent Crops, permanent crops have an important role, low values correspond to grains and livestock. Significant values of unemployment rate and female employment rates.

5. Bovine Cattle, frequently characterized of important values linked to cattle.

6. Density and unemployment, encompasses areas of high density levels, but also with significant levels of long term unemployment. Significant amount of lands dedicated to cereals.

7. Total dependency, refers to areas with low density levels, with a population but high dependency values. High values linked to UAA, not oriented towards fruits.

8. Density of rural population, includes areas with high density but also significant values of UAA and low rates of aging.

Cluster analysis led to the identification of 12 first-stage clusters (table 4.5).

In order to obtain clusters that contain a significant (but not in the statis tical sense) number of regions, according to the output of the Sas routine (table 4.5), we decided to merge the clusters with only one region to the statistically nearest cluster.

Table 4.5: Cluster Summary

Cluster	Frequency	RMS Std Deviation	Maximum Distance from Seed to Observation	Radius Exceeded	Nearest Cluster	Distance Between Cluster Centroids
1	36	0.8479	4.5303		4	3.5849
2	22	1.0829	4.0632		4	3.7664
3	1	.	0		4	8.0157
4	53	0.7591	3.6900		11	2.5254
5	19	0.6140	2.8042		12	3.9498
6	1	.	0		2	6.8450
7	1	.	0		8	11.1624
8	1	.	0		7	11.1624
9	10	1.1057	3.8372		2	4.8742
10	1	.	0		6	11.1780
11	44	0.6622	3.6303		4	2.5254
12	19	0.6928	2.7301		5	3.9498

Table 4.6: Clusters

Code	Regions	Cluster	Code	Regions	Cluster	Code	Regions	Cluster
be21	ANTWERPEN	**1**	de71	DARMSTADT	**4**	pt16	CENTRO	**9**
be22	LIMBURG	**1**	de72	GIESSEN	**4**	pt17	LISBOA E VALE DO TEJO	**9**
be23	OOST-VLAANDEREN	**1**	de73	KASSEL	**4**	pt18	ALENTEJO	**9**
be25	WEST-VLAANDEREN	**1**	de8	MECKLENBURG-VORPOMMERN	**4**	pt15	ALGARVE	**9**
be33	LIEGE	**1**	de91	BRAUNSCHWEIG	**4**	pt30	MADEIRA	**9**
de13	FREIBURG	**1**	de92	HANNOVER	**4**	be24	VLAAMS BRABANT	**11**
de14	TÜBINGEN	**1**	de93	LÜNEBURG	**4**	be31	BRABANT WALLON	**11**
de21	OBERBAYERN	**1**	de94	WESER-EMS	**4**	be34	LUXEMBOURG	**11**
de22	NIEDERBAYERN	**1**	dea1	DÜSSELDORF	**4**	be35	NAMUR	**11**
de27	SCHWABEN	**1**	dea2	KÍLN	**4**	dk00	DANMARK	**11**
deb2	TRIER	**1**	dea3	MÜNSTER	**4**	es24	ARAGON	**11**
es11	GALICIA	**1**	dea4	DETMOLD	**4**	es41	CASTILLA Y LEON	**11**
es12	PRINCIPADO- ASTURIAS	**1**	dea5	ARNSBERG	**4**	fr21	CHAMPAGNE-ARDENNE	**11**
es13	CANTABRIA	**1**	deb1	KOBLENZ	**4**	fr22	PICARDIE	**11**
itc2	VALLE D'AOSTA	**1**	deb3	RHEINHESSEN-PFALZ	**4**	fr23	HAUTE-NORMANDIE	**11**
itd1	ALTO-ADIGE	**1**	dec	SAARLAND	**4**	fr24	CENTRE	**11**
nl11	GRONINGEN	**1**	ded	SACHSEN	**4**	fr25	BASSE-NORMANDIE	**11**

Table continues

Table 4.6: (continued)

Code	Regions	Cluster	Code	Regions	Cluster	Code	Regions	Cluster
nl12	FRIESLAND	1	dee1	DESSAU	4	fr26	BOURGOGNE	11
nl13	DRENTHE	1	dee2	HALLE	4	fr41	LORRAINE	11
nl21	OVERIJSSEL	1	dee3	MAGDEBURG	4	fr43	FRANCHE-COMTE	11
nl22	GELDERLAND	1	def	SCHLESWIG-HOLSTEIN	4	fr51	PAYS DE LA LOIRE	11
nl23	FLEVOLAND	1	deg	THÜRINGEN	4	fr52	BRETAGNE	11
nl31	UTRECHT	1	gr11	ANATOLIKI MAKEDONIA	4	fr53	POITOU-CHARENTES	11
nl32	NOORD-HOLLAND	1	gr12	KENTRIKI MAKEDONIA	4	fr61	AQUITAINE	11
nl33	ZUID-HOLLAND	1	gr13	DYTIKI MAKEDONIA	4	fr62	MIDI PYRENEES	11
nl41	NOORD-BRABANT	1	es21	PAIS VASCO	4	fr63	LIMOUSIN	11
nl42	LIMBURG	1	es22	COMUNIDA F. DE NAVARRA	4	fr71	RHONE-ALPES	11
at21	KÄRNTEN	1	es30	COMUNIDAD DE MADRID	4	fr72	AUVERGNE	11
at22	STEIERMARK	1	es51	CATALUNA	4	ie	IRELAND	11
at31	OBERÍSTERREICH	1	es53	ISLAS BALEARES	4	nl34	ZEELAND	11
at32	SALZBURG	1	fr10	ILE DE FRANCE	4	at12	NIEDERÍSTERREICH	11
at33	TIROL	1	fr30	NORD - PAS-DE-CALAIS	4	fi	FINLAND	11
at34	VORARLBERG	1	fr42	ALSACE	4	se01	STOCKHOLM	11
pt20	ACORES	1	itc1	PIEMONTE	4	se02	ÍSTRA MELLANSVERIGE	11
ukf	EAST MIDLANDS	1	itc4	LOMBARDIA	4	se04	SYDSVERIGE	11
ukk	SOUTH-WEST UK	1	itd3	VENETO	4	se06	NORRA MELLANSVERIGE	11
es23	LA RIOJA	2	itd4	FRIULI-VENEZIA GIULIA	4	se07	MELLERSTA NORRLAND	11
es42	CASTILLA-LA MANCHA	2	itd5	EMILIA-ROMAGNA	4	se08	ÍVRE NORRLAND	11
es43	EXTREMADURA	2	ite1	TOSCANA	4	se09	SMALAND MED ÍAMA	11
es61	ANDALUCIA	2	ite2	UMBRIA	4	se0a	VÄSTSVERIGE	11
gr14	THESSALIA	2	ite3	MARCHE	4	ukc	NORTH-EAST UK	11
gr21	IPEIROS	2	ite4	LAZIO	4	ukd	NORTH-WEST UK	11
gr22	IONIA NISIA	2	itf1	ABRUZZO	4	uke	YORKSHIRE - HUMBER	11
gr23	DYTIKI ELLADA	2	itf2	MOLISE	4	ukg	WEST MIDLANDS	11
gr24	STEREA ELLADA	2	cz02	STREDNÍ CECHY	5	ukh	EASTERN UK	11
gr25	PELOPONNISOS	2	cz03	JIHOZÁPAD	5	ukj	SOUTH-EAST UK	11
gr30	ATTIKI	2	cz04	SEVEROZÁPAD	5	ukl	WALES	11
gr41	VOREIO AIGAIO	2	cz05	SEVEROVÝCHOD	5	ukm	SCOTLAND	11
gr42	NOTIO AIGAIO	2	cz06	JIHOVÝCHOD	5	ukn	NORTHERN IRELAND	11
gr43	KRITI	2	cz07	STREDNÍ MORAVA	5	lt0	LITHUANIA	12
fr81	LANGUEDOC-ROUSSILLON	2	cz08	MORAVSKOSLEZKO	5	pl11	LÓDZKIE	12
fr82	PROVENCE-ALPES-C. D'AZUR	2	ee0	ESTONIA	5	pl12	MAZOWIECKIE	12
fr83	CORSE	2	lv0	LATRIA	5	pl21	MALOPOLSKIE	12
itc3	LIGURIA	2	hu10	KÖZÉP-MAGYARORSZÁG	5	pl22	SLASKIE	12
itf3	CAMPANIA	2	hu21	KÖZÉP-DUNÁNTÚL	5	pl31	LUBELSKIE	12
itf4	PUGLIA	2	hu22	NYUGAT-DUNÁNTÚL	5	pl32	PODKARPACKIE	12
itf5	BASILICATA	2	hu23	DÉL-DUNÁNTÚL	5	pl33	SWIETOKRZYSKIE	12
itf6	CALABRIA	2	hu31	ÉSZAK-MAGYARORSZÁG	5	pl34	PODLASKIE	12
itg1	SICILIA	2	hu32	ÉSZAK-ALFÖLD	5	pl41	WIELKOPOLSKIE	12
itg2	SARDEGNA	2	hu33	DÉL-ALFÖLD	5	pl42	ZACHODNIOPOMORSKIE	12
cz01	PRAHA	4	sk01	BRATISLAVSKÝ KRAJ	5	pl43	LUBUSKIE	12
at11	BURGENLAND	4	sk02	ZÁPADNÉ SLOVENSKO	5	pl51	DOLNOSLASKIE	12
be32	HAINAUT	4	si0	SLOVENIA	5	pl52	OPOLSKIE	12
de11	STUTTGART	4	cy0	CYPRUS	7	pl61	KUJAWSKO-POMORSKIE	12
de12	KARLSRUHE	4	mt0	MALTA	7	pl62	WARMINSKO-MAZURSKIE	12
de23	OBERPFALZ	4	es52	COMUNIDAD VALENCIANA	9	pl63	POMORSKIE	12
de24	OBERFRANKEN	4	es62	REGION DE MURCIA	9	sk03	STREDNÉ SLOVENSKO	12
de25	MITTELFRANKEN	4	es70	CANARIAS	9	sk04	VÝCHODNÉ SLOVENSKO	12
de26	UNTERFRANKEN	4	itd2	TRENTINO	9			
de4	BRANDENBURG	4	pt11	NORTE	9			

According to the aforementioned merging procedure, cluster 3 has been included in cluster 4 (the nearest in statistical sense), cluster 6 in the 2, cluster 10 in the 6 and cluste r 8 in the 7. As a result, we obtain 8 clusters (table 4.6 and figure 4.1).

- *Territorial Systems with the highest levels of development (cluster 1):* the majority of regions belonging to this group are from Belgium, Holland, and Austria (almost 7% of total a reas, but over 21% of the GDP). They have a high demographic density. Agriculture is not particularly relevant for either employment or income. These territories nevertheless compete in an important way to the European agricultural production with 19% of c ows (primarily milk cows).
- *Mediterranean Systems with a low level of development and with agriculture playing an important role (cluster 2):* southern regions of Italy, Spain, and Greece fall into this category, which is characterized by low GDP per capita. Nonetheless, this GDP per capita is still higher than that of the NMS. Agriculture represents an important sector for employment (almost 10% of total workers); there are high rates of aging. The prevailing productions are intensive: vineyards (44% of the total) and also grain cultivation is widespread. Gaps in development make evident the high rates of unemployment in the long term.
- *Continental Systems with a high level of development and both intensive and extensive agriculture (cluster 4):* some German regions and Northern Italian regions (15.6% of total areas) fall into this category, which is densely populated. Especially in the Italian regions there is a link between the continental and Mediterranean productions. Cereals (over 22% of the total), vineyards (18.5%), milk cows, and pigs are the main products.
- *Systems in the NMS with large gaps in socio-economic development (cluster 5):* mainly regions in Czech Republic and Hungary, in which agriculture doesn't play a major role for employment even though workers represent over 11% of the EU total. Cereals and livestock (cows, pigs, and poultry) are important.
- *Mediterranean Systems in the NMS (Cluster 7):* Cyprus and Malta play a very minor role in agriculture and rural development within the European scenari o.
- *Mediterranean Systems with an average level of development and intensive agriculture (cluster 9):* this includes some regions in Spain and Portugal with an elevated population density. The agricultural sector is based on fruits and vegetable production.

Table 4.7: Average PC values for first-stage clusters

Cluster	Principal component	Low socio-economic level	Livestock	Vineyard	Permanent Crops	Bovine Cattle	Density and Unemployment	Total Dependency	Density of Rural Population
1	**Mean**	**-2.07**	**2.15**	**-0.40**	**0.40**	**0.96**	**-0.34**	**0.22**	**-0.42**
	(std)	0.794	1.177	0.541	0.789	0.790	0.941	0.792	0.828
2	**Mean**	**0.16**	**-2.67**	**1.86**	**1.03**	**0.48**	**0.46**	**0.36**	**-0.36**
	(std)	1.086	0.809	2.100	2.735	1.952	1.006	1.390	1.292
4	**Mean**	**-0.54**	**-0.35**	**-0.43**	**-0.36**	**-0.14**	**1.12**	**-0.51**	**-0.11**
	(std)	0.946	1.046	0.756	0.850	0.627	0.808	0.815	0.848
5	**Mean**	**3.03**	**1.04**	**-0.32**	**-1.18**	**-0.79**	**-0.31**	**-0.68**	**-0.74**
	(std)	0.556	0.596	0.586	0.655	0.457	0.775	0.810	0.338
7	**Mean**	**4.73**	**7.95**	**8.53**	**3.06**	**-4.92**	**1.77**	**2.21**	**0.13**
	(std)	0.689	4.987	0.007	1.899	1.101	2.504	0.108	5.084
9	**Mean**	**-0.17**	**-0.63**	**2.12**	**0.30**	**1.07**	**-2.37**	**-2.42**	**1.17**
	(std)	0.948	1.214	1.119	0.596	1.318	1.206	1.017	1.255
11	**Mean**	**-1.71**	**-0.67**	**-0.43**	**-0.26**	**-0.86**	**-0.49**	**0.79**	**0.56**
	(std)	0.671	0.937	0.469	0.603	0.581	0.601	0.634	0.704
12	**Mean**	**5.76**	**0.30**	**-1.05**	**0.28**	**0.71**	**-0.63**	**0.48**	**0.38**
	(std)	0.801	0.548	0.477	0.535	0.520	0.885	1.023	0.535

Table 4.8: Average clusters value

Cluster	**1**	**2**	**4**	**5**	**7**	**9**	**11**	**12**	**EU-25**
Regions	**36**	**24**	**54**	**19**	**2**	**10**	**44**	**19**	**208**
				SOCIO DEMOGRAPHIC VARIABLE					
Popden	281.6	139.8	288.8	125.6	662.6	231.9	133.5	121.5	208.2
Ageing	94.3	117.9	121.1	87.2	59.8	106.6	95.6	66.2	101.3
Depend	49.0	51.3	48.3	44.1	48.2	47.9	54.5	45.5	49.4
				ECONOMIC VARIABLES					
Female	5.8	17.9	10.0	8.9	6.7	9.1	7.2	20.5	10.4
Unempl	5.0	12.2	9.0	8.1	5.9	7.1	6.7	19.8	9.0
GDP	23680.8	16914.8	22188.1	12139.6	16528.2	18193.7	21941.8	8889.5	19406.8
Empagr	1.6	6.6	1.8	7.2	5.6	4.2	1.7	24.8	5.0
Empter	69.2	68.0	65.9	36.3	27.7	65.8	72.8	27.3	61.6
Empind	29.2	25.4	32.1	56.5	66.8	30.1	25.5	47.8	33.3
Ltunem	29.5	50.6	45.7	45.4	32.7	30.0	29.7	56.1	40.1
				AGRICULTURE					
				Agriculture structural					
UAA	209.7	694.2	468.8	698.4	73.4	407.7	1239.7	1051.5	680.5
				Agriculture-Land Allocation					
Cereals	13.3	23.9	44.3	42.1	21.1	7.5	32.0	45.6	31.9
Vine	0.4	10.1	2.2	1.1	8.5	9.6	0.8	0.0	2.6
Permcrops	0.3	21.8	1.3	2.3	18.7	3.5	0.1	1.3	3.6
Orchards	1.7	4.5	1.4	1.2	6.5	26.4	0.7	1.2	2.9
Fallows	0.1	2.1	0.5	3.7	5.7	17.0	0.6	10.4	2.7
				Agriculture-Livestock					
Shegoa	0.0	0.3	0.1	0.1	3.5	0.1	0.1	0.1	0.1
Pigs	0.9	0.0	0.4	0.8	5.4	0.3	0.2	1.0	0.5
Poultry	0.3	0.1	0.1	7.5	84.0	0.0	0.1	3.6	2.0
Cow	0.9	0.1	0.3	0.1	0.5	0.2	0.3	0.2	0.4
Milk	0.7	0.0	0.2	0.1	0.5	0.1	0.2	0.2	0.2
Milkow	82.7	41.1	74.3	86.2	100.0	62.6	55.3	96.6	70.7
Beefor	0.9	2.6	0.9	4.4	3.1	0.5	0.8	7.5	2.0
				Agriculture-Productivity					
Awuint	0.1	0.2	0.1	0.8	3.3	0.4	0.0	1.3	0.3
				ENVIRONMENT					
Woods	7.6	0.7	4.4	31.4	3.4	10.8	1.1	31.9	9.1
Livint	4.1	11.0	3.3	0.4	4.5	6.8	2.4	0.4	3.8

Table 4.9: Percentage clusters value

Cluster	**1**	**2**	**4**	**5**	**7**	**9**	**11**	**12**	**EU-25**
Regions	17.3	11.5	26.0	9.1	1.0	4.8	21.2	9.1	100.0
% Pop	12.0	10.7	31.6	6.3	0.3	4.0	25.0	10.2	100.0
% Area	6.9	12.3	15.6	8.1	0.2	3.5	42.9	10.4	100.0
% GDP	21.1	10.1	29.7	5.7	0.8	4.5	23.9	4.2	100.0
% Empagr	3.5	9.6	9.1	11.0	0.4	2.4	8.7	55.4	100.0
% Empter	12.9	7.7	33.9	6.0	0.3	3.6	28.1	7.7	100.0
% Empind	12.2	5.9	34.7	8.9	0.2	4.6	23.0	10.3	100.0
% UAA	5.3	11.8	17.9	9.4	0.1	2.9	38.5	14.1	100.0
% Cereals	2.4	8.3	22.2	11.3	0.1	1.1	35.9	18.7	100.0
% Vine	1.0	44.2	18.5	4.8	0.7	10.2	20.5	0.1	100.0
% Permcrops	0.5	69.5	8.4	7.1	0.9	5.6	1.2	6.9	100.0
% Orchards	3.2	20.7	17.6	6.5	0.5	29.6	11.4	10.6	100.0
% Fallows	0.3	9.1	2.5	11.3	0.2	21.9	11.4	43.3	100.0
% Shegoa	3.4	21.8	8.0	11.8	5.6	3.1	39.7	6.6	100.0
% Pigs	10.4	1.1	17.6	18.0	0.9	1.4	16.5	34.1	100.0
% Poultry	1.4	0.3	1.1	52.5	3.0	0.1	3.5	38.1	100.0
% Cow	18.2	4.3	18.2	4.2	0.1	1.7	43.9	9.5	100.0
% Milk	19.7	1.6	22.6	5.6	0.1	1.0	35.1	14.3	100.0
%Milkow	21.6	2.3	21.8	5.4	0.1	1.2	33.9	13.8	100.0

- *Continental Systems with an average level of development and primarily extensive agriculture (cluster 11):* These systems are comprised by the majority of French, English, and Swedish regions. This category includes a large amount of the European territory (almost 43%) and 24% of the GDP. They have the lowest unemployment rates for the long term. With almost 36% of European grains production, 39.7% of sheep, 43.9% of cows, the impact of the Fischler reform will be momentous.
- *Systems with the highest gaps in development in the NMS (cluster 12):* this group includes regions from Poland, Lithuania, and Slovakia, 10% of total areas and population but barely 4.2% of the GDP. The majority of agricultural workers in the enlarged Europe live in these areas (over 55%). The most prevalent agricultural products are cereals (almost 19% of the total) and livestock (cow, pigs, poultry). This data shows how direct aid can play an important role and that there is a strong need for rural development measures.

4.2 The Multi-criteria Analysis (MCA)

4.2.1 Methodology

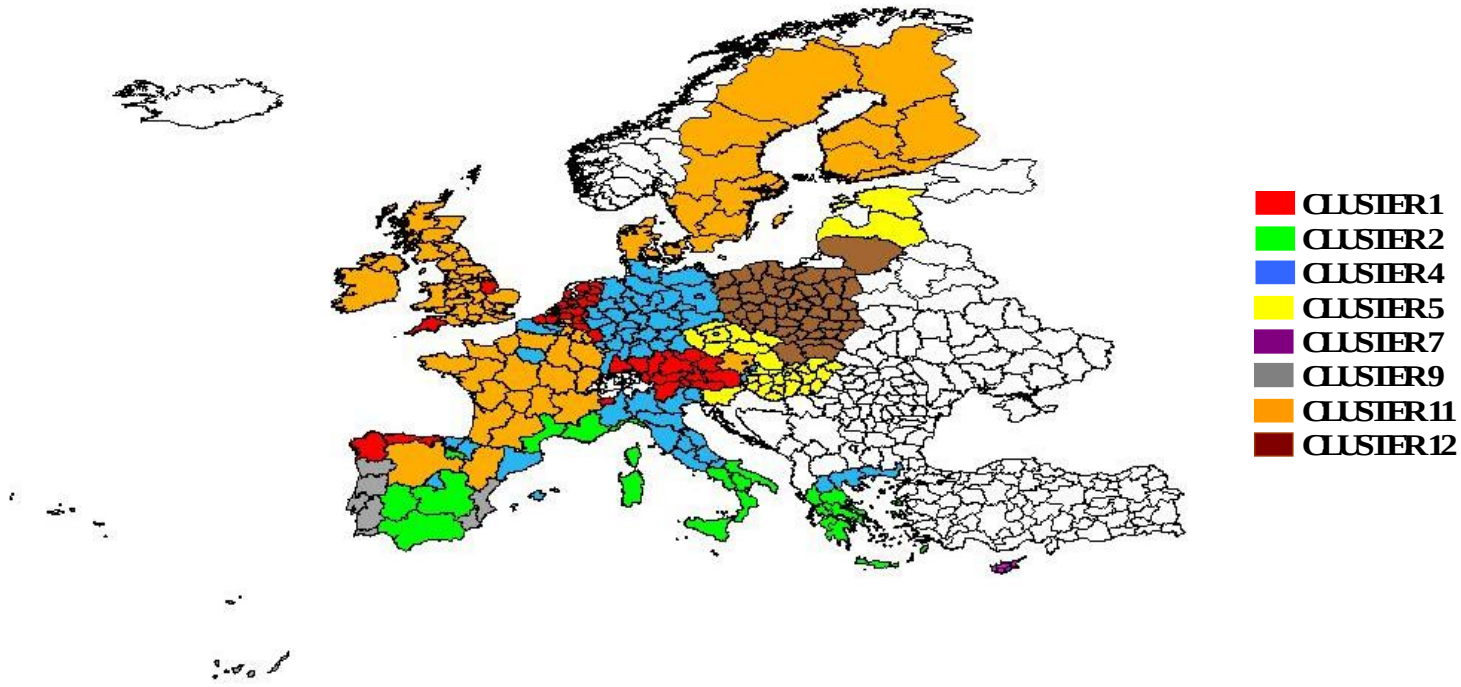
Using the results from the technical multivariate analysis (PCA and CA) for the clustering of the EU-15 regions, we performed a multi-criteria analysis (MCA).

This analysis classifies the various alternatives, in our case, the different groups, on the basis of decisional criteria taken into account simultaneously. Even though differences exist between the groups, these previously established criteria can be used in the creation of different scenarios, based on the specific needs of the analysis. The result of this analysis corresponds to a ranking between the different considered alternatives based on the examined criteria. For the proper application of this analysis, the number of alternatives can vary from a minimum of three to a maximum of eight and the number of criteria considered must not exceed seven.

We can therefore:

1) make different scenarios based on the variables or criteria defined previously according to specific requirements;
2) consider the different alternatives within each scenario;

Figure 4.1: UE-25 Map



3) justify his choices. This means that the choices made do not refer to a single variable, but rather, to a set of variables.

Given a generic alternative X^k (k=1,..., m), this defines a specific situation according to the research requirements and brings together all of the existing possible alternatives, the space X of the possible alternatives. Each alternative is described by the assumed values from the *n* attributes or observed criteria. An attribute representing a physical or economic characteristic (ex. weight, area, number of farms, income, employment) and is measured using specific measurement units. Starting with the considered alternatives, an evaluation matrix is created in which scores of attributes (observed variables) are calculated for each alternative. Usually, for each variable, we assign the lowest score to the alternative that we consider the worst and the highest score to the alternative that we consider the best. This matrix represents a starting point for the analysis since it summarizes all the available information. The dimension of the matrix is *n x k*, with *n* number of attributes and *k* number of alternatives (figure 4.2).

Figure 4.2: MCA - Evaluation Matrix

	Alternative 1	Alternative 2	…	Alternative k
Attribute 1 Attribute 2 … Attribute n	Score			
	Total Score Alternative 1	Total Score Alternative 2		Total Score Alternative k

The evaluation matrix allows to order the preferences according to determined criteria, obtaining an initial ranking of considered alternatives.

We define alternatives inefficient or Pareto-dominated, that which can be improved by at least one quality without worsening the result of the other attributes. Through the dominance analysis on the evaluation matrix, the alternatives are matched by paired comparison, determining a set of efficient alternatives or the Pareto-optimal. Assuming the chosen criteria as rational, we should prefer only non dominated options, therefore reducing the set of possible alternatives that we can consider. From an economic standpoint, each set should be understood as the curve of the production possibilities frontier.

If it is not possible to identify a precise ranking of the alternatives by the dominance analysis we move onto the Multi Attribute Analysis (MAA). The MAA allows us to choose between *k* discrete alternatives, previously defined and based on their quantitative or qualitative evaluation regarding *n* attributes. Such analyses are based on the Utility Function Theory (Keeney and Raiffa, 1976). This

theory is characterized by the identification of a utility function that summarizes important attributes (variables). This process requires first the estimate of the utility function of the examined variables and then their composition with the introduction of weights.

To determine the utility of each considered attribute, we can refer to an interval of values from 0 to 1 in which 0 represents the minimum utility and 1 represents the maximum utility.

The weight corresponds to the coefficient assigned to each individual attribute within the utility function. Generally, the vector of the weights tends to even out so that the sum of the components is equal to one.

Weights can be assigned to individual coefficients or directly or through the use of specific methodologies, for example, using the technique of examining different attributes by paired comparison. Different methods such as questionnaires, interviews, and focus groups provide information that can assist in determining hierarchies based on different attributes. Once the weights are estimated and the individual utility functions are associated to each attribute, it is possible to obtain the utility function associated with each alternative.

Linear utility functions are generally considered under the hypothesis of the full independence of attributes. In this way, a weighted utility matrix is created from which it is possible to obtain a complete score for each alternative, determining in this way a second ranking of the various alternatives based on the weighted utility function. Through these scores, it is possible to obtain the weighted sum of the various alternatives in each scenario.

The alternatives are then ordered by cardinal values, summarized in a single value together with the relative weighted utility to other analyzed options. It is important to note, however, that this type of approach implies that strong hypotheses (made according to the preferences) are viewed as a perfectly rational agent[5].

The final ranking shows therefore that the order of the preferences for the analyzed scenario. The alternatives ranked at the top of the list will be those most closely tied to the variables present in the scenario and consequently could feel possible effects of their potential variations. If the range of each scenario (that is the maximum minus the minimum value) is reduced, it means that potential variations of the considered variables will have similar effects for each alternative. On the other hand, a high range will bring forth diverse effects between the different alternatives based on the changes in value of the considered variables.

[5] The hypotheses are: 1) The existence of the utility functions 2) The preferences have to be the same during the decision process 3) The independence of the preferences and of the utilities.

4.2.2 The results in the EU-15

In our analysis, there were three different scenarios:

- *Scenario 1: The Socio-Economic Context*
- *Scenario 2: The Land Use*
- *Scenario 3: The Rural Context*

For each scenario an evaluation matrix was created calculating scores of attributes for each alternative (cluster).

As just described in par. 3.2, the clusters in EU 15 are:

- *Cluster 1. Continental urban systems with a high level of socio-economic development and with a highly specialized agriculture.*
- *Cluster 2. Mediterranean Systems with gaps in socio-economic development.*
- *Cluster 3. Mediterranean systems with an average level of socio-economic development and with both extensive and intensive agriculture.*
- *Cluster 5. Continental systems with a low level of socio-economic development.*
- *Cluster 7. Systems in the mountains and hills.*
- *Cluster 8. Systems with a high level of development and a highly productive agricultural sector.*
- *Cluster 10. Continental Systems with extensive agriculture and a high level of socio-economic development*.

The criteria for scoring (from 7 to 1 point) was based on the value of the variable considered relating to each cluster for all of the variables with the exception of the unemployment rate, dependency rate and the percentage of farms with owners over 55 years of age, to the cluster with the highest value was assigned the highest score (7) dropping until the lowest score (1) to the group with the lowest value of the considered variable. For the variables already specified, the order was inverted.

The dominance analysis was not possible for each scenario to determine a ranking between the different alternatives. Taking into account the limited and discrete number of alternatives (7) the MAA was applied. It was based on the concept of expected utility. The aim is to determine a utility function of individual attributes with minimum value of the worst considered option and the highest value for the best considered option and then their composition through appropriate weights. In this case, the weights assigned to the attributes were identical.

The linear utility functions were estimated based on the hypothesis that the individual attributes were independent in the relative scenarios. The values allowed us to ca lculate the weight of each alternative within the observed scenario.

Table 4.10: Scenario 1 - The Socio-Economic Context (Evaluation Matrix)

	Alternatives						
Attributes	**1**	**2**	**3**	**5**	**7**	**8**	**10**
Per capita GDP	6	1	3	2	4	7	5
Population density	7	4	1	3	2	6	5
Employment ratio	7	1	2	3	6	4	5
Unemployment ratio	7	2	3	1	5	6	4
Dependency ratio	4	5	3	7	1	6	2

Table 4.11: Scenario 1 - The Socio-Economic Context (Utility of Individual Attributes)

	Alternatives						
Attributes	**1**	**2**	**3**	**5**	**7**	**8**	**10**
Per capita GDP	0.95	0.58	0.68	0.60	0.86	1.00	0.91
Population density	1.00	0.29	0.14	0.29	0.16	0.55	0.34
Employment ratio	1.00	0.66	0.81	0.82	0.92	0.83	0.92
Unemployment ratio	1.00	0.26	0.44	0.24	0.67	0.78	0.58
Dependency ratio	0.91	0.91	0.89	1.00	0.85	0.95	0.84

Table 4.12: Scenario 1 - The Socio-Economic Context (Alternatives Ranking)

Weight	*Cluster*
0.20	1
0.17	8
0.14	10
0.14	7
0.12	3
0.12	5
0.11	2

Such a ranking relative to scenario 1 shows the potential sensitivity of the different clu sters to a variation of the variables fixed beforehand in the definition of the scenario (t able 4.12). The most sensitive clusters were numbers 1 and 8, characterized by the hig hest levels of GDP per capita. This brings us to the conclusion that decisions made to f avour socio-economic development would bring larger advantages to clusters 1 and 8. Ho wever the range of the scenario, equal to .08, highlights that all analyzed clusters are tied to vari ations of the socio-economic variables.

Table 4.13: Scenario 2 - The Land Use (Evaluation Matrix)

	Alternatives						
Attributes	**1**	**2**	**3**	**5**	**7**	**8**	**10**
% UAA under cereals	1	2	5	7	3	4	6
% UAA under vegetable crops and flowers	7	6	3	1	2	5	4
% UAA under vineyards	1	6	7	2	3	5	4
% UAA under permanent crops	4	7	6	3	1	5	2
% UAA under orchards	4	6	7	1	3	5	2
% UAA under forage crops	7	1	3	2	6	5	4
Other crops - industrial crops (% UAA)	5	4	3	7	1	2	6

Table 4.14: Scenario 2 - The Land Use (Utility of Individual Attributes)

	Alternatives						
Attributes	**1**	**2**	**3**	**5**	**7**	**8**	**10**
% UAA under cereals	0.20	0.43	0.66	1.00	0.48	0.62	0.74
% UAA under vegetable crops and flowers	1.00	0.92	0.29	0.03	0.04	0.64	0.39
% UAA under vineyards	0.00	0.92	1.00	0.00	0.09	0.70	0.18
% UAA under permanent crops	0.02	1.00	0.14	0.00	0.00	0.11	0.00
% UAA under orchards	0.20	0.85	1.00	0.01	0.09	0.48	0.08
% UAA under forage crops	1.00	0.22	0.39	0.33	0.98	0.59	0.55
Other crops - industrial crops (% UAA)	0.60	0.46	0.32	1.00	0.27	0.32	0.77

Table 4.15: Scenario 1 - The Land Use (Alternatives Ranking)

Weight	*Cluster*
0.21	2
0.17	3
0.16	8
0.14	1
0.12	10
0.11	5
0.09	7

The variables inserted in scenario 2, relative to the different uses of the land, were chosen to identify possible effects of the introduction of direct payments to farmers decoupled from production[6]. Variables relating to livestock were not inserted because, contrary to the majority of crops in which total decoupling was instituted, decoupling of livestock was only partial. From the

[6] The attributers of this scenario are not independent; however the results have to be considered like possible indications.

ranking, we see that cluster 2 is that which is most closely linked to the possible variations in the use of land. This cluster incorporates regions in which the agricultural sector plays a significant role and could potentially represent an opportunity to promote competition. The range of this scenario was reduced equal to .12, thus emphasizing the importance of possible variations in the use of land, variations that take on even more importance in light of this new farm aid (table 4.15).

The composition of scenario 3 takes up the main themes dealt with through rural development policies that aim to economically revive disadvantaged areas through adding value to these lands. Within this scenario, we have defined two sub-scenarios, which consider the role of the employment in the industrial sector and in the tertiary sector. Since rural areas are typically characterized by significant employment in agriculture, the development of these areas could depend on employment in other sectors that may have more potential for economic growth.

Furthermore, we have to consider that the attributes related to the employment in the three economic sectors are not independent and so they can not be inserted in the same scenario, basing on the MCA hypothesis.

Table 4.16: Sub-Scenario 3 (Industry) - The Rural Context (Evaluation Matrix)

	Alternatives						
Attributes	**1**	**2**	**3**	**5**	**7**	**8**	**10**
Per capita GDP	6	1	3	2	4	7	5
Employees in Industry (% total)	4	2	7	3	5	6	1
UAA per farm	4	1	3	7	5	2	6
% farms with holder aged more than 55	4	2	3	7	6	1	5

Table 4.17: Sub-Scenario 3 (Industry) - The Rural Context (Utility of Individual Attributes)

	Alternatives						
Attributes	**1**	**2**	**3**	**5**	**7**	**8**	**10**
Per capita GDP	0.95	0.58	0.68	0.60	0.86	1.00	0.91
Employees in Industry (% total)	0.84	0.76	1.00	0.83	0.91	0.97	0.75
UAA per farm	0.10	0.02	0.08	1.00	0.12	0.04	0.24
% farms with holder aged more than 55	0.62	0.45	0.48	1.00	0.77	0.42	0.75

The range of this sub-scenario, equal to .09, highlights that all analyzed clusters are tied to aspects of rural development; therefore, it would be interesting to verify by the sensitivity analysis, which cluster could take more advantage from possible decisions based on change of the

employees from the agricultural to the industrial sector, which can advantage both sectors and consequently the rural areas (table 4.18).

Table 4.18: Sub-Scenario 3 (Industry) - The Rural Context (Alternatives Ranking)

Weight	*Cluster*
0.19	5
0.15	7
0.15	10
0.14	1
0.14	8
0.13	3
0.10	2

Table 4.19: Sub-Scenario 3 (Tertiary) - The Rural Context (Evaluation Matrix)

	Alternatives						
Attributes	**1**	**2**	**3**	**5**	**7**	**8**	**10**
Per capita GDP	6	1	3	2	4	7	5
Employees in Tertiary (% total)	6	3	1	4	5	2	7
UAA per farm	4	1	3	7	5	2	6
% farms with holder aged more than 55	4	2	3	7	6	1	5

Table 4.20: Sub-Scenario 3 (Tertiary) - The Rural Context (Utility of Individual Attributes)

	Alternatives						
Attributes	**1**	**2**	**3**	**5**	**7**	**8**	**10**
Per capita GDP	0.95	0.58	0.68	0.60	0.86	1.00	0.91
Employees in Tertiary (% total)	0.96	0.91	0.85	0.93	0.93	0.91	1.00
UAA per farm	0.10	0.02	0.08	1.00	0.12	0.04	0.24
% farms with holder aged more than 55	0.62	0.45	0.48	1.00	0.77	0.42	0.75

Table 4.21: Sub-Scenario 3 (Tertiary) - The Rural Context (Alternatives Rankings)

Weight	*Cluster*
0.19	5
0.16	10
0.15	7
0.14	1
0.13	8
0.12	3
0.11	2

The range, equal to .08 and the ranking of this sub-scenario, are similar with respect to the other sub-sector and so what we have put in evidence about the previous sub-scenario, we can resume about this sub-scenario too. Even in this case, the sensitive analysis could show some directions about a possible relation between the agricultural and the tertiary employment and the possible positive effects with respect to both sectors (table 4.21).

4.3 The Sensitivity Analysis (SA)

4.3.1 Methodology

By means of the multi-criteria analysis (MCA), the clusters were classified according to each scenario thanks to the targeted selection of specific variables. The next stage in the analysis will aim to measure the sensitivity of each cluster to possible effects of changes in the variables that could depend on specific choices of interventions at the EU level. All of these issues can be given values through the results of the Sensitivity Analysis (SA).

Applying such an analysis to the obtained results will make it possible to analyze how they change with the variation of variables within each scenario, the rankings of the groups, making it possible to provide an evaluation about the regions that could profit or not from certain interventions.

The sensitivity analysis measures the effects of changes in the variables of a model, thus giving value to the quality of the adjustment. A classification of the various forms of application of this analysis is provided by Frey and Patil (2002) [7]: mathematical method, statistical method, and graphic method.

The mathematical model studies the impact of the present variables on the results of the considered model according to their range of variability. The statistical model refers to simulations in which probability distributions are assigned to the variables. In this way, researchers can analyze the variability for each variable and how this could influence the results of the model. The graphic model is used as a visual representation of the results of the analysis according to one of the possible application methods.

The applied model will refer to the mathematical model and the results will be displayed in the graphical model. The first step consists of taking up the variables associated with decisional

[7] Frey H.C., Patil S.R. (2002), "Identification and Review of Sensitivity Analysis Methods", in Risk Analysis, Vol. 22/2002, pp.553-578.

parameters used in the previous analysis and therefore in the reconsideration of the various scenarios

Here we speak of analyses for future scenarios or *what if* scenarios since they give value to the changes of assumed values of decisional parameters. The standard procedure of the application of the Sensitivity Analysis consists of changing one variable at a time while keeping the other variables constant, therefore:

$$\Delta U = U(x_1,..., x_i + \Delta x_i,..., x_n) - U(x_1,..., x_i,..., x_n)$$

with

U	linear utility function
$x_1,....x_n$	Variables or attributes analyzed
$x_i + \Delta x_i$	Variation of the attribute i
ΔU	Variation of the Utility Function

The SA allows us to evaluate the uncertainty that surrounds each of the independent variables could influence the assumed value at the base of the evaluation. The impact depends on:

- the range of each variable;
- analytical relations relating to the analyzes subject.

The SA provides useful hints with regards to the risk of a project and to the sources from which it originates. This procedure is based on examining the variations of changing one variable at a time while keeping the others constant. On the one hand, it simplifies the analysis; on the other, it presents some limitations, for example, the risk of considering extremely unlikely situations and the risk of the dependency relationship between the considered variables (in which case, between the considered hypotheses there is the independence of observed variables).

The application of the sensitivity analysis took place using the software *Visual Interactive Sensitivity Analysis (V.I.S.A.)*. This software offers a graphical representation of the results on a Cartesian Axis. The importance of the criteria or attribute considered is shown on the axis and along with ordering the positions of the various alternatives within their chosen ranking. The software requires first the definition of the variables that will have the role of parameters or decisional criteria with the specific corresponding weight. Each weight represents the role of the variable within the scenario. The method allows us to graphically analyze the effects on each individual variable of the change in value within its range.

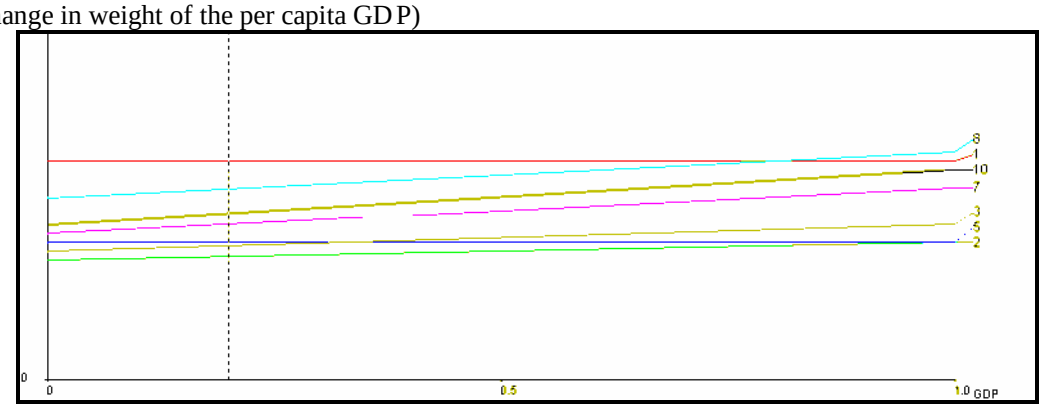
4.3.2 Results in the EU-15

Scenario 1: The Socio-Economic Context

In scenario 1 (socio-economic context), in the first ranking, the potentially most sensitive group to the variations of variables tied to the socio-economic context is cluster 1 even if the difference between the first group and the last group was small (equal to .09 percentage points).

If we imagine a change in the value of the per capita GDP, as for example a possible consequence of choices or interventions aimed at increasing the economic wealth of the regions, the ranking of the different clusters would undergo some changes (figure 4.3). The largest benefits should concern clusters 8 and 10 that would develop even more significantly their economic potential, which is already at a good level as well as cluster 7 that could profit with an improved development of its resources. Cluster 1, already characterized by a high level of socio-economic development would not benefit significantly. On the contrary, small advantages should be expected instead for clusters 3, 5, and 2, characterized by both social and economic problems that should be resolved beforehand in order to increase their economic potential.

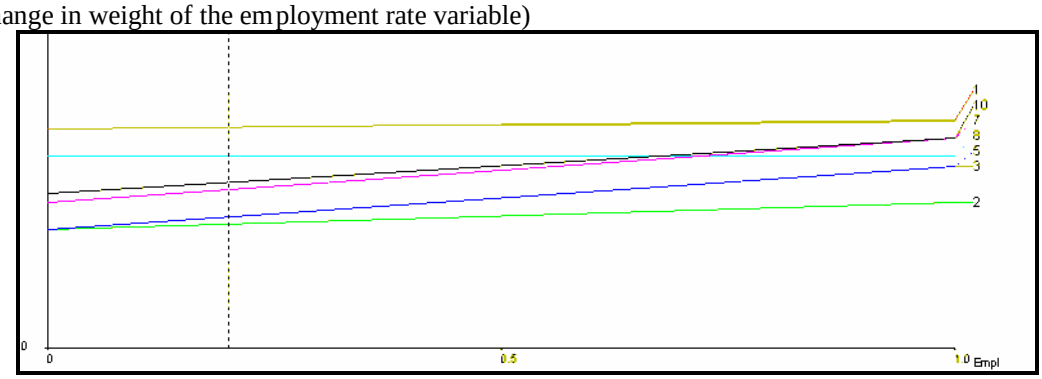
Fig. 4.3: Scenario 1 - The Socio-Economic Context (Change in the Cluster Ranking due to the change in weight of the per capita GDP)



If we suppose that instead of altering the value of the employment rate as a possible consequence of policies and interventions, policy makers aimed at favouring or increasing employment in the different regions they would have different results between the various clusters (figure 4.4).

Cluster 1, already characterized by a good employment situation could benefit slightly, but at a smaller scale than clusters 7 and 10, which could count on this theme for their economic growth. The rise in employment could represent a relevant aspect for clusters 5 and 3 as well as for cluster 2, all of which suffer the unemployment problem to a great extent. A rise in employment in cluster 2 could be more difficult because of the high number of people who have been long term unemployed. As for the other variables referred to in this scenario, it is worth saying that important variations between the first and last rankings do not emerge for the unemployment rate and the dependency rate. This shows that the effects from variations tied to these variables would produce positive effects on a macro level but not on the specific level of individual clusters.

Figure 4.4: Scenario 1 - The Socio-Economic Context (Change in the Cluster ranking from a change in weight of the employment rate variable)



Scenario 2: The Land Use

Scenario 2 includes variables that relate to different types of land use. With the introduction of the new system of direct payments in agriculture, decoupling from production, the choice of a certain production could be a key to success for the promotion of competition in the sector. Only variables linked with crops were considered since for the majority of these, this new form of economic subsidy was applied totally. The application for livestock production is only partial.

If it assumes a variation in the percentage of the land areas used to produce cereals, the clusters that could benefit would be the 5 and 10, already producing a significant amount. The orientation towards the cereal sector would not bring specific advantages to clusters 1 and 2 (figure 4.5).

As for the percentage of areas dedicated to vegetable and flowers production, the cluster that could benefit from a possible increase would be cluster 1, especially when you consider flowers production. An increase of the areas for vegetable production could be well received by cluster 2

and cluster 8, while clusters 5 and 7 might not find it partic ularly favourable since they are more oriented towards continental production (figure 4.6).

Figure 4.5: Scenario 2 – The Land Use (Change in ranking of cluster to change of weight of variable to the percentage of the cereal crop areas)

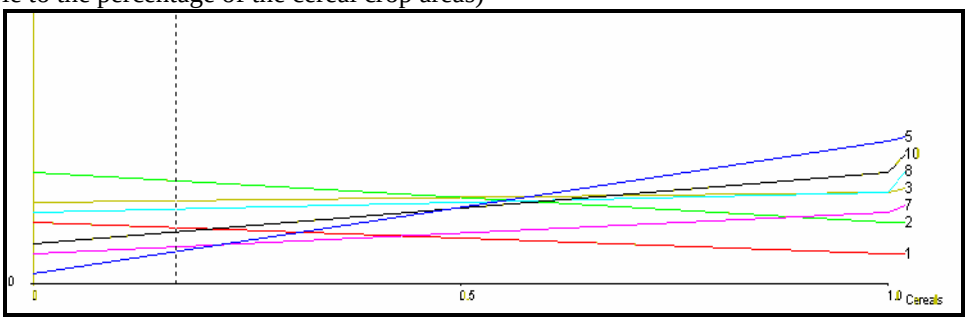
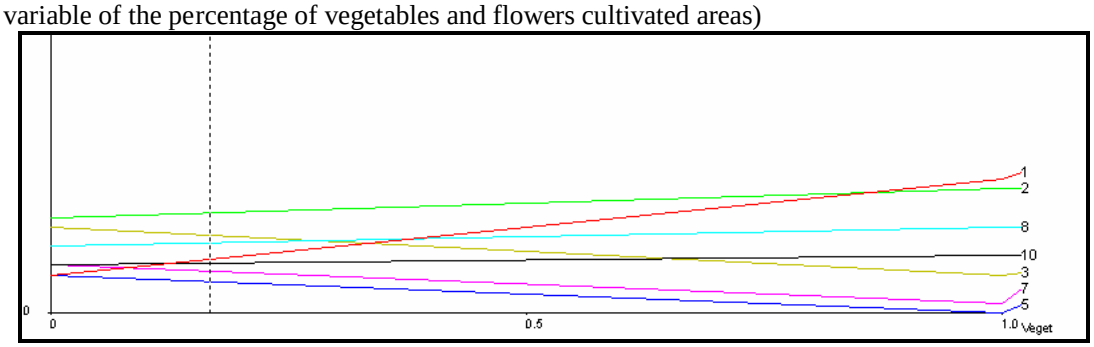
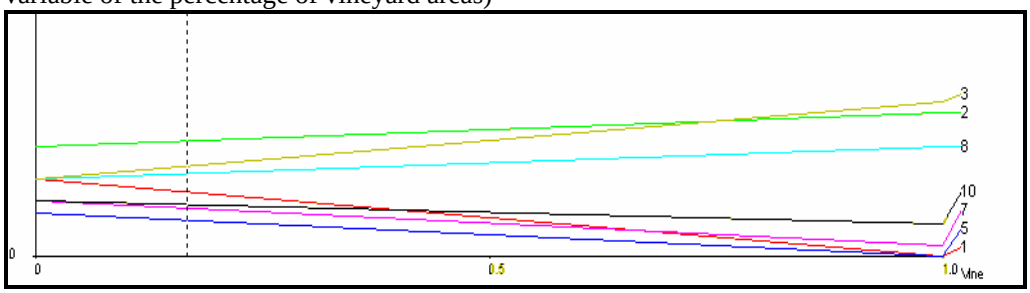


Figure 4.6: Scenario 2 – The Land Use (Change in cluster ranking with a change in weight of the variable of the percentage of vegetables and flowers cultivated areas)



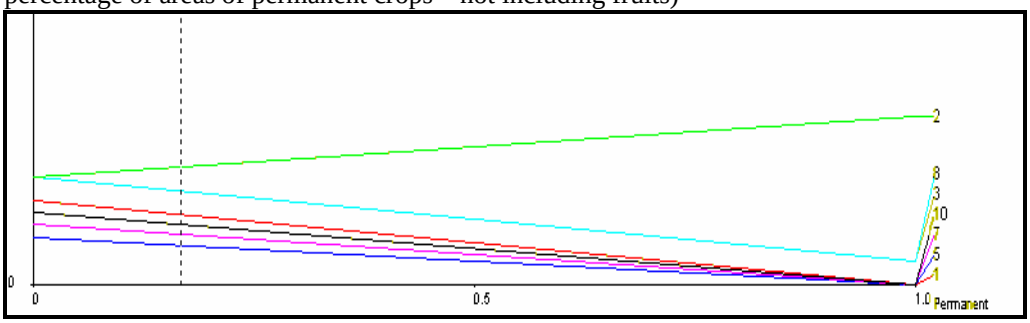
An increase of the areas used for vineyards could be well received by clusters 3, 2, and 8, all composed mainly of regions in the Mediterranean (Greece, Spain, and Italy). The effect would definitely be smaller on clusters 1, 5, and 7, which are already producing other crops (figure 4.7).

Figure 4.7: Scenario 2 – The Land Use (Change in cluster ranking with a change in the weight of the variable of the percentage of vineyard areas)



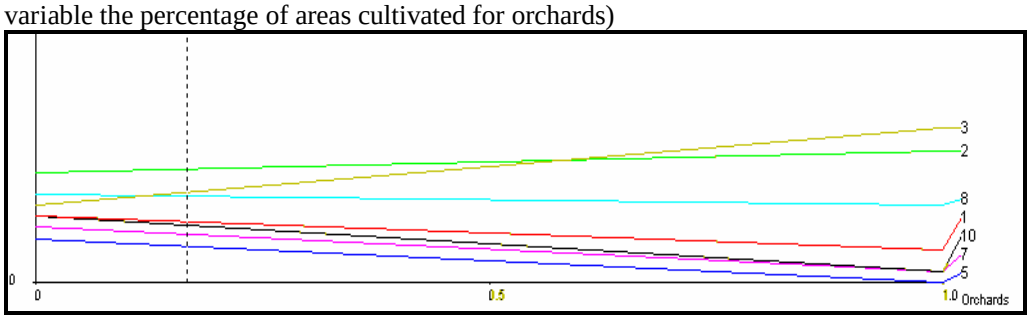
The only cluster that would seem to benefit specifically from an increase in land reserved especially for the production of permanent crops, not including fruits, is cluster 2. This cluster includes regions in southern Italy, Spain, and a large part of the regions in Greece, and is strongly oriented towards permanent crop production. For all of the clusters, specific benefits are not foreseen by a choice aimed in this direction (figure 4.8).

Figure 4.8: Scenario 2 - The Land Use (Change in cluster ranking with a change in the variable of the percentage of areas of permanent crops - not including fruits)



If we alter the variable relating to fruit production (orchards), we see that both clusters 2 and 3 would potentially benefit from an increase in areas for these crops, since they already produce a significant amount of fruit (figure 4.9).

Figure 4.9: Scenario 2 – The Land Use (Change in cluster ranking with a change in the weight of the variable the percentage of areas cultivated for orchards)



An increase in the importance of the role of forage could be favourable to clusters 1 and 7: for this last cluster, it must consider how this form of land use is connected to the territorial characteristics of these regions, usually located in the mountain and hill areas (figure 4.10).

A possible increase in areas dedicated to industrial crops could be well -received especially by cluster 5, which as we have seen, is specialized in continental productions, e specially grains. Cluster 10, which is also specialized in these produc tions would also benefit (figure 4.11).

Figure 4.10: Scenario 2 – The Land Use (Change in the cluster ranking with a change in weight of the variable of the percentage of lands for forage)

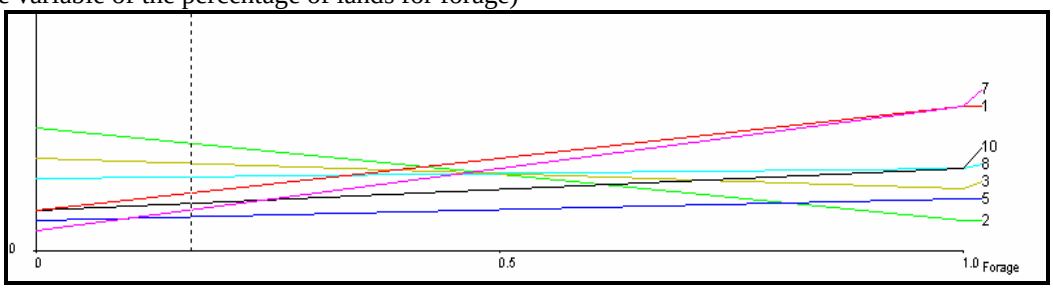
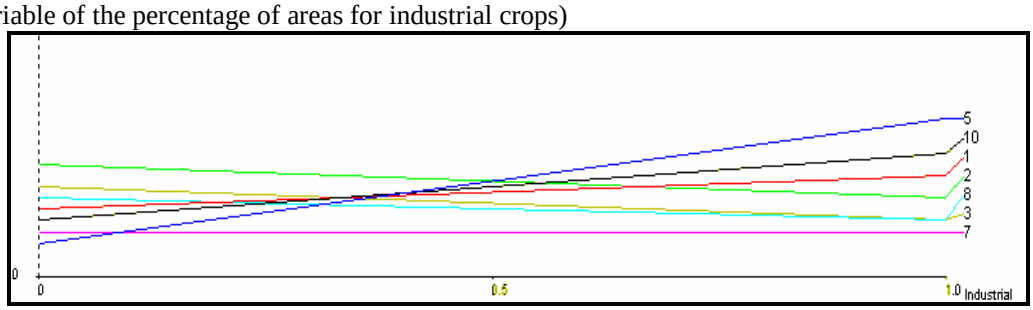


Fig. 4.11: Scenario 2 – The Land Use (Change in the cluster ra nking with a change in weight of the variable of the percentage of areas for industrial crops)



In conclusion, for each cluster it is possible to identify potential strategies and action plans. They must however take into account both the competitive cap acities of the farms, their specific characteristics, and market trends.

Cluster 1: Given the main role of livestock, it could aim to flowers production, forage, and industrial crops.

Cluster 2: A success factor for the agricultural sector could be repr esented by an improvement in production and competitiveness in Mediterranean production.

Cluster 3: Should seek to exploit its potential in fruit and viticulture.

Cluster 5: Strongly characterized by continental productions, a potential change in pr oduction would most likely take place in cereals or industrial crops.

Cluster 7: mountain and hill regions should focus on forage or on the specific quality of products.
Cluster 8: Given the strong competition in terms of continental productions, could orient it self towards Mediterranean products.
Cluster 10: Connected to livestock (although less than cluster 1), could benefit from or ienting itself towards industrial cultivations.

Scenario 3: The Rural Context

The reduction of the regional disparities represents one of the main objectives of the European Union. Over the years, at a socio-economic level, different lines of intervention have been established aimed at the helping the regions with a low level of wealth approach the levels of the more wealthy regions. One tool for intervention is represented in rural development policies. The objectives of these policies are the improvement of competitiveness in the agricultural sector, valorisation and economic development of the rural areas. In scenario 3, we put variables at the basis of rural development policies (GDP, agricultural workers, UAA per farm, farms run by old farmers), to identify the sensitivity of clusters in regards to each of the considered variables. We focused the attention not only on the agricultural employees, but also on the industrial and tertiary employees, through the analysis of two sub-scenarios. In facts the development of the rural areas means to try to valorise the agricultural sector, making its competitive; however the relevance of the agricultural employees is high, so it could be useful to turn a part of these to the other economic sectors that are more considerable at economic level.

First of all, we underline that the analysis of the variables about the GDP, UAA and farms holders are the same for both scenarios.

If the per-capita GDP variable is analyzed, one can see a possible increase tied to interventions aimed towards an economic boost, would favour the regions with levels already high (represented by clusters 8 and 1) while it would not have the same effects on regions with low levels of economic development and structural problems (clusters 5 and 2). This could create a risk of increasing inequalities between regions (figure 4.12).

In regards to the average UAA, a variation would be well accepted by cluster 5, which already has large scale farm structures and is specialized in continental productions. A better use of the UAA, maybe geared towards potentially more profitable productions, could represent an economic growth for these regions (figure 4.13).

A development of the industrial sector could be positive for most of the clusters. Cluster 5 and 10 might benefit less, because they currently are not characterised by high industrial employees' level with respect to the other clusters. It is interesting to observe that this hypothesis could be

represent one solution for the initial development of the cluster 2, in which the agricultural employment plays an important role (figure 4.14).

An increase in the importance of the role of tertiary employment could be favourable to all the clusters, confirming the more ever relevant role that this sector could play in the economic development of the EU, particularly in the rural areas (figure 4.15). These r egions could use this opportunity for the valorisation and economic development of their areas.

Figure 4.12: Scenario 3 – The Rural Context (Change in cluster ranking with a change in weight of the per capita GDP variable)

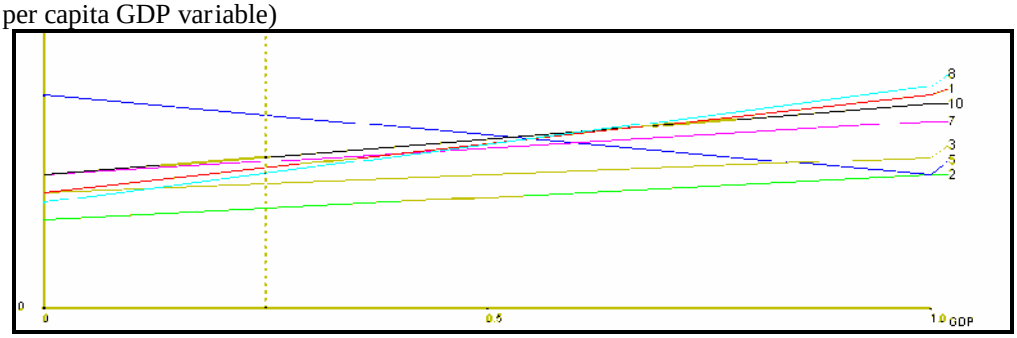
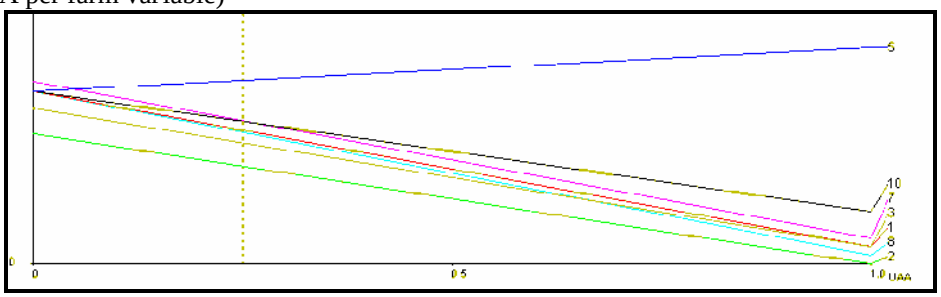


Figure 4.13: Scenario 3 – The Rural Context (Change in cluster ranking with a change in weight of the UAA per farm variable)



Finally, as for the variable tied to the percentage of farms with holders under 55, there are not differences from the first ranking. This confirms that the clusters that would o btain the most benefits are those with the higher percentages of young farmers. It should be emphasized, however, that the potential problem of generational change could be confronted in a better way if the threshold of age was moved to 60 years old or more. The analys is of this scenario highlights, how interventions at a rural level do not favour a single group of regions but are able to contribute to a promotion of rural areas present in all the regions although by different means. The importance of

this policy, if implemented correctly, could represent a compelling means to the promotion of the agricultural sector both at a competitive and structural level.

Figure 4.14: Sub - Scenario 3 (Industry) – The Rural Context (Change in cluster ranking with a change in weight of variable of the percentage of employees in industry)

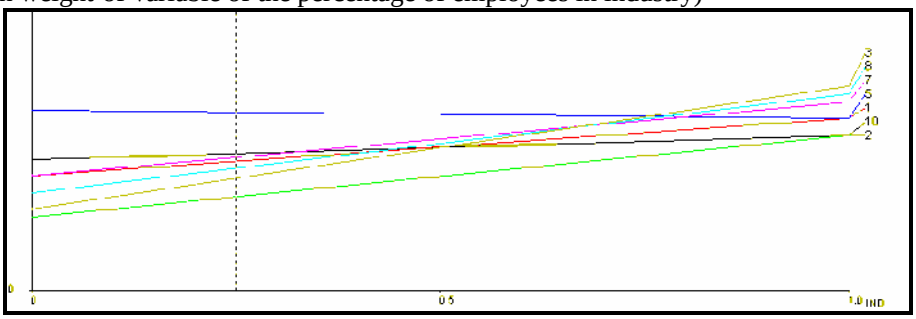


Figure 4.15: Sub - Scenario 3 (Tertiary) – The Rural Context (Change in cluster ranking with a change in weight of variable of the percentage of employees in tertiary)

In conclusion, the aim of this analysis was to verify possible elements that could contribute to development and the promotion of economies in the EU-15. The analysis was divided into 3 scenarios: the economic scenario, the agricultural scenario linked to production, and the agricultural scenario linked to rural development. Particular attention was put on the agricultural sector. Each group, and hence each region, demonstrates both strong and weak points. The objective therefore consists of trying to support the strong points and find solutions for problem areas (that are often linked to structural and socio-economic characteristics). Therefore, the objective of the European Union consists of providing to individual regions and to individual Member States, the necessary tools for the promotion and growth of their economies. Each region should seek to take these opportunities to improve its competitive position within the market. Since

the enlargement to 25 States (2004), this market has become the largest commercial area at the global level.

4.4 Sensitivity Analysis in the EU-25

4.4.1 Results of the multi-criteria analysis

Using the same methodology utilized for the analysis of the regions in the EU-15, we conducted a territorial analysis for the new EU-25 that grouped the community regions in 8 different clusters. As in table 4.6, the clusters are the following:

- *Territorial Systems with the highest levels of development (cluster 1)*.
- *Mediterranean Systems with a low level of development and with agriculture playing an important role (cluster 2)*.
- *Continental Systems with a high level of development and both intensive and extensive agriculture (cluster 4)*.
- *Systems in the NMS with large gaps in socio-economic development (cluster 5)*.
- *Mediterranean Systems in the NMS (Cluster 7)*.
- *Mediterranean Systems with an average level of development and intensive agriculture (cluster 9).*
- *Continental Systems with an average level of development and primarily extensive agriculture (cluster 11)*.
- *Systems with the highest gaps in development in the NMS (cluster 12)*.

Starting with these results, we decided to apply the MCA, the methodology that was introduced in par.4.2.1

The following scenarios were considered:

- *Scenario 1: The Socio-Economic Context*
- *Scenario 2: The Land Use*
- *Scenario 3: The Rural Context*

The considered scenarios were the same as in previous analyses; nevertheless, we were unable to use some of the variables because they were unavailable for all of the regions taken into

consideration. For each scenario, an evaluation matrix was created in which scores for the variables for each cluster were calculated. The criteria for the scores (from 8 to 1 point) was based on the value of the considered variable relative to each cluster.

For all of the variables, with the exception of the unemployment rate, the dependency ratio, and the percentage of uncultivated utilized agricultural area, the variables within the clusters were assigned scores starting with the highest value receiving the highest score (8) dropping until the lowest score (1) was given to the group with the lowest value. For the previously specified variables, the order was inverted. In the first scenario, the variable tied to population density was excluded since for Cluster 7 (Cyprus and Malta) the average value differed significantly from the other clusters. This difference is tied exclusively to the reduced frequency of this group with regards to the others.

The dominance analysis did not allow, for each scenario, rankings between the various alternatives. Therefore, taking into account the limited and discrete number of alternatives (8), the MAA was applied, based on the concept of expected subjective utility, with the aim of determining a function of utility consisting of the considered variables, that must be independent (according to the hypothesis).

The final ranking of Scenario 1 resembles the ranking associated to the GDP variable, even though the differences between the various clusters are minimal. In fact, the range of the scenario is equal to .05. As a result, the variations of the socio-economic variables could benefit the regions that have already achieved good economic levels, whereas they might not be enough for the clusters, located in the last places of the ranking, among which cluster 5 and cluster 12 include new regions (table 4.24).

Table 4.22: Scenario 1 – The Socio-Economic Context (Evaluation Matrix)

	Alternatives							
Attributes	**1**	**2**	**4**	**5**	**7**	**9**	**11**	**12**
Per capita GDP	8	4	7	2	3	5	6	1
Employment ratio	8	1	3	4	5	6	7	2
Unemployment ratio	8	2	3	4	7	5	6	1
Dependency ratio	3	2	4	8	5	6	2	7

This scenario groups the main agricultural variables that describe the various types of land use [8]. It will be interesting to observe what effects the entrance of new regions will have on the Community market. These new regions are characterized by important continental productions and livestock. It will also be interesting to see the effects on the market in light of the introduction of decoupled direct aid. The range of the scenario is equal to .13; this means that the different clusters are connected to these agricultural variables in a slightly different way. Occupying the first place is cluster 2, which includes primarily the Mediterranean areas where the agricultural sector takes on a significant value. In the final places, there are the areas with strong cereal productions that would therefore be less affected by interventions in sectors other than cereals.

Table 4.23: Scenario 1 - The Socio-Economic Context (Utility of Individual Attributes)

	Alternatives							
Attributes	**1**	**2**	**4**	**5**	**7**	**9**	**11**	**12**
Per capita GDP	1.00	0.71	0.94	0.51	0.70	0.77	0.93	0.38
Employment ratio	1.00	0.73	0.89	0.90	0.94	0.95	0.97	0.82
Unemployment ratio	1.00	0.41	0.56	0.62	0.85	0.70	0.75	0.25
Dependency ratio	0.90	0.86	0.91	1.00	0.91	0.92	0.81	0.97

Table 4.24: Scenario 1 - The Socio-Economic Context (Alternatives Ranking)

Weight	*Cluster*
0.15	1
0.13	11
0.13	7
0.13	9
0.13	4
0.12	5
0.11	2
0.10	12

The definition of the scenario 3 takes on the main themes faced by the rural development policies that are aimed at economic production of disadvantaged areas by means of their territorial improvement. Also in this case, two scenarios have been identified within the same scenario with particular attention put on the role of employment according to the economic sector under analysis. This is connected to the fact that rural areas are characterized by a significant share of agricultural employment and therefore their promotion should be connected to a major importance of the

[8] The attributers of this scenario are not independent; however the results have to be considered like possible indications.

employment in other sectors. Furthermore, the independent condition of the attributes that is at the basis of the performed analysis doesn't allow us to take into account the employment values in the three different sectors within the same scenario.

Table 4.25: Scenario 2 – The Land Use (Evaluation Matrix)

	Alternatives							
Attributes	**1**	**2**	**4**	**5**	**7**	**9**	**11**	**12**
% UAA under cereals	2	4	7	6	3	1	5	8
% UAA under vineyards	2	8	5	4	6	7	3	1
% UAA under permanent crops	2	8	4	5	7	6	1	4
% UAA under orchards	5	6	4	3	7	8	1	2
% UAA non cultivated	8	5	7	4	3	1	6	2

Table 4.26: Scenario 2 – The Land Use (Utility of Individual Attributes)

	Alternatives							
Attributes	**1**	**2**	**4**	**5**	**7**	**9**	**11**	**12**
% UAA under cereals	0.29	0.52	0.97	0.92	0.46	0.16	0.70	1.00
% UAA under vineyards	0.04	1.00	0.22	0.11	0.84	0.95	0.08	0.00
% UAA under permanent crops	0.01	1.00	0.06	0.11	0.86	0.16	0.00	0.06
% UAA under orchards	0.06	0.17	0.05	0.05	0.25	1.00	0.03	0.05
% UAA not cultivated	1.00	0.05	0.20	0.03	0.02	0.01	0.17	0.01

Table 4.27: Scenario 2 - The Land Use Context (Alternatives Ranking)

Weight	*Cluster*
0.20	2
0.18	7
0.17	9
0.11	4
0.10	1
0.09	5
0.08	12
0.07	11

The range of the sub-scenario (industry) came out reduced (.05), therefore all of the clusters could be affected by the potential variations of the predefined variables within the scenario. One can see that in the second and third places are groups compiled completely of new regions (mainly from Central and Eastern Europe) whereas cluster 1, which was already positioned in good economic standing is found amongst the last places (table 4.30).

If attention is geared towards those working in the service sector, the range passes to .12, remaining still at reduced levels (table 4.33). This ranking reflects the distinction at an economic level between the old and new regions in the E uropean Union; in fact, the last three places of the rankings consist of groups of new regions that demonstrate structural problems at the tertiary sector level and they therefore need interventions aimed at the relaunching of not only this level but also the entire economy.

Table 4.28: Sub-Scenario 3 (Industry) - The Rural Context (Evaluation Matrix)

	Alternatives							
Attributes	**1**	**2**	**4**	**5**	**7**	**9**	**11**	**12**
Per capita GDP	8	4	7	2	3	5	6	1
Employees in Industry (% total)	3	1	5	7	8	4	2	6
UAA	2	5	4	6	1	3	8	7

Table 4.29: Sub-Scenario 3 (Industry) - The Rural Context (Utility of Individual Attributes)

	Alternatives							
Attributes	**1**	**2**	**4**	**5**	**7**	**9**	**11**	**12**
Per capita GDP	1.00	0.71	0.94	0.51	0.70	0.77	0.93	0.38
Employees in Industry (% total)	0.44	0.38	0.48	0.85	1.00	0.45	0.38	0.72
UAA	0.17	0.56	0.38	0.56	0.06	0.33	1.00	0.85

Table 4.30: Sub-Scenario 3 (Industry) - The Rural Context (Alternatives Ranking)

Weight	*Cluster*
0.16	11
0.13	12
0.13	5
0.12	4
0.12	7
0.12	2
0.11	1
0.11	9

Table 4.31: Sub-Scenario 3 (Tertiary) - The Rural Context (Evaluation Matrix)

	Alternatives							
Attributes	**1**	**2**	**4**	**5**	**7**	**9**	**11**	**12**
Per capita GDP	8	4	7	2	3	5	6	1
Employees in Tertiary (% total)	7	6	5	3	2	4	8	1
UAA	2	5	4	6	1	3	8	7

Table 4.32: Sub-Scenario 3 (Tertiary) - The Rural Context (Utility of Individual Attributes)

	Alternatives							
Attributes	**1**	**2**	**4**	**5**	**7**	**9**	**11**	**12**
Per capita GDP	1.00	0.71	0.94	0.51	0.70	0.77	0.93	0.38
Employees in Tertiary (% total)	0.95	0.93	0.91	0.50	0.38	0.90	1.00	0.38
UAA per farm	0.17	0.56	0.38	0.56	0.06	0.33	1.00	0.85

Table 4.33: Sub-Scenario 3 (Tertiary) - The Rural Context (Alternatives Ranking)

Weight	*Cluster*
0.19	11
0.14	4
0.14	2
0.13	1
0.13	9
0.10	12
0.10	5
0.07	7

4.4.2 Results of the Sensitivity Analysis

By means of the multi-criteria analysis (MCA), the clusters were classified in relation to each scenario defined thanks to the choice of previously established variables. The follo wing phase of the analysis will seek to evaluate the sensibility of each cluster to the possible effects of changes of the considered variables that could be tied to specific intervention choices made at the Community level. All of these considerations cou ld be valued through the results of the sensitivity analysis (SA). By applying such an analysis to the previously obtained results, it will be possible to analyze how the group rankings change (with a change of the variables within each cluster). In this w ay, it will be possible to provide an evaluation regarding the regions that could benefit or not from certain means of intervention.

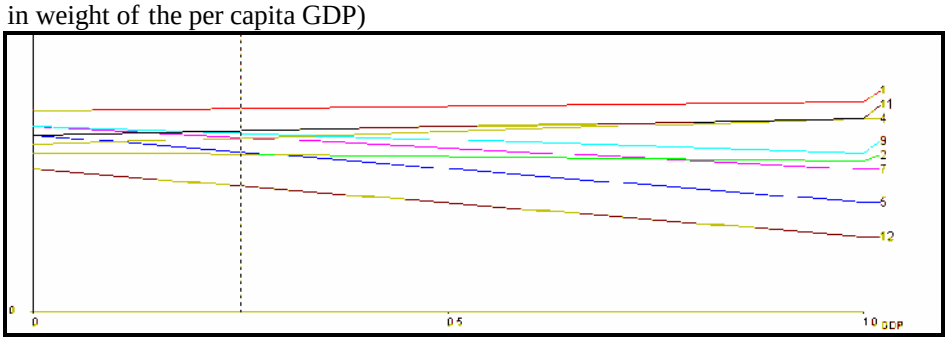
Scenario 1- The Socio-Economic Context

If we suppose to raise the level of GDP per capita as a possible consequence of interventions or specific decision, the regions that will benefit most would be those that already have high levels of GDP per capita. Whereas, in the regions with lower levels of GDP per capita there would be smaller advantages. In particular, the new reg ions (cluster 7, 5, and 12) that already demonstrate

significant economic gaps with respect to the already present Community regions (fig.4.16). From this emerges the need for interventions aimed not only at an economic level, but also at a structural level in order to attempt to reduce the strong inequalities between old and new regions.

A possible intervention at the structural level could be represented by measures or decisions aimed at increasing the employment rate with a resulting reduction of the un employment rate in the medium and long term. Assuming we want to increase in the employment rate, all of the clusters would benefit, even those including the new regions (5, 7, and 12). Cluster 2 will benefit less significantly, and should aim to give valu e to its territory and to the growth of the competitive edge, by means of an improvement to the employment in the other sectors (figure 4.17).

Fig. 4.16: Scenario 1 - The Socio-Economic Context (Change in the Cluster Ranking due to the change in weight of the per capita GDP)



Scenario 2: The Land Use

The considered variables in this scenario pertain to the various forms of land use. With the introduction of the new systems of direct aid in agriculture, decoupling from production, the choice of a certain type of production could be a success factor for the competitive improvement of the sector. Only variables tied to crop production were considered, since for the most part of these, this new form of economic subsidy was applied completely. The introduction of decoupling in the livestock sector was only partial.

Agricultural production increasingly shifted towards cereals farming would be welcomed by clusters 4 and 11, both of which include old community regions with high production levels, as well as by clusters 5 and 12, which include the already mentioned new regions mainly in Central and Eastern Europe (figure 4.18). It is therefore obvious how the grains market could feel the effects of the Eastern enlargement, seeing that farms already present in the s ector should confront a decisively more competitive market, strongly linked to a productive potential, united to production costs lower than those in the new regions.

Figure 4.17: Scenario 1 - The Socio-Economic Context (Change in the Cluster ranking from a change in weight of the employment rate variable)

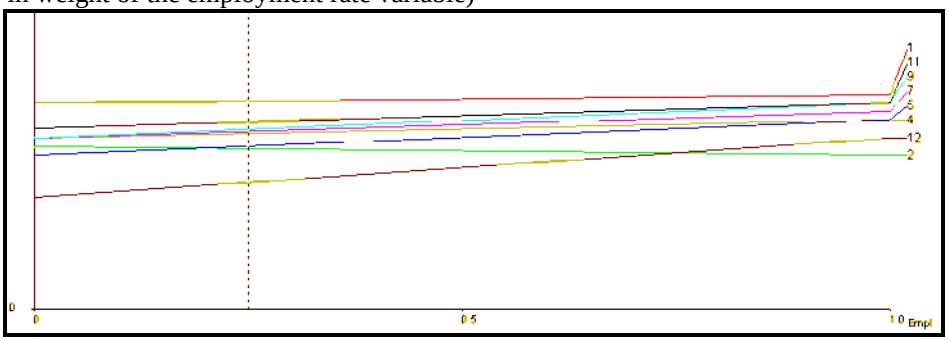
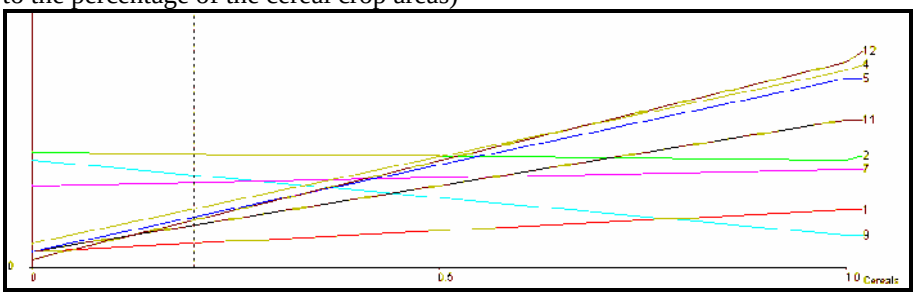


Figure 4.18: Scenario 2 – The Land Use (Change in ranking of cluster to change of weight of variable to the percentage of the cereal crop areas)



A possible increase in the areas for vineyard could benefit clusters 2, 9, and 7, all of which have significant values associated with this type of land use, especially clusters 2 and 9. Other clusters, oriented towards other farm products, would have smaller effects (figure 4.19).

Cluster 2 is the only cluster that could gain particular advantage from an increase of the areas reserved for permanent crop production, not including fruit production. This cluster is comprised of main Mediterranean regions of Italy, Spain, and Greece already strongly oriented to wards this type of production. For all other clusters, no explicit benefits are foreseen based on a choice oriented in this direction (figure 4.20).

If one considers fruit production in relation to a possible increase in areas, the cluster that would benefit most would be cluster 9, already inclined towards this type of land use (figure 4.21). Cluster 2 would also profit in a smaller way. The regions in the subgroup should aim at a productivity improvement in that production level is already high.

In conclusion, one can see how the new regions are characterized by a strong productive potential in regards to continental productions, especially cereals. If, on the one hand, the cereal market could represent an opportunity of growth for these regions; on the other, it could forecast

problems for producers already present in the Community market that should face a higher competition connected to a large productive potential and on reduced economic costs. According to the first implications from the introduction of decoupling, significant changes should not be expected in terms of the type of production as regarding the regions already present in the European Union.

Figure 4.19: Scenario 2 – The Land Use (Change in cluster ranking with a change in the weight of the variable of the percentage of vineyard areas)

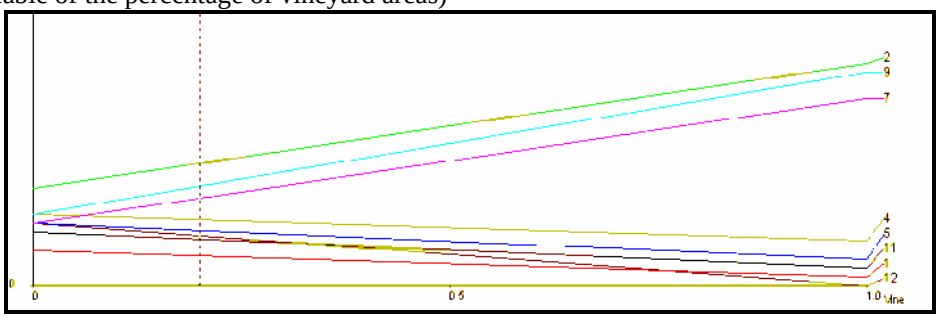


Figure 4.20: Scenario 2 - The Land Use (Change in cluster ranking with a change in the variable of the percentage of areas of permanent crops - not including fruits)

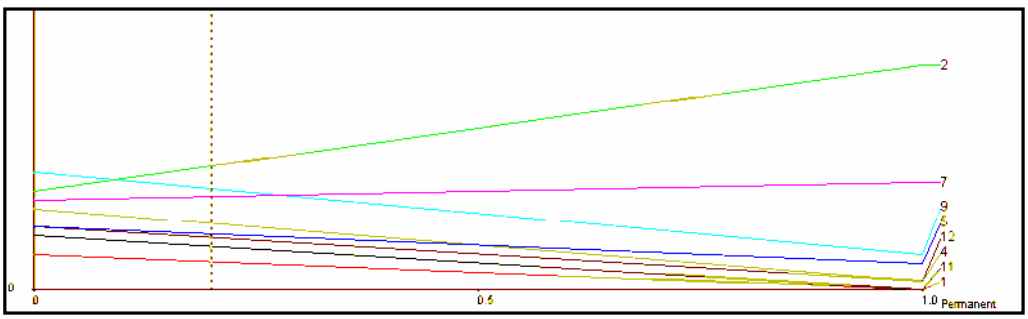
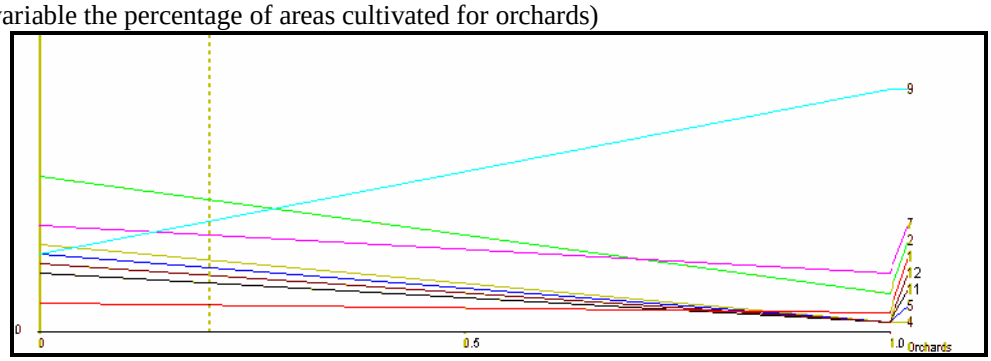


Figure 4.21: Scenario 2 – The Land Use (Change in cluster ranking with a change in the weight of the variable the percentage of areas cultivated for orchards)



Scenario 3 - The Rural Context

The reduction of the regional disparities represents one of the objectives always of high importance in the EU, especially since the enlargement including the 10 New Member States (2004). Over the years, socio-economic lines of intervention were defined aimed at promoting the regions with a low level of wealth, in the attempt to bring them closer to the richer regions. One intervention tool is represented by the rural development policy, whose objectives are the improvement of competitiveness of the agricultural sector, the valorization and promotion of rural zones. In the scenario 3, variables at the base of the rural development policy were inserted (GDP, employees in agriculture, UAA) in order to successfully identify the different sensitivities of the various clusters with respect to each of the considered variables.

Particular attention was given not only to agricultural workers, but also to those employed in the industrial and service sectors with the consequent definition of the 2 sub-scenarios. In fact, the economic development of the rural areas consists in seeking to promote the agricultural sector, making it competitive. Nevertheless, employees in the agricultural sector are very important in these areas, therefore it would be appropriate to send some of these workers also towards other sectors, that would have a decisively more important role that the agricultural sector when examined from an economic point of view.

We must preface that the comments relating to variables linked to the GDP and UAA are the same for both of the considered sub-scenarios.

If one imagines an increase in the level of GDP per capita, the regions that would benefit most profoundly would be those regions with the highest levels of GDP, whereas the regions that already demonstrate economic problems, that is to say the new regions (clusters 5, 7, and 12), would not have the same benefits with a consequential risk of an increase of the regional economic inequalities within the European Union (figure 4.22).

If we consider the UAA, an increase should favour clusters 11 and 12, that already have high values with a strong specialization in continental productions. A better use of the UAA, geared towards the improvement of productivity, could represent a growth opportunity for these regions, especially for cluster 12, which includes Polish and Slovenian regions (figure 4.23) .

A hypothetical development of employment in the industrial sector could be well-understood by the clusters in which lie new regions (5, 7,12). One must recall that in these regions, firms that had been formerly controlled by the state closed down with the fall of the Communist regimes. As a result, the unemployment rate in the industrial sector increased. Consequently, necessary

interventions should be aimed at promoting the industrial sector both in regards to productivity and employment (figure 4.24).

Figure 4.22: Scenario 3 – The Rural Context (Change in cluster ranking with a change in weight of the per capita GDP variable)

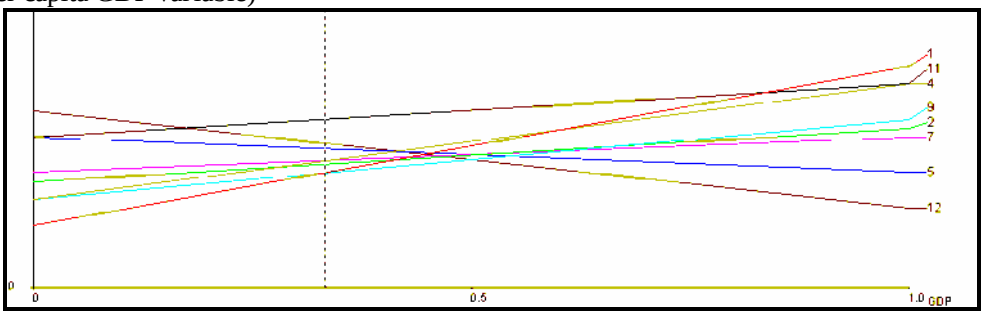
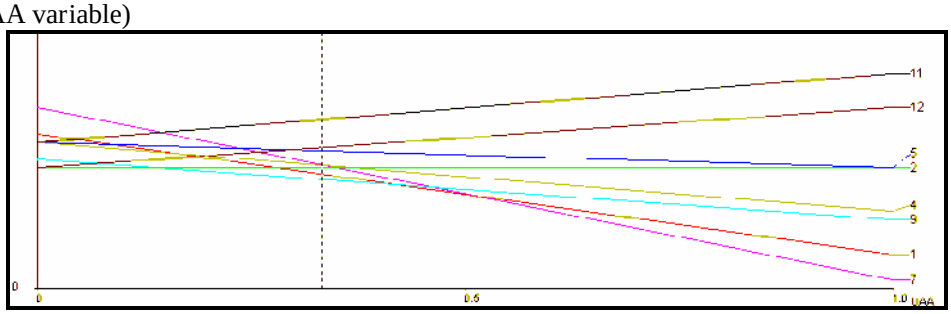


Figure 4.23: Scenario 3 – The Rural Context (Change in cluster ranking with a change in weight of the UAA variable)



On the other hand, a hypothetical development of employment in the service sector could bring about significant advantages in the clusters consisting of old regions, that could use the development of this sector to favour their own economic growth, while in the new regions it might be necessary first to concentrate on the socio-economic structural problems, whose resolution should contribute to the reduction of the gap with other regions (figure 4.25).

To conclude, we can say that this analysis has demonstrated an EU at two different levels; from one side, the regions already present and on the other, the new regions. The strong differences between the old and the new regions, important at a socio-economic level, renders the process of integration complex and difficult implementation, in light of the problems that could emerge, with specific reference to the economic and social spheres. It should not be forgotten, however, how this process of inclusion, although far from easy, is extremely important to the aim of reinforcing the position of the EU at a global level and how therefore it is important to make this process take place in the best possible way.

Figure 4.24: Sub - Scenario 3 (Industry) – The Rural Context (Change in cluster ranking with a change in weight of variable of the percentage of employees in industry)

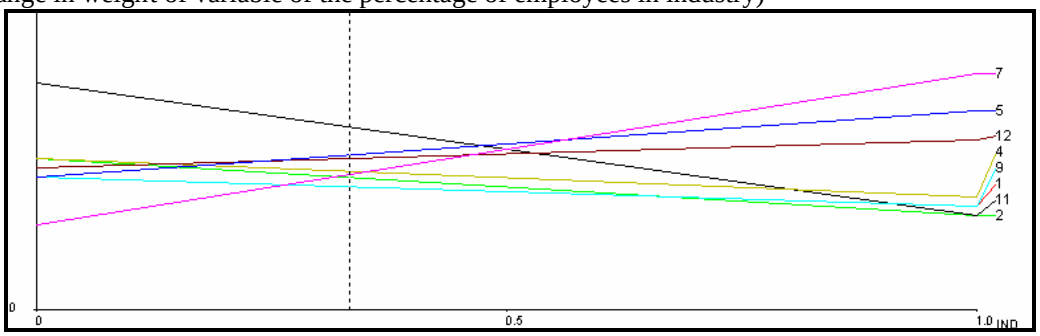
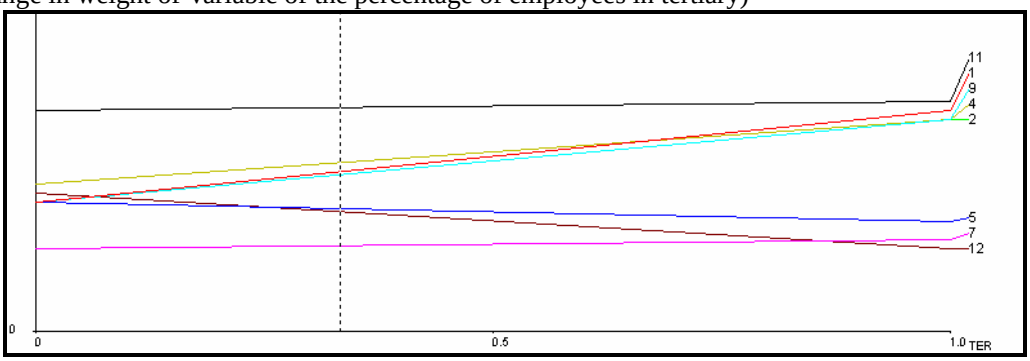


Figure 4.25: Sub - Scenario 3 (Tertiary) – The Rural Context (Change in cluster ranking with a change in weight of variable of the percentage of employees in tertiary)



Chapter V
Agricultural productivity between decoupling and the socio-economic context in the EU regions: a spatial approach

5.1 Introduction

The analysis developed in the previous chapters has highlighted the relationships between the regional agricultural and socio-economic systems in the EU-15 emphasising their possible change as a consequence of decoupling. The results have underlined the need for assessing the impact of decoupling on the agricultural sector in light of the interaction between the direct payments and the socio-economic variables sensitive to the measure. Some of these variables deserve special attention as objectives of the recently defined cross-compliance, modulation and rural development interventions. They should be affected not only by decoupling but a lso by specific policy measures making the understanding of each impact difficult to be evaluated separately. On the other side, these variables are of significant importance for the new Member States where rural development represents the main financial channel for agricultural support. This leads to another important policy issue that concerns the different impact of the socio-economic variables on the sector.

Furthermore, the analysis in the previous chapters has underlined that decoupling seems to affect agricultural and socio-economic systems only in relatively restricted geographic areas. Thus, the estimation of the different impact intensity exerted on the agricultural sector by the policy sensitive socio-economic variables in combination with decou pling becomes important. It can provide a significant contribution to the explanation of the achieved results.

Another aspect highlighted in the previous analysis concerns the need for territorial interventions in order to promote local factors of agricul tural development. In this context, the understanding of the existence of different regional models that influence the agricultural productivity has a key relevance from a policy point of view.

A final relevant issue concerns the influence of the neighbou ring observations. This is an important but understudied area in empirical literature. Regions are not “isolated islands”; spatial

patterns, associations and heterogeneity should affect, at time also strongly, the relationships at the regional level.

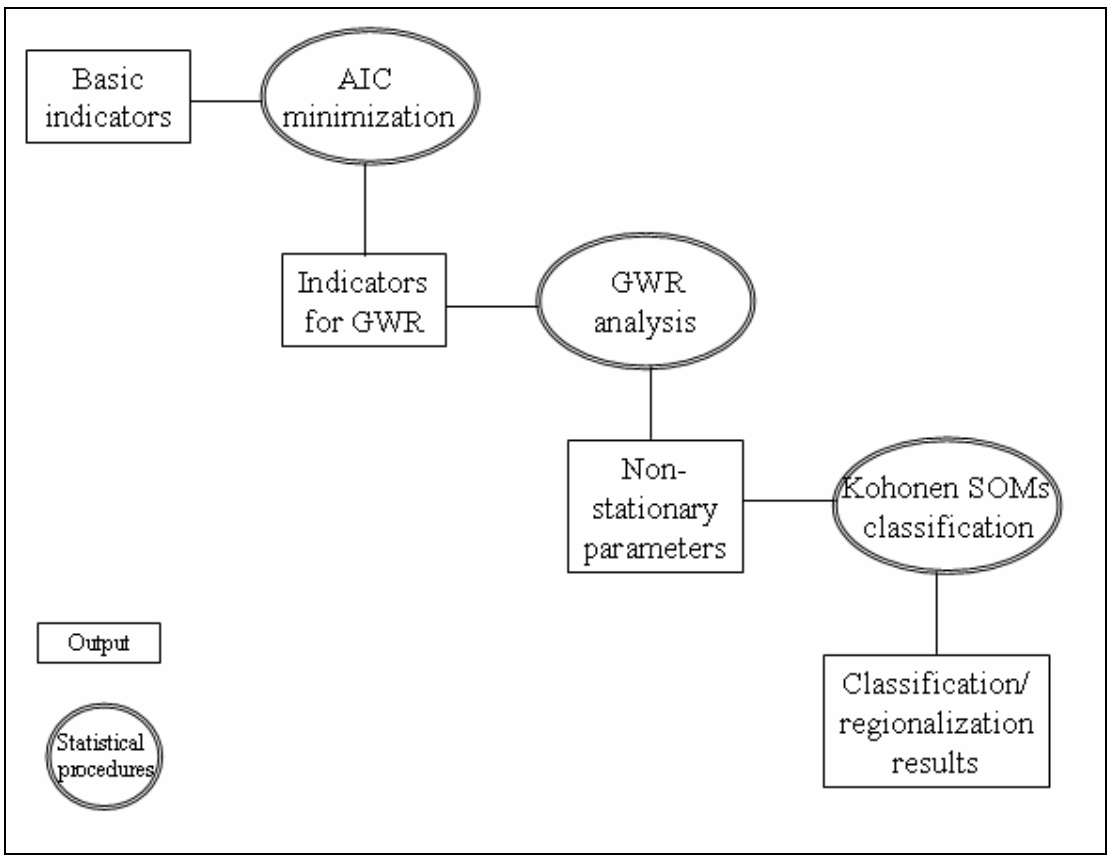
The Chapter faces these issues. More precisely, it is aimed at:

- Identifying, by a Geographically Weighted Regression (GWR) 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. In other words, this part of the analysis verifies if the regional impact of the parameters' values is combined with their spatial proximity.

This is of special importance within the current debate focused on the suitability of local vs. homogeneous interventions for the European territories. In fact, the study provides useful insight s for territorial and decentralised intervention policymaking aimed at agricultural and rural development. The analysis refers to both the EU -15 and the EU-25 regions.

Figure 5.1: Data processing chain



The first step in the analysis is the indicators selection. The previous chapters have pointed out the relevant agricultural and socio-economic areas affected by decoupling and the analysis of the key component of the CAP and Rural Development Policy reform, briefly illustrated in Section 5.2, has underlined those that are also objectives of specific policy interventions.

The number of variables adopted has been limited by the Geographical Weighted Regression (GWR) requirements. For this reason, the data set presented in the previous chapters has been processed in order to determine a set of synthetic indicators suitable to express the specified areas. Furthermore, the possible collinearity among variables has been faced by the AIC minimization that has allowed the exclusion of one of the correlated variable and, when possible, its substitution with an uncorrelated one.

The indicators adopted are discussed shortly in Section 5.3.

Afterwards, a GWR model has been defined according to the methodology presented in Section 5.4.1 and 5.4.2. The results, illustrated in Section 5.5.1, 5.5.2, 5.5.3 and 5.5.4, has pointed out the non-stationary parameters. They have been the inputs for the cluster analysis presented in Section 5.5.5, and carried out according to Kohonen Self-Organizing Maps approach illustrated in Section 5.4.3.

5.2 Agricultural and socio-economic characters sensitive to the CAP and the rural development policy

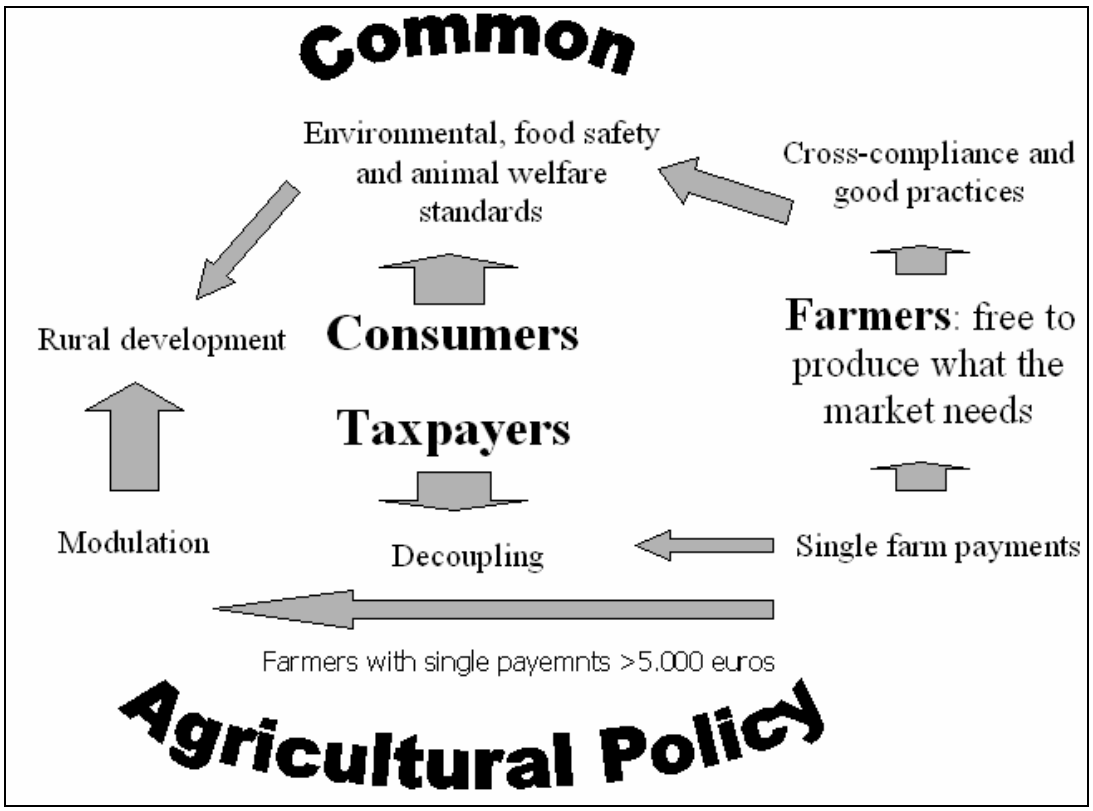
As mentioned in the Introduction, the selection of the indicators has taken into account the key components of the CAP reform of 2003 and 2004 and the reform of the Rural Development Policy for the programming period 2007-2013 in order to understand the socio-economic variables affected not only by decoupling but also by specific agricultural and rural interventions.

The CAP reform has represented an important step in the shift from price support to direct income support as delineated in the strategic document Agenda 2000 and according to the objectives of the Göteberg sustainability goals and the Lisbon Strategy for growth and jobs (European Commission, 2004; European Commission, 2005a, 2005b, 2005c, 2005d).

The main aim of the CAP reform has been decoupling in combination with the strengthening of the rural interventions. Consumers and taxpayers have a central role in the new agricultural policy, while farmers are free to produce according to the market signals generated by consumers demand rather than by quantity-related policy incentives (Figure 5.1). With the possibility for farmers to receive subsidies only if they are independent from the volume of production, the reform has

introduced the principle of decoupling according to which policies reduce their interference with production decisions. This implies the need for a competitive sector able to face the market challenges (European Commission, 2001, 2002a).

Figure 5.2: The CAP architecture



Source: from Sassi, 2006

Through "cross-compliance" the Member States have the possibility to maintain the link between production and subsidies only in order to prevent the abandonment of production. Furthermore, the "single farm payments" should be conditional to the achievement of specific targets that satisfy specific consumers' interests in terms of environmental, food safety and animal welfare standards. According to "modulation", a reduction in direct payments for bigger farmers, more money is available to farmers for rural development programs.

In other words, "cross-compliance" and "modulation" have reinforced the key pillar of the CAP that is the Rural Development Policy reinforcing, at the same time, consumer confidence and the environmental sustainability of farming.

Table 5.1: Axes, measures and sub-measures according to the Council Regulation (EC) n. 1698/2005

AXES	MEASURES	SUBMEASURES
Axis 1 – Improving the competitiveness of the agricultural and forestry sector	(a) measures aimed at promoting knowledge and improving human potential	(i) vocational training and information actions, including diffusion of scientific knowledge and innovative practices, for persons engaged in the agricultural, food and forestry sector (ii) setting up young farmers (iii) early retirement of farmers and farm workers (iv) use of advisory services by farmers and forest holders; (v) setting up farm management, farm relief and farm advisory services, as well as forestry advisory services;
	(b) measures aimed at restructuring and developing physical potential and promoting innovation	(i) modernization of agricultural holdings; (ii) improving the economic value of forests; (iii) adding value to agricultural and forestry products (iv) cooperation for development of new products, processes and technologies in the agriculture and food sector and in the forestry sector; (v) improving and developing infrastructure related to the development and adaptation of agriculture and forestry (vi) restoring agricultural production potential damaged by natural disasters and introducing appropriate prevention actions
	(c) measures aimed at improving the quality of agricultural production and products	(i) helping farmers to adapt to demanding standards based on Community legislation (ii) supporting farmers who participate in food quality schemes (iii) supporting producer groups for information and promotion activities for products under food quality schemes
	(d) transitional measures for the Czech Republic, Estonia, Cyprus, Lithuania, Hungary, Malta, Poland, Slovenia, and Slovakia	(i) supporting semi-subsistence agricultural holdings undergoing restructuring (ii) supporting setting up of producer groups
Axis 2 - Improving the environment and the countryside	(a) measures targeting the sustainable use of agricultural land	(i) natural handicap payments to farmers in mountain areas (ii) payments to farmers in areas with handicaps, other than mountain areas (iii) Natura 2000 payments and payments linked to Directive 2000/60/EC (iv) agri-environment payments (v) animal welfare payments (vi) support for non-productive investments
	(b) measures targeting the sustainable use of forestry land	(i) first afforestation of agricultural land (ii) first establishment of agroforestry systems on agricultural land (iii) first afforrestation of non-agricultural land (iv) Natura 2000 payments (v) forest environment payments (vi) restoring forestry potential and introducing prevention actions (vii) support for non-productive investments
Axis 3 - The quality of life in rural areas and diversification of the rural economy	(a) measures to diversify the rural economy	(i) diversification into non-agricultural activities (ii) support for the creation and development of micro-enterprises with a view to promoting entrepreneurship and developing the economic fabric (iii) encouragement of tourism activities
	(c) a training and information measure for economic actors operating in the fields covered by axis 3 (d) a skills-acquisition and animation measure with a view to preparing and implementing a local development strategy	
Axis 4: Leader	(a) implementing local development strategies as referred to in Article 62(1)(a), with a view to achieving the objectives of one or more of the three other axes defined in Sections 1, 2, and 3 (b) implementing cooperation projects involving the objectives selected under point (a) (c) running the local action group, acquiring skills and animating the territory as referred to in Article 59	

Table 5.2: Objectives, Priorities and Key Actions according to the Council Decision 2006/144/EC

Specific objective	Priorities	KEY ACTIONS
Improving the competitiveness of the agricultural and forestry sector	- Knowledge transfer, modernisation, innovation and quality in the food chain - Investment in physical and human capital	(i) Restructuring and modernisation of the agricultural sector (ii) Improving integration in the agrifood chain (iii) Facilitating innovation and access to research and development (iv) Encouraging the take-up and diffusion of information and communications technologies (v) Fostering dynamic entrepreneurship (vi) Developing new outlets for agricultural and forestry products (vii) Improving the environmental performance of farms and forestry
Improving the environment and the countryside	- Biodiversity and the preservation and development of high nature value farming and forestry systems and traditional agricultural landscape - Water - Climate change	(i) Promoting environmental services and animal-friendly farming practices (ii) Preserving the farmed landscape and forests (iii) Combating climate change (iv) Consolidating the contribution of organic farming (v) Encouraging environmental/economic win-win initiatives (vi) Promoting territorial balance
Improving the quality of life and encouraging diversification of the rural areas	Creation of employment opportunities and conditions for growth	(i) Raising of economic activity and employment rates in the wider rural economy (ii) Encouraging the entry of women into the labour market (iii) putting the heart back into the villages (iv) developing micro-business (v) training young people in skills neede for the diversification of the loca economy (vi) Encouraging the take-up and diffusion of ITC (vii) Developing the provision and innovative use of renewable energy sources (vii) Encouraging the development of tourism (viii) Upgrading local infrastructure
Building local capacity for employment and diversification	- Improving governance; - Mobilising the endogenous development potential of rural areas	(i) Building local partnership capacity (ii) Promoting private-public partnership (iii) Promoting cooperation and innovation (iv) Improving local governance

At the same time, the EU enlargement to 10 new Member States, the budget implications for cohesion and rural development and the need for simplification, resources concentration and decentralization have strongly influenced the reform of the policy for the rural areas (European Commission, 2005e).

In 2005, the Council Ministers adopted a Rural Development regulation for the period 2007-2013 based on the principle of "one programme, one fund" and that have introduced three economic, environmental and territorial objectives:

- Improving the competitiveness of agriculture and forestry;
- Improving the environment and country-side;

- Improving the quality of life in rural areas and encouraging diversification of economic activity.

According to the Reg. (EC) n. 1698/2005, four axes should implement these objectives and for each of them specific measures and operations have been defined (Table 5.1).

In 2006, the European Council has set out the strategic guidelines for rural development programming period 2007-2013 in order to identify the major priorities for the Community and to promote their integration. Table 5.2 illustrates priorities, strategic guidelines and examples of key actions as presented in the Council Decision of 20 February 2006 (2006/144/EC). They represent the reference for Member States during the preparation of the National Strategy Plan an the Rural Development Programmes.

The reform of the Rural Development Policy can provide an important contribution to the improvement of the European agriculture competitiveness encouraging structural adjustment and modernization and, on the same time, to growth, employment and sustainability in the rural areas that are the socio-economic dimension that in the previous chapters have resulted directly affected by decoupling.

5.3 Indicators

Table 5.3 illustrates the indicator selected, a short description and the reference source.

Important data issues need to be mentioned because they have strongly constrained the analysis. First, there is a lacking geographical breakdown. At NUTS2 level important aspects cannot be quantified at all or even with proxy. Among them there are agricultural production quality, capital and integration with the food chain, land and water quality, environmental services, diversification in non agricultural activities and infrastructure. The issue has also affected the selection of the dependent variable. The agricultural labour productivity, in terms of agricultural working units, is not available for a large number of regions. Thus, the analysis has made reference to the farm net value added per UAA.

The lacking geographical breakdown has another effect on the regions in the sample that not always are at NUTS2 level but at NUTS1 introducing certain distortion in the analysis due to the different structure of the territorial units (Table 5.4). For the same reason the sample adopted differs slightly form that of the previous analysis.

Table 5.3: 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		
Popden	Population density	REGIO	2002
Ageing	Ageing index	REGIO	1998-2001
Ho3555	Age Structure in Agriculture ratio: farmers <35 / >= 55 years old (%)	REGIO	2003
Learru	Life-Long Learning in Rural Areas: % of 25_64 y.o. participating in education and training	REGIO	2004
Ho5005	Physical Farm Size Distribution ratio of holdings <= 50 / >= 5 ha UAA (Portugal <=40 UDE/<=8 UDE) (%)	REGIO	2003
Insepa	Agriculture inseparable output/ Agriculture total output (%)	REGIO	2000-2002
Othgai	Farmers with Other Gainful Activities: % holders with other gainful activity(%)	REGIO	2003
Compay	Compensatory payments / UAA (€/UAA)	FADN	2000-2002
Setpre	Set aside premiums / UAA (€/UAA)	FADN	2000-2002
Subliv	Total livestock subsidies / UAA (€/UAA)	FADN	2000-2002
Totsub	Total subsidies / UAA (€/UAA)	FADN	2000-2002
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
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
Gdpind	Economic Development GDP(in pps)/capita (index EU-25=100)	REGIO	2000-2002
Unempr	Unemployment rate (% active population)	REGIO	2004
Empper	Employment Rate Employed persons/total population (15_64 y.o.) (%)	REGIO	2004
Eduter	Students ISCED levels 5 and 6 / Total students (<= 29 y.o.) (%)	REGIO	2000-2002
Emprur	Employment in PR and IR rural areas (=ER) / Mean (ER)	REGIO	2002
Berupo	Tourism Infrastructure in Rural Areas: Total bed places / Total population	EUROSTAT	2004
Empagp	Employment in primary sector / Total employment (%)	REGIO	2001,2002
Pubtot	Employment in public sector / Total employment (%)	REGIO	2000-2002
Female	Female unemployment ratio (%)	REGIO	2003
Netmig	Net migration rate (%)	REGIO	2001,2002,2003
Selfsh	Self-employment / Total employment (%)	REGIO	2004
Knoint	Total knowledge-intensive services (% total employment)	REGIO	2000-2002
Mhtech	High and medium high technology manufacturing sector (as % total employment)	REGIO	2000-2002
Ipcagr	IPC agriculture / IPC total (%)	REGIO	2000-2002
Veipop	Vehicles / Total population(Vehicles per capita)	REGIO	2000-2002

Another weakness concerns the policy intervention particularly in the new Member States and that has implied to limit the analysis only to the subsidies paid to the EU-15 farmers.

Table 5.4: The sample

NUTS code	Label	NUTS code	Label
at11	BURGENLAND	gr11	ANATOLIKI MAKEDONIA, THRAKI
at12	NIEDERÖSTERREICH	gr12	KENTRIKI MAKEDONIA
at21	KÄRNTEN	gr13	DYTIKI MAKEDONIA
at22	STEIERMARK	gr14	THESSALIA
at31	OBERÖSTERREICH	gr21	IPEIROS
at32	SALZBURG	gr22	IONIA NISIA
at33	TIROL	gr23	DYTIKI ELLADA
at34	VORARLBERG	gr24	STEREA ELLADA
be21	PROV. ANTWERPEN	gr25	PELOPONNISOS
be22	PROV. LIMBURG (B)	gr30	ATTIKI
be23	PROV. OOST-VLAANDEREN	gr41	VOREIO AIGAIO
be24	PROV. VLAAMS BRABANT	gr42	NOTIO AIGAIO
be25	PROV. WEST-VLAANDEREN	gr43	KRITI
be31	PROV. BRABANT WALLON	hu10	KÖZÉP-MAGYARORSZÁG
be32	PROV. HAINAUT	hu21	KÖZÉP-DUNÁNTÚL
be33	PROV. LIÈGE	hu22	NYUGAT-DUNÁNTÚL
be34	PROV. LUXEMBOURG (B)	hu23	DÉL-DUNÁNTÚL
be35	PROV. NAMUR	hu31	ÉSZAK-MAGYARORSZÁG
cy00	CYPRUS	hu32	ÉSZAK-ALFÖLD
cz01	PRAHA	hu33	DÉL-ALFÖLD
cz02	STREDNÍ CECHY	ie0	IRELAND
cz03	JIHOZÁPAD	itc1	PIEMONTE
cz04	SEVEROZÁPAD	itc2	VALLE D'AOSTA/VALLÉE D'AOSTE
cz05	SEVEROVÝCHOD	itc3	LIGURIA
cz06	JIHOVÝCHOD	itc4	LOMBARDIA
cz07	STREDNÍ MORAVA	itd1	PROVINCIA AUTONOMA BOLZANO -BOZEN
cz08	MORAVSKOSLEZKO	itd2	PROVINCIA AUTONOMA TRENTO
de11	STUTTGART	itd3	VENETO
de12	KARLSRUHE	itd4	FRIULI-VENEZIA GIULIA
de13	FREIBURG	itd5	EMILIA-ROMAGNA
de14	TÜBINGEN	ite1	TOSCANA
de21	OBERBAYERN	ite2	UMBRIA
de22	NIEDERBAYERN	ite3	MARCHE
de23	OBERPFALZ	ite4	LAZIO
de24	OBERFRANKEN	itf1	ABRUZZO
de25	MITTELFRANKEN	itf2	MOLISE
de26	UNTERFRANKEN	itf3	CAMPANIA
de27	SCHWABEN	itf4	PUGLIA
de40	BRADENBURG	itf5	BASILICATA
de71	DARMSTADT	itf6	CALABRIA
de72	GIEßEN	itg1	SICILIA
de73	KASSEL	itg2	SARDEGNA
de80	MECKLENBURG-VORPOMMERN	lt00	LITHUANIA
de91	BRAUNSCHWEIG	lv00	LATVIA
de92	HANNOVER	mt00	MALTA
de93	LÜNEBURG	nl11	GRONINGEN
de94	WESER-EMS	nl12	FRIESLAND
dea1	DÜSSELDORF	nl13	DRENTHE

Table continues

Table 5.4: (continued)

NUTS code	Label	NUTS code	Label
dea2	KÖLN	nl21	OVERIJSSEL
dea3	MÜNSTER	nl22	GELDERLAND
dea4	DETMOLD	nl23	FLEVOLAND
dea5	ARNSBERG	nl31	UTRECHT
deb1	KOBLENZ	nl32	NOORD-HOLLAND
deb2	TRIER	nl33	ZUID-HOLLAND
deb3	RHEINHESSEN-PFALZ	nl34	ZEELAND
dec	SAARLAND	nl41	NOORD-BRABANT
ded0	SACHSEN	nl42	LIMBURG (NL)
dee1	DESSAU	pl11	LÓDZKIE
dee2	HALLE	pl12	MAZOWIECKIE
dee3	MAGDEBURG	pl21	MALOPOLSKIE
def0	SCHLESWIG-HOLSTEIN	pl22	SLASKIE
deg0	THÜRINGEN	pl31	LUBELSKIE
dk00	DENMARK	pl32	PODKARPACKIE
ee00	ESTONIA	pl33	SWIETOKRZYSKIE
es11	GALICIA	pl34	PODLASKIE
es12	PRINCIPADO DE ASTURIAS	pl41	WIELKOPOLSKIE
es13	CANTABRIA	pl42	ZACHODNIOPOMORSKIE
es21	PAIS VASCO	pl43	LUBUSKIE
es22	COMUNIDAD FORAL DE NAVARRA	pl51	DOLNOSLASKIE
es23	LA RIOJA	pl52	OPOLSKIE
es24	ARAGÓN	pl61	KUJAWSKO-POMORSKIE
es30	COMUNIDAD DE MADRID	pl62	WARMINSKO-MAZURSKIE
es41	CASTILLA Y LEÓN	pl63	POMORSKIE
es42	CASTILLA-LA MANCHA	pt11	NORTE
es43	EXTREMADURA	pt15	ALGARVE
es51	CATALUÑA	pt16	CENTRO (PT)
es52	COMUNIDAD VALENCIANA	pt17	LISBOA
es53	ILLES BALEARS	pt18	ALENTEJO
es61	ANDALUCIA	se01	STOCKHOLM
es62	REGIÓN DE MURCIA	se02	ÖSTRA MELLANSVERIGE
fi0	FINLAND	se04	SYDSVERIGE
fr10	ÎLE DE FRANCE	se06	NORRA MELLANSVERIGE
fr21	CHAMPAGNE-ARDENNE	se07	MELLERSTA NORRLAND
fr22	PICARDIE	se08	ÖVRE NORRLAND
fr23	HAUTE-NORMANDIE	se09	SMÅLAND MED ÖARNA
fr24	CENTRE	se0a	VÄSTSVERIGE
fr25	BASSE-NORMANDIE	si00	SLOVENIA
fr26	BOURGOGNE	sk01	BRATISLAVSKÝ
fr30	NORD - PAS-DE-CALAIS	sk02	ZÁPADNÉ SLOVENSKO
fr41	LORRAINE	sk03	STREDNÉ SLOVENSKO
fr42	ALSACE	sk04	VÝCHODNÉ SLOVENSKO
fr43	FRANCHE-COMTÉ	ukc	NORTH-EAST
fr51	PAYS DE LA LOIRE	ukd	NORD WEST
fr52	BRETAGNE	uke	YORKSHIRE AND THE HUMBER
fr53	POITOU-CHARENTES	ukf	EAST MIDLANDS
fr61	AQUITAINE	ukg	WEST MIDLANDS

Table continues

Table 5.4: (continued)

NUTS code	Label	NUTS code	Label
fr62	MIDI-PYRÉNÉES	ukh	EAST OF ENGLAND
fr63	LIMOUSIN	ukj	SOUTH EAST
fr71	RHÔNE-ALPES	ukk	SOUTH WEST
fr72	AUVERGNE	ukl	WALES
fr81	LANGUEDOC-ROUSSILLON	ukm	SCOTLAND
fr82	PROVENCE-ALPES-CÔTE D'AZUR	ukn	NORTHERN IRELAND
fr83	CORSE		

A final issue regards the unavailability of time series long enough for understanding the dynamic aspects of certain areas, particularly those with structural characteristics. For this reason, the analysis is static in the sense that it makes reference to a "central year", where indicators are average values for time periods included from 2000-2002, when possible, or values referred only to one year within the time period 2000-2004.

Turning to the indicators, the CAP direct intervention has been represented by COMPAY, SETPRE, SUBLIV and TOTSUB.

The second area described by the variables selected is agricultural competitiveness and structure (European Commission, 2002b). *Innovation and diversification* are the two main factors affecting the future agricultural productivity performance and thus competitiveness, one of the main targets of decoupling.

Research and Development (R&D) and human capital have the most significant impact on innovation. They are at the heart of the Lisbon Strategy and, thus, understood as key contributors to the creation of a dynamic knowledge-based economy (European Commission, 2005f).

The results from R&D should increase inputs productivity, support the introduction of new production methods and of improved institutional structures. On the other side, human resources are at the basis of the technological change. They depends strongly on the education level of workers and their life-long learning (Sassi, 2006a).

The innovation capacity of the agricultural sector has been approximated by IPC in the agricultural sector on total. As innovation in the agricultural sector is mostly imported from other sectors the KNOINT and MHTECH have been adopted in order to include the overall regional innovation capacity in the model.

Due to lack of data it is difficult to fully comprehend the state and level of human capital in the agricultural sector. The dimension has been approximated by the LEARRU. Also in this case, as for innovation, a specific variable has been introduced in order to take into account the level of education at the regional level: EDUTER has this function.

Diversification consists in the ability of farmers to have access to alternative sources of income (Sassi, 2006b). It has been approximated by two variables, the INSEPA and OTHGAI.

Farm structure underlines 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 the number and size of farmers, concentration of production, tenure, farm organization and the characteristics of farmers and their households. Farm structure both affects and is affected by policy and the economy at all level. The available data has allowed to consider only the following variables in this areas: HO3555, HO5005, BOVUAA and CERUAA.

The age structure of farmers in combination with the importance of off-farm working provides preliminary information on the vitality and sustainability of the agricultural sector at the regional level (Vidal, Eiden, Hay, 2001)

The two latter variables can be also understood as a proxy of the *environmental sustainability* of agriculture in the sense that they allow to emphasising crop and livestock intensity.

In the area of environment, two other factors have been introduced: SORIS and WOODSL.

The areas of the *socio-economic context* affecting agricultural productivity and relevant for decoupling that have been taken into account have been the following:

- Economic development;
- Labour market;
- Infrastructure; and
- Attraction capacity.

The level of economic development has been approximated by the GDPIND (the best available estimate of average regional income levels), while the labour market has been represented in terms of UNEMPR, EMPPER, EMPRUR, EMPAG, SELFSH, and FEMALE (OECD, 1996).

Infrastructure is another area where data is significantly lacking. Three proxies have been introduced: VEIPOP, BERUPO, PUBTOT. As tourist infrastructure can be a proxy of the social image of the rural areas, BERUPO can also be understood as an indicator of the attraction capacity of the rural areas. PUBTOT has been considered as a proxy of the social infrastructures due to the fact that it includes not only public administration and defence, but also the sectors of health, social care and education.

The net migration flows (NETMIG) has been considered as an index of regional attraction capacity. The variable is linked with employment creation and quality of jobs, on the one side, and with quality of life factors on the other (Bryden, Copus, MacLeod, 2002).

Finally, the demographic variables POPDEN and AGEING are important indicators for measuring strengths and weaknesses of a region in the sense that a low level of population density and a high share of elderly people can be interpreted as a signal of the fragility of an area and vice versa.

5.4 Methodology

5.4.1 The spatial analysis

Important advances in the analysis of spatial data have been made over the last decades, in general moving from an initial focus on testing for spatial pattern using spatial autocorrelation statistics (Cliff and Ord, 1981), to modeling spatial pattern by means of regression models with spatial components (Anselin, 1988; Haining, 1990; Cressie, 1991).

Particularly, the application of spatial statistics and GIS in regional development studies has a relatively short history. Goodchild (1987) argued for the importance of the spatial analytical aspects of GIS to further the solution of generic spatial research questions, considerable progress has been made, particularly from a technical viewpoint (Anselin, 1999). Undoubtedly, spatial analysis, especially the application of spatial statistics and spatial econometrics in regional studies, and GIS have revolutionized the manipulation of geographic information and the way of doing geography-related studies, such as regional development study. In general terms, spatial analysis and GIS contribute to the current regional studies in at least three aspects: first, the development of "exploratory spatial data analysis" (ESDA) and its combination with GIS tools provide a robust analytical milieu in the sense of "geography matters". As more and more spatial databases become available for researchers, the context of regional studies turns to be data rich but theory poor. The best way in reality then is to "let the data speak for themselves" (Anselin, 1996). Various methods following the pioneering idea of Tukey (1977) on "exploratory data analysis" (EDA) were developed. When we turn our specific attention to spatial data and geographical references of the data, EDA becomes ESDA. The largest benefit brought by ESDA in regional studies is that the analysis provides an inductive approach to discovering spatial patterns, spatial associations (First Law of Geography), and spatial heterogeneity (geographical variation), which were usually masked by traditional non-spatial analyses.

Second, spatial analysis and GIS provide the basis for data integration, or the conversion of data collected at one spatial scale to other scales. Although large spatial databases are readily available, the data entries or the scale of the data may not always fit the researcher's needs. Through proper manipulation of the available data within the context of spatial analysis and GIS (for example, spatial interpolation, spatial regression, geographically weighted regression, etc.), one could reasonably obtain data for data-sparse regions. The conversion of data from one scale to another is also possible via summarization, decomposition using spatial analysis and GIS.

Third, while providing more intuitive analytical result through spatial analysis and GIS, the rapid development of spatial analysis (especially ESDA) and the GIS techniques boosts the development of regional study theory as well. New theoretical grounds were broken rapidly during the past decades, aided by the more and more robust spatial data manipulation methods.

5.4.2 The GWR methodology

The models we will introduce represent the attempts to accommodate spatial variation in modeling spatial process and analyzing regional transformation. The essence of local models is that they allow the parameters of the model to vary with the geographical location of the sample data (vs. in the global model, parameters of the model are all-the-same across various geographical locations).

The first such model was introduced by Casetti (1972) and later modified, and generally labeled a spatial expansion model. In a very general way, the model is shown as follow:

$$\boldsymbol{Y} = \boldsymbol{X\beta} + \boldsymbol{\varepsilon}$$

$$\boldsymbol{\beta} = \boldsymbol{Z\beta}_0$$

where:

$$\boldsymbol{Z} = \begin{pmatrix} 1 & Z_{E1} & Z_{N1} \\ \vdots & \vdots & \vdots \\ 1 & Z_{En} & Z_{Nn} \end{pmatrix} \text{ and } \boldsymbol{\beta}_0 = \begin{pmatrix} \beta_E \\ \beta_N \end{pmatrix} \quad (1)$$

The geographical location information is recorded in the matrix $\boldsymbol{Z}$, the elements 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. The original parameter matrix $\boldsymbol{\beta}$ (k*1, k is the number of explanatory variables) was expanded by the geographical lo cation information. Such model specification actually posits that the parameters of the model vary as a function of geographical location (represented by latitude and longitude coordinates, which are already known). The expansion method has been very impor tant in promoting awareness of spatial nonstationarity and geographical variation. However, it does have some limitations. Geographically weighted regression, as a form of locally weighted linear regression method, is a relatively simple, but effective, new technique for exploring spatial nonstationarity. Informally, a spatial process $\{ Y(\boldsymbol{s}), \boldsymbol{s} \in R\}$ is stationary, if its statistical propriety are 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 nonstationarity.

GWR has been developed mainly along lines that parallel developments in the literature on smoothing methods, in particular local likelihood estimation, kernel regression, and locally weighted regression. From this perspective, GWR is seen as a locally weighted regression method that operates by assigning a weight to each and every observation i depending on its distance from a specific geographical location o, also called a focal point.

Considering the spatial expansion models (1), if we replace the β term in the first equation with the second equation, and we assume a much more general parsimonious speci fication of the expansion equation than the linear one above (say, for example, let $\beta = \boldsymbol{f}(\boldsymbol{Z_E}, \boldsymbol{Z_N})$, $\boldsymbol{f}$ is a $(k + 1) * 1$ dimension function vector, representing the actual spatial variation of the regression coefficients at each location, $\boldsymbol{Z_E}$, $\boldsymbol{Z_N}$ represent the vector of geographical coordinates on east and north directions), we obtain:

$$\boldsymbol{Y} = \boldsymbol{X}\,\boldsymbol{f}(\boldsymbol{Z_E}, \boldsymbol{Z_N}) + \boldsymbol{\varepsilon} \qquad (2)$$

This model is termed the geographically weighted regression by Fortheringham, Brunsdon and Charlton (1996, 1998, 1999, 2002). Instead of assuming a specific function form of the spatial expansion equation, GWR model only assume that there is a continuous surface of parameter values, which takes the form as $\boldsymbol{f}(\boldsymbol{Z_E}, \boldsymbol{Z_N})$. At this point, it is worth mentioning that since the expansion equation $\boldsymbol{f}(\boldsymbol{Z_E}, \boldsymbol{Z_N})$ is parsimonious in nature, an unbiased estimate o f the local coefficient is not possible (bias here results from inferring the outcome of a non -stationary process at location i from data collected at locations other than i). In GWR, an observation is weighted in

accordance with its proximity to location i so that the weighting of an observation is no longer constant in the calibration but varies with i. Data from observations close to i are weighted more than data from observations farther away.

To obtain the geographically varying estimates, let's rewrit e the ordinary regression equation (OLS) and its estimation:

$$\boldsymbol{Y} = \boldsymbol{X}\beta + \boldsymbol{\varepsilon}$$

by ordinary least square technique, the familiar estimation form of β is:

$$\hat{\boldsymbol{\beta}} = (\boldsymbol{X}'\boldsymbol{X})^{-1}\boldsymbol{X}'\boldsymbol{Y}$$

Recall from the above GWR mode (2), with slight change in the matrix form, the equivalent of the ordinary regression model is:

$$\boldsymbol{Y} = (\boldsymbol{\beta}^{*} \otimes \boldsymbol{X})\boldsymbol{1} + \varepsilon$$

where $\otimes$ is a logical multiplication operator in which each element of $\boldsymbol{\beta}^{*}$ is multiplied by the corresponding element of $\boldsymbol{X}$. For n observations and k explanatory variables, both $\boldsymbol{\beta}^{*}$ and $\boldsymbol{X}$ are n * (k+1) matrix and $\boldsymbol{1}$ is a (k +1) * 1 vector of 1s. The elements of the matrix $\boldsymbol{\beta}^{*}$ is determined by the elements of the function vector $\boldsymbol{f}$, and take the form of:

$$\boldsymbol{\beta}^{*} = \begin{pmatrix} f_0(Z_{E1}, Z_{N1}) & f_1(Z_{E1}, Z_{N1}) & \cdots & f_k(Z_{E1}, Z_{N1}) \\ f_0(Z_{E2}, Z_{N2}) & f_1(Z_{E2}, Z_{N2}) & \cdots & f_k(Z_{E2}, Z_{N2}) \\ \cdots & \cdots & \cdots & \cdots \\ f_0(Z_{En}, Z_{Nn}) & f_1(Z_{En}, Z_{Nn}) & \cdots & f_k(Z_{En}, Z_{Nn}) \end{pmatrix}$$

f_j (Z_{Ei}, Z_{Ni}) is a function value for coefficient j (j = 0,…, k, the first coefficient is the intercept, and subscripted as 0 by default) at location i (i = 1,…,n), and will be simplified as $f_j(i)$ in individual value and $\boldsymbol{f}(i)$ in matrix notion. According to the weighted least square technique, the estimation of $\boldsymbol{f}(i)$ is:

$$\hat{\boldsymbol{f}}(i) = (\boldsymbol{X}'\boldsymbol{W}(i)\boldsymbol{X})^{-1}\boldsymbol{X}'\boldsymbol{W}(i)\boldsymbol{Y}$$

where $\boldsymbol{W}(i)$ is an $n * n$ diagonal spatial weighting matrix that except for the diagonal elements of the matrix representing the weighting mechanism of the observation i and other observations in the dataset, other elements are zeros, in matrix form:

$$\boldsymbol{W}(i) = \begin{pmatrix} w_{i1} & 0 & \cdots & 0 \\ 0 & w_{i2} & \ddots & 0 \\ \vdots & \ddots & \ddots & \vdots \\ 0 & 0 & \cdots & w_{in} \end{pmatrix}$$

From the above discussion, we see that different weighting scheme will result different parameter estimations, thus the selection of weighting scheme becomes important in calibrating GWR models. Rather different from using contiguity rule (border-sharing) in the univariate spatial analysis when we are only interested in the spatial dependence/association of spatial units, contiguity rules would not provide much insight in GWR analysis since such rule practically result in local regressions with only a handful of sample data and a constant weight for the neighbors. Distance rules are more appropriately employed under such circumstances. One obvious and often cited choice is the Gaussian distance-decaying function, where:

$$w_{ij} = \exp[-\frac{1}{2}(d_{ij}/b)^2] \ (j = 1, \ldots, n) \text{ for all } i = 1, \ldots, n \qquad (3)$$

where b is usually referred to as the bandwidth. The Gaussian distance-decaying weighting scheme gives every observation in the dataset a weight larger than zero. The idea may be genuine since it is always possible that "everything is related with everything else". However, some of the observations that are far enough away from the observation i and their weights may be very near zero, the inclusion of such observations in calibrating the GWR model may increase the computational intensity, but alters the parameter estimation very little. For this consideration, an alternative weighting scheme utilizes the bi-square function to produce the weights:

$$w_{ij} = \begin{cases} [1-(d_{ij}/b)^2]^2 & \text{if } d_{ij} < b \\ 0 & \text{otherwise} \end{cases} \quad (j = 1, \ldots, n) \text{ for all } i = 1, \ldots, n \qquad (4)$$

This weighting scheme is particularly useful because it provides a continuous, near-Gaussian weighting function up to distance b from the observation i and then zero weights any observations beyond b.

Methods of selecting optimal bandwidth are abundant in the literature. One obvious way would be to minimize the quantity:

$$cv = \sum_{i=1}^{n} (y_i - \hat{y}_{\neq i}(b))^2 \qquad (5)$$

where y_i is the observed dependent variable value of the ith observation, and $\hat{y}_{\neq i}(b)$ is the GWR fitted value of y_i using a bandwidth of b with the observations for point i omitted from the calibration process. The minimization of such problem is called the out-of-sample cross-validation (CV) approach suggested for local regression by Cleveland (1979) and for kernel density estimation by Bowman (1984). The reason of omitting observation i in the procedure of calibration is because the inclusion of observation i will actually result a zero bandwidth which gives the actual y_i as the estimates, and produce a useless zero CV score. With this procedure, and after the selection of a weighting scheme (the weighting scheme has to be decided before the cross-validation procedure, since the cross-validation will use the weighting scheme to produce fitted value of observations), the one b results in smallest CV score is the optimal bandwidth. Other approaches of determining the optimal bandwidth by minimizing the Akaike Information Criterion (AIC), or Bayesian Information Criterion (BIC, also referred to as the Schwartz Information Criterion, SIC) are present in the literature. Methods of producing spatially varying bandwidths also can be found in the literature, for detailed discussion, see Fortheringham, et al. (2002).

5.4.3 The cluster methodology

Data mining[9] computerized methods based on cluster analysis have been followed in the study. This methodology identifies groups of statistic units characterised by internal cohesion and external distance, it is, maximizing both the internal cluster homogeneity and the inter-cluster heterogeneity.

According to the literature, the analysis has been articulated into three steps: model specification, comparison and interpretation.

For the specification of the model two non hierarchical cluster approaches have been compared: the k-means algorithm for a number of clusters equal to six and a 3x2 Kohonen map.

[9] For a thorough analysis refer to Giudici (2004).

In order to prevent the results from being influenced by the units of measurement of the indicators, by giving a major weight to the highest distances, the variables have been standardised by subtracting the maximum value to the variable values and then dividing the variable values by the range[10].

The two models have been compared by splitting the total variability into within-group variability and between-group variability, leading to the overall R^2 and to the R^2 for the specific parameters object of classification. The comparison has favoured the Kohonen Maps. This latter seems to be a better choice also from an economic point of view. The algorithm selected has the advantage to define more distinct groups determined by a distinct behaviour than those from k-means clustering that are due to randomness.

5.4.3.1 The unsupervised Kohonen networks

A neural network is a set of elementary computerised units, called neurons, connected each other through weighted connections (Fauset, 1994, Gurney, 1997). Each neuron [11] (so called knot or unit) represents an autonomous computerised unit activated when reached by concrete input signs. If activated, the unit can, through the so called net potential function, generate inputs. Each neuron produces, by means of the transference function, only one sign. Each input sign is associated to a concrete connection weight which establishes the relative importance that the income signs can have in order to generate the final impulse emitted by the neuron. These connections are classified as stimulating (positive weight), inhibiting (negative weight) or absent (nil weight).

The units in a neural network (it is, the neurons) are organized in a concrete logic according to which each neuron is precisely connected to the neurons in the previous and in the successive position (Haykin, 1999).

The most usual neural networks are the causal ones, whose principal scope is to understand the relationship between the input and the output variables, according to the available observations. The controversial point in this kind of statistic analysis is finding, with a finite number of observations, a proper dependency relationship between the output variables (the answer ones) and the input variables (the explicatives) (Varfis, Versino, 1993).

[10] The alternative standardization procedure based on the standard deviation has been rejected due to the worsening of the statistic tests.
[11] In this analysis each neuron represents one cluster.

Three different types of neural networks can be distinguished according to the way in which the values of the connection weight that constitute the unknown parameters are obtained:

- with fix weight;
- unsupervised;
- supervised (Giudici, 2004).

The second case is the only one through which experience can be the explanatory input. Since no information is available regarding the value undertaken by the dependent variables as corresponding to the value of the independent variables, the weight will be based on the independent variables themselves (without supervision).

The SOM models are part of this construction.

A Kohonen network is formed by two levels of neurons: a first one of incoming neurons and a second and bi-dimensional one (Kohonen, 1997, Kohonen, 1998, Kohonen et al., 1984). The incoming level is used to calculate the total weight of the input, whereas the bi-dimensional one calculates the output of the net.

Considering $w_{ij}(t)$ as the weight between the input for the neuron in the i position and the output of the neuron where

$0 \leq i \geq n - 1$

n = number of input

t = step in the learning model

if $N_i(t)$ is the number of neurons close to the j position and if $x_i(t)$ is the input in the i position, the learning algorithm is as follows:

a) the map dimensions are defined by establishing the weights $w_{ij}(t)$ between 0 and 1 initially and fixing the value of $N_i(0)$ as high as possible;
b) presentation of an input $x_0(t), x_1(t), x_2(t), \ldots, x_n(t)$ for which its values multiplied by the respective synaptic weight represents the stimulus given to the neuron in the network of Kohonen;
c) the Euclidian distances are calculated, d^2_j, between the input and each neuron of output j;
d) the successful neuron, j^*, is selected. It is, the one matching the minimum distance or the higher activation value;
e) the weights are modified from the neuron of input to the j^* neuron and to those close to it[12] defined into the $N^*_i(t)$. The new weights are given by

[12] The fact that even the neurons being close to j* have been modified, derives from the network's property to generalize. In fact, the network tries to create regions constituted by a large amount of values that lie around

$$w_{ij}(t + 1) = w_{ij}(t) + n(t) [x_i(t) – w_{ij}(t)]$$

where n(t), which is smaller than 1 and higher than 0, is the velocity of adjustment. It decreases over time in order to progressively decrease weights adjustment.

f) back to step b) (Giudici, 2004).

g) because of the existence of vicinity and the sensitivity to history of this algorithm the result is a homogeneous classification of the observations rarely characterised by relatively large groups coexisting with relatively small ones. The used learning algorithm depends on the frequency of past allocation allowing to solve the problems of the *elephant cluster*, i.e. an over dimensioned class in terms of relative number of observations.

A SOM works by smoothing the seeds in a manner similar to kernel estimation methods, but smoothing is done in neighborhoods in the grid space rather than in the input space (Mulier, Cherkassky, 1995).

Finally, the number of clusters has been firstly decided applying to the Ward method and to the statistic R^2 and then evaluating the result in the light of economic considerations.

5.5 Results

5.5.1 The spatial distribution of the variables

The spatial distribution of some variables [13] presented in Table 2.2.a and in Table 5.3 is shown in Figure 5.3 where maps are shaded according to quintile ranges. Some interesting spatial features of the data are made apparent by these maps. In particular, we may observe the concentration of high or low values of the variables in the study area; this suggests to verify the existence of the spatial patterns of these distributions. In order to better understand whether spatial patterns exist, we adopted Local Indicators of Spatial Association (LISA) and local Moran's I. LISAs measure the degree of spatial dependence between a value of a variable at one location and the values of its neighbours, where neighbourhood is defined according to some measure of proximity or contiguity. LISAs are able to accommodate non-stationarity across space. In practice, in socio-economic

the input. In this way, the vectors being closer to the training values are properly classified. This concept is not present in the traditional classification methodologies.

[13] According to following GWR results we propose only the maps of the nonstationary variables for the EU-15 and EU-25.

analysis, the definition of the neighborhood is usually linked to the system of area units through which socio-economic data are made available, the NUTS2 and NUTS1 in our case.

Local Moran's I are well suited for identifying the existence of hot spots or local spatial clusters, assessing assumptions of spatial stationarity, and identifying spatial lags beyond which no discernible association can be detected. For Anselin (1995) the LISAs for each observation provide an indication of the extent of significant spatial clustering of similar values around an observation. This makes them a useful inductive device for ascertaining the scale of ''pockets'' or ''neighborhoods'' of hardship. Since the local Moran's I varies by location, it is more easily interpreted visually by color coding of each region. Figure 5.4 presents the normalized local Moran's I values for the first-order spatial weights matrix of each of the 12 variables in the EU-15 regions. These maps show that all of the variables are more or less characterized by positive spatial autocorrelation patterns. These patterns correspond to the areas with an homogeneous color. Interpreting the results, we must recall that a high value of the local Moran's I does not necessarily correspond to the highest value of the variable but it shows a strong homogeneity of these values across contiguous regions that can be either high or low. This can be better identified comparing the maps for the same variable as show in figures 5.3 and 5.4.

Focusing the attention on the areas with the darkest colors of POPDEN, population density, the local Moran's I is high in Scandinavia, in some of the Central-Western areas and in some areas in Spain and France; in map HO5005, Farm Structure Index, the local Moran's I has high values in the regions of Greece, in central France, in the North and in Scotland.

5.5.2 Variables selection for the GWR models

The variable selection in GWR model such as forward, backward, or step wise methods typically utilized for calibrating ordinary least squared (OLS) regression models is very difficult (see Leung et al., 2000). Given this limitation, to find the best model, ideally models with all possible combinations of all independent variables should be tested. However, with more than 20 independent variables, the number of all possible combinations is very large. Therefore, variables were screened to identify those that were considered promising because of their strong correlations with agricultural value added. These variables were then used to construct candidate model.

Another challenge in variable selection is to decide which explanatory variables are global and which are local. A global variable's impact on agricultural value added is more or less stable over

Figure 5.3: Spatial distribution by quintile range for POPDEN, AGEING, MHTECH, IPCAGR, HO5005, GDPIND, EMPPER, LEARRU, EMPRUR, HO3555, BOVUAA and TOTSUB in EU-15 regions

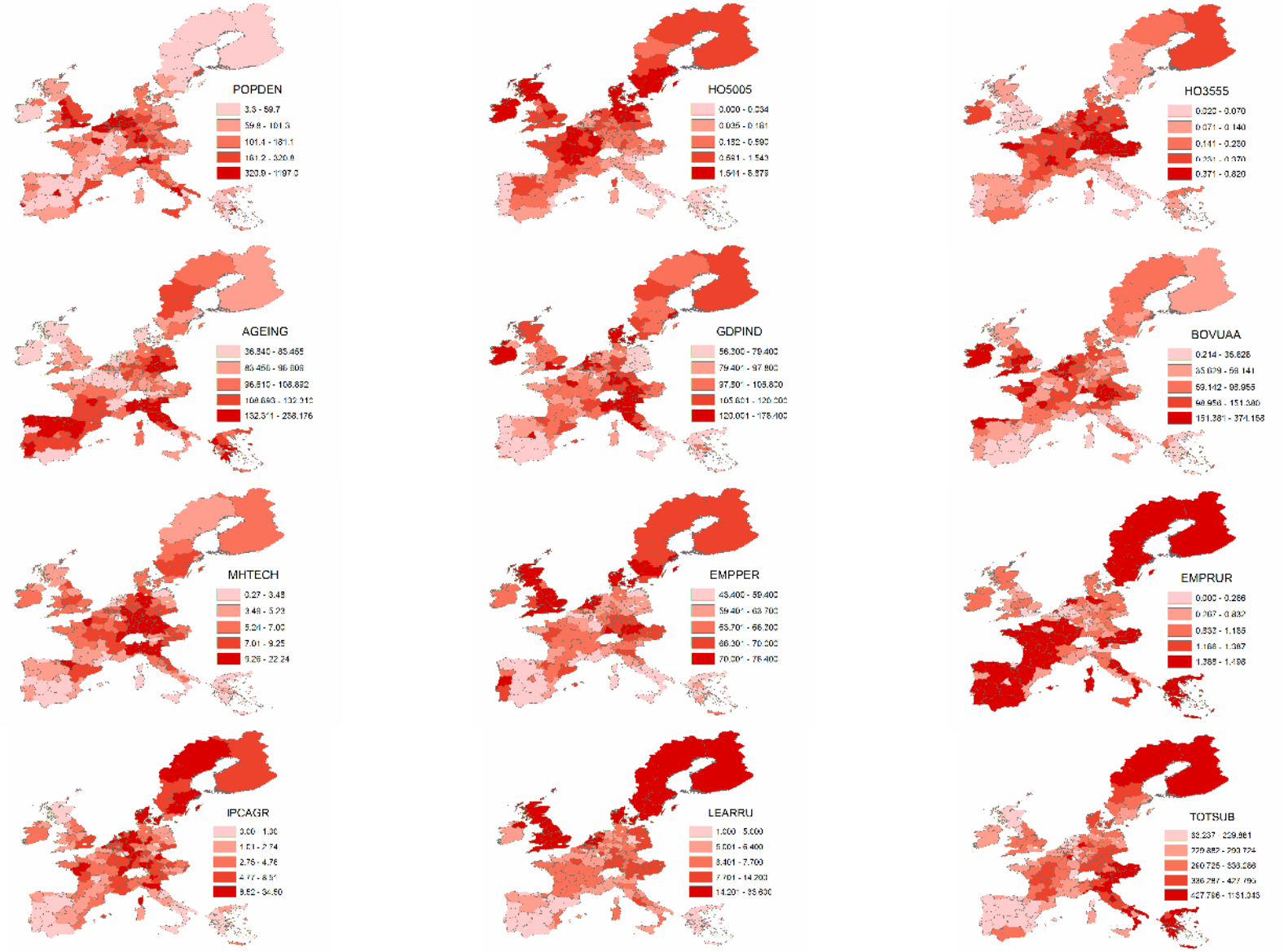


Figure 5.4: Local Moran's I statistics for POPDEN, AGEING, MHTECH, IPCAGR, HO5005, GDPIND, EMPPER, LEARRU, EMPRUR, HO3555, BOVUAA and TOTSUB in EU-15 regions

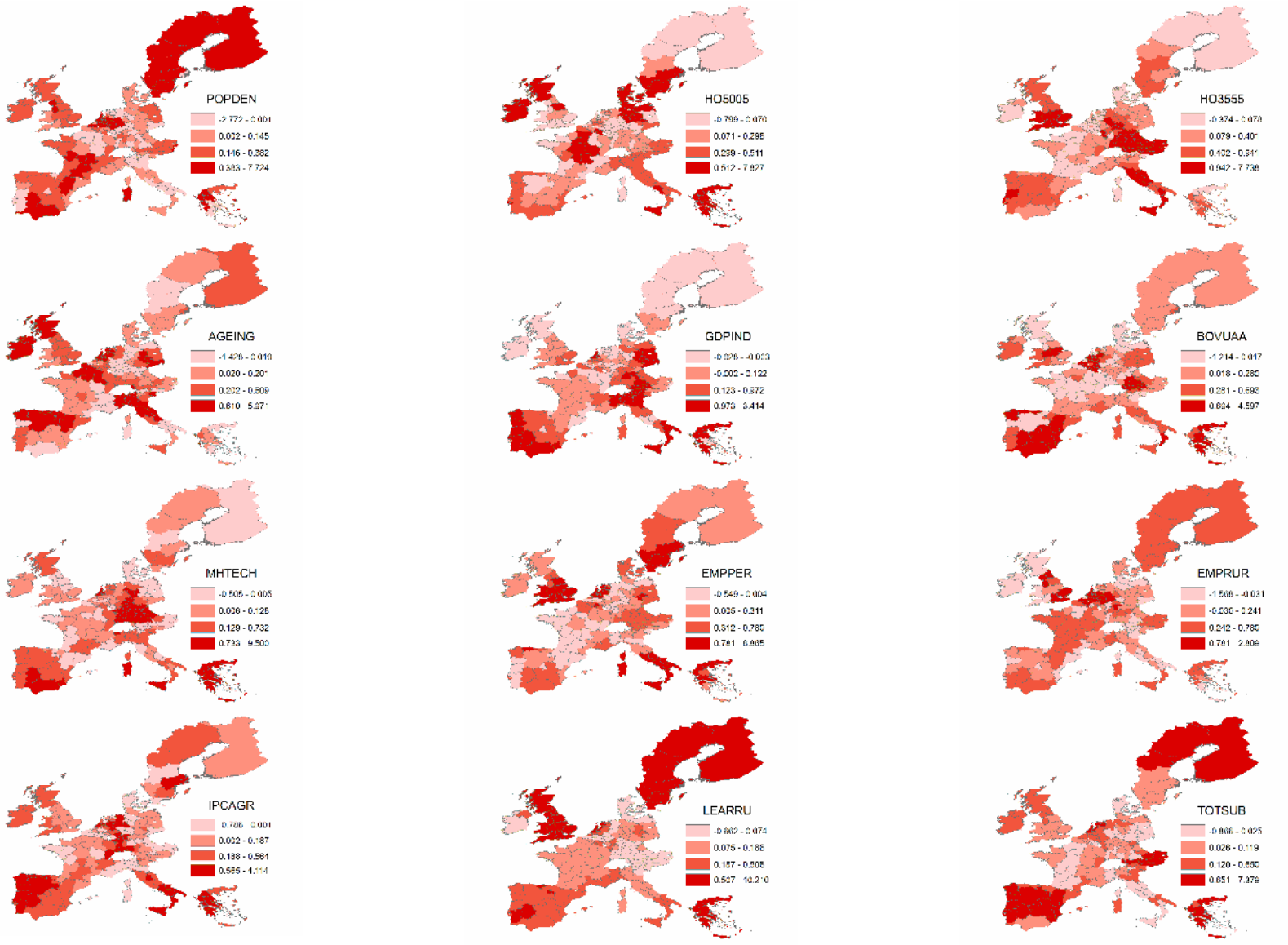


Figure 5.5: Spatial distribution by quintile range for MHTECH, EDUTER, GDPIND, UNEMPR, BERUPO, NETMIG, LEARRU, HO3555, OTHGAI and PUBTOT in EU-25 regions

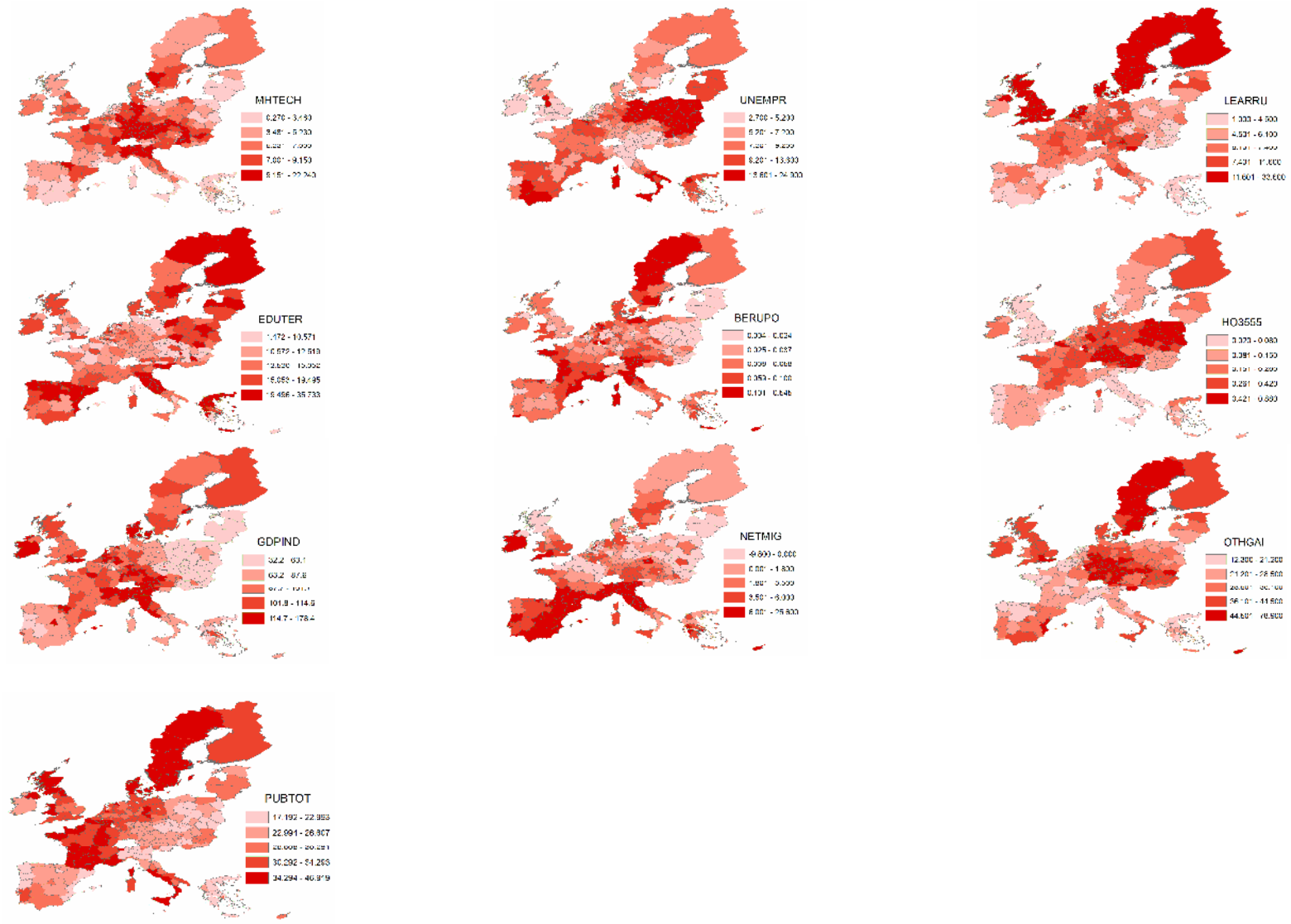
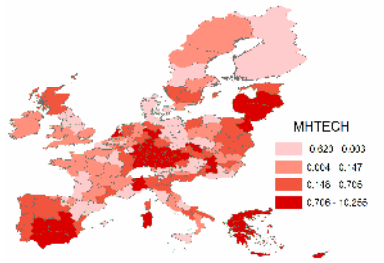
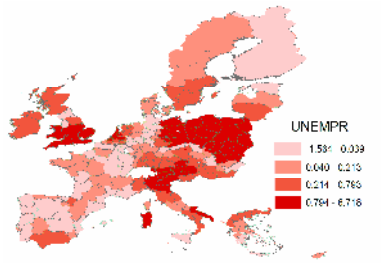
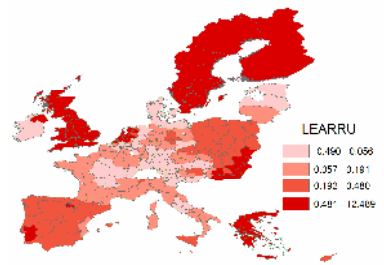
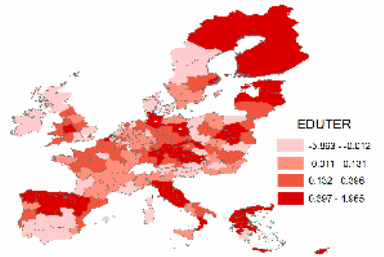


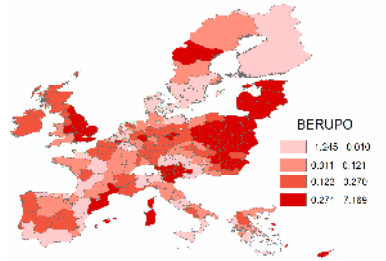
Figure 5.6: Local Moran's I statistics for MHTECH, EDUTER, GDPIND, UNEMPR, BERUPO, NETMIG, LEARRU, HO3555, OTHGAI and PUBTOT in EU-25 regions

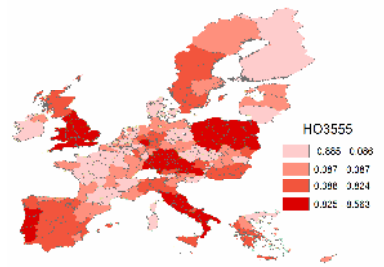


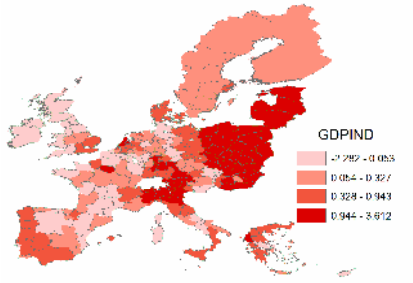


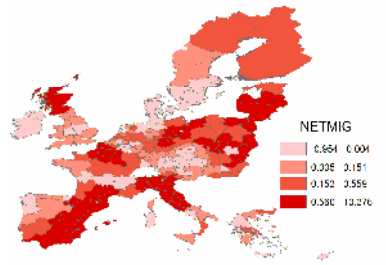


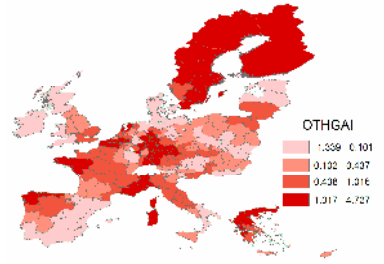


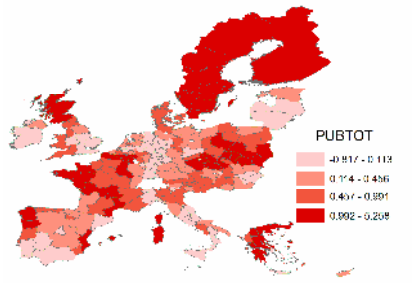












the space therefore its coefficient will remain a constant at every point in the space. In contrast, the impact of a local variable on the dependent variable varies spatially and its coefficient will change across the space.

To identify potentially significant variables, GWR regression were performed first to test the relationship between the dependent variable and each of the indepe ndent variables. The results of GWR are relatively insensitive to the choice of a weighting function but are sensitive to bandwidth. The kernel bandwidth, adaptive in this case, is determined by Akaike Information Criterion (AIC) minimization.

Tables 5.5a. EU-15, and 5.5b, EU-25, summarizes the test statistics including AIC and Monte Carlo nonstationary significance test for the single variable GWR models [14]. AIC provides a basis for not only bandwidth selection in GWR, but also variable selection. The best G WR model should be the one with the lowest AIC. Monte Carlo significance test is a simulation approach to verify the spatial stationarity of variables. The test is based on the concept that if a model is global, then changing the geographic locations of the observations would not alter the model estimation significantly. Therefore, the null hypothesis to be tested through the Monte Carlo significance test is that parameter estimates from any spatial arrangements of the data points are equally likely. In the test, the observed variance of the local parameter estimates from the original data is first computed and stored. A given number of randomizations are then performed to arbitrarily relocate the observations and the variances are computed and compared with the observed variance to determine if the null hypothesis should be accepted or rejected.

In Table 5.1 and 5.2, the AIC values were sorted in ascending order - the variables are considered as promising if they have low AIC - while the last column show if the variable is included (T) or not included (F) in GWR model.

In the GWR models for the EU-15 and the EU-25 the variables with a correlation index greater or equal to 0.65 have not been included. In the EU-15 model, CERUAA and COMPAY have resulted correlated. Thus, only the latter has been included due to its importance in explaining decoupling. FEMALE is correlated to UNEMPR (UNEMPR has a higher value than AIC of FEMALE but has been chosen because it is considered more representative of the general conditions of the labor market), SUBLIV is correlated with BOVUAA, and KNOINT is correlated to LEARRU, SELFSH, EMPAGR, and PUBTOT. The other variables, excluded for the highest

[14] For the estimates of the GWR models we have utilized GWR 3.0 software (Charlton M., Brunsdon C. and Fotheringham S., 2003) and Roger Bivand and Danlin Yu (200 7), spgwr: Geographically weighted regression, R package version 0.4-01.

AIC with the exception of GDPIND and AGEING that represent important indicators of the socio-economic context.

Table 5.5a: AIC and P_value of nonstationarity test for GWR Models with a single variable: EU -15

Variable	GWR AIC	P-value	Included (True/False)
Popden	313.51	0.060	T
Ceruaa	316.20	0.340	F
Compay	317.55	0.000	T
Ho5005	320.49	0.000	T
Ipcagr	321.51	0.020	T
Totsub	325.07	0.000	T
Ho3555	326.80	0.000	T
Bovuaa	329.69	0.010	T
Female	330.01	0.000	F
Mhtech	333.02	0.160	T
Emprur	334.44	0.440	T
Subliv	336.36	0.690	F
Learru	337.39	0.000	T
Knoint	337.90	0.030	F
Woodsl	338.60	0.000	T
Empper	340.63	0.040	T
Selfsh	341.80	0.000	T
Unempr	342.92	0.000	T
Eduter	345.87	0.950	F
Berupo	346.57	0.880	F
Setpre	348.31	0.000	F
Insepa	348.76	0.000	F
Empagr	350.83	0.020	F
Soiris	352.39	0.000	F
Netmig	352.51	0.420	F
Gpind	353.05	0.000	T
Pubtot	362.76	0.040	F
Othgai	434.62	0.000	F
Veipop	443.52	0.040	F
Ageing	470.21	0.480	T

In the GWR model for the EU-25, FEMALE has been excluded because it was correlated with UNEMPR and EMPPER, EMPPER with UNEMPR. EMPAGR and KNOINT have the s ame high value of AIC and are correlated the former with SELFSH and the latter with LEARRU and PUBTOT.

Table 5.5b: AIC and P_value of nonstationarity test for GWR Models with a single variable: EU -25

N	Variable	GWR AIC	P-value	Included (True/False)
1	*Veipop*	345.06	0.000	T
2	*Ho5005*	369.35	0.000	T
3	*Female*	371.14	0.000	F
4	*Learru*	372.26	0.000	T
5	*Othgai*	383.11	0.070	T
6	*Woodsl*	386.23	0.000	T
7	*Mhtech*	386.77	0.550	T
8	*Emprur*	389.10	0.000	F
9	*Berupo*	389.88	0.130	T
10	*Ho3555*	391.13	0.010	T
11	*Bovuaa*	393.40	0.000	T
12	*Pubtot*	397.09	0.000	T
13	*Unempr*	397.56	0.000	T
14	*Gpind*	399.48	0.020	T
15	*Empper*	404.77	0.000	F
16	*Soiris*	405.35	0.000	T
17	*Ceruaa*	405.86	0.110	T
18	*Selfsh*	406.57	0.000	T
19	*Netmig*	407.85	0.000	T
20	*Eduter*	408.28	0.000	T
21	*Empagr*	409.77	0.000	F
22	*Knoint*	413.13	0.060	F

5.5.3 The GWR models and the results of the estimates

In this paragraph we discuss the main results of the two models estimated for the EU -15, 164 regions, and EU-25, 205regions.

5.5.3.1 The GWR model for EU-15

$$VALADD_i = b_0(i) + b_1(i)POPDEN_i + b_2(i)AGEING_i + b_3(i)WOODSL_i + b_4(i)MHTECH_i + b_5(i)IPCAGR_i + b_6(i)HO5005_i + b_7(i)GDPIND_i + b_8(i)EMPPER_i + b_9(i)LEARRU_i + b_{10}(i)HO3555_i + b_{11}(i)COMPAY_i + b_{12}(i)OTHGAI_i + b_{13}(i)BOVUAA_i + b_{14}(i)EMPRUR_i + b_{15}(i)TOTSUB_i + b_{16}(i)SUBCRO_i + b_{17}(i)UNEMPR_i + b_{18}(i)SELFSH_i$$

where:

$b_0(i)$ is intercept term of region i;

$b_{(1\ to\ 18)}(i)$ are the local parameters of the independent variables.

Table 5.6: Parameters of EU-15 GWR and OLS models

Variable	Minimum	Lwr Quartile	Median	Upr Quartile	Maximum	OLS
Intcpt	-1.1920	-0.0816	0.1469	0.3493	0.7562	0.0000
Popden	-0.4237	0.1080	0.2373	0.2718	0.5073	0.1685
Ageing	-0.3922	-0.1286	-0.0311	0.0962	0.2509	-0.0296
Woodsl	-0.4425	-0.1322	0.0240	0.0521	0.0850	-0.0076
Mhtech	-0.3998	-0.2116	-0.0974	-0.0340	0.0659	-0.1518
Ipcagr	0.0113	0.0568	0.0905	0.1385	0.3245	0.1643
Az50a5	-0.8837	-0.6708	-0.4421	-0.2086	0.0392	-0.2499
Gdpind	-0.2119	-0.0850	-0.0321	0.1411	0.4268	0.1823
Empper	-0.5821	-0.0911	0.1362	0.4249	0.5525	-0.0541
Learru	-0.3674	-0.2184	-0.0636	0.2824	1.0160	-0.0397
Ho3555	-0.2448	-0.1433	-0.0184	0.1419	0.4583	0.1278
Compay	-0.9939	-0.5265	-0.3477	0.0924	1.6420	-0.2041
Othgai	-0.5046	-0.3953	-0.2475	-0.0972	0.1350	-0.3340
Bovs15	-0.0947	-0.0291	0.0630	0.2262	0.4895	0.0822
Emru15	-0.2977	-0.1167	-0.0843	-0.0609	0.0776	-0.1104
Totsub	-0.3679	-0.0109	0.0552	0.0938	0.1816	0.1005
Subcro	-2.4070	-0.3591	0.3408	0.6929	1.5090	0.2668
Unempr	-0.4862	-0.1620	-0.0538	-0.0067	0.0917	-0.0885
Selfsh	-0.3982	0.0115	0.2009	0.3139	0.5297	0.1360

Table 5.7 shows a significant improvement in the GWR estimation, in term of residual sum of square (RSS), with respect to ordinary least square (OLS), while the F test value, as proposed by Brundson et al. (1999), is 0.5197 (p-value = 0.000).

Table 5.7 : RSS GWR EU-15 improvement vs. OLS

RSS OLS	RSS GWR improvement	RSS GWR
66.527	43.253	23.274

In the recent development of spatial analysis, the interest is increasingly concerned with the issue of spatial nonstationarity. For a specific model, its parameters might vary in space. In general, there are at least three reasons why parameters might be different in different regions (Fotheringham and Pitts 1995; Fotheringham 1997; Fotheringham et al.1996, 1997a,b, 1998). First, there are certain spatial nonstationarities caused by random variations existed in the study areas. Second, some relationships in various areas are intrinsically different. For example, there are spatial differences in the effect of the levels of regional agricultural development in the rural development, the contribution of the cereals to the agricultural value added, and physical geographical conditions. Third, the ordinary linear regression (OLS) model improperly measures

the spatial interactions and one or more relevant variables are either omitted from the model or are represented by an incorrect functional form.

In the analysis of the rural development of the EU-15, 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. That is, parameters of the regression models are different in different areas and every area has its unique local regression parameters representing the relationship.

The parameter estimates of various factors affecting rural development in the EU regions show different spatial variations indicating possible spatial nonstationarity (cfr. Tables 5.6 and 5.9). Thus, the GWR technique appears to be a useful method to investigate spatial nonstationarity. However, from the statistical viewpoint, two critical questions remain. One is whether the GWR model describes the relationship significantly better than an OLS model. The other is whether each set of parameter estimates exhibit significant spatial variation over the study areas (Leung et al. 2000; Brunsdon et al. 1999).

The first question is a goodness-of-fit test for a GWR model. However, it is very important to answer this question when the GWR technique is adopted to examine the relationship among various factors. Usually, a GWR model will fit a given data set better than an OLS model. However, from the practical point of view, the simpler a model, the easier it can be applied and interpreted. If a GWR model does not perform significantly better than an OLS model, it means that there is no significant drift in any of the model parameters. If the answer to the first question is positive, the second question then needs to be entertained. Generally, by knowing whether or not the parameters in a GWR model exhibit significant spatial variation, a better understanding on both the data and the framework within which the data are examined can be achieved. In this analysis, a greater insight on the relationships between regional rural development and its factors helps us to understand the spatial variation of the main mechanisms of the regional rural development and provides useful information for decision-makers to formulate valid and effective regional economic policies.

Leung et al. (2000) and Brunsdon et al. (1999) developed techniques to solve the above two questions in the context of classical hypothesis testing. Under some assumptions, Leung et al. (2000) have constructed several appropriate statistics and derived their approximated null distributions for the statistical test of the above hypotheses. To test the presence of nonstationarity

in GWR models for the analysis of rural development in EU regions, we have adopted the testing method F3 developed by Leung et al. (2000).

Table 5.8: Spatial nonstationarity of the independent variables of the GWR EU-15 model

Variable	F stastistics	Numerator d.f.	Denominator d.f.	Pr.(>F)	Signif. 0.05
Intcpt	1.1602	27.9691	149.66	0.27981	ns
Popden	2.0475	28.4194	149.66	0.00315	*
Ageing	1.6354	62.8221	149.66	0.00807	*
Woodsl	0.6111	34.7644	149.66	0.95485	ns
Mhtech	11.1740	53.1384	149.66	< 2.20E-16	*
Ipcagr	13.5082	56.0762	149.66	< 2.20E-16	*
Az50a5	10.7607	50.7023	149.66	< 2.20E-16	*
Gdpind	11.7912	47.1797	149.66	< 2.20E-16	*
Empper	1.8101	65.5518	149.66	0.00160	*
Learru	14.1676	70.5315	149.66	< 2.20E-16	*
Ho3555	3.1228	42.9660	149.66	< 1.67E-07	*
Compay	0.4584	14.2309	149.66	0.95273	ns
Othgai	0.8163	73.0706	149.66	0.83350	ns
Bovs15	1.4873	48.9850	149.66	0.03641	*
Emru15	147.3107	41.8682	149.66	< 2.20E-16	*
Totsub	1.4915	53.9634	149.66	0.03124	*
Subcro	0.2736	12.6246	149.66	0.99376	ns
Unempr	0.2703	45.3259	149.66	0.99999	ns
Selfsh	0.2157	70.8458	149.66	1.00000	ns

The results reveal some important points. WOODSL, COMPAY, OTHGAI, SUBCRO, UNEMPR and SELFSH do not show significant spatial variation, while POPDEN, AGEING, MHTECH, IPCAGR, HO5005, GDPIND, EMPPER, LEARRU, HO3555, BOVUAA, EMPRUR and TOTSUB are significantly varying across the space. The twelve spatially varying socio-economic indicators show interesting patterns (see paragraph 5.5.4); this underline that spatial nonstationarity plays important role in the explication of different levels of agricultural value added in the EU-15 regions.

Figure 5.7 show the choropleth map of the local values of R^2 for the a goodness-of-fit measure that can ‘‘informally depict the accuracy with which the model replicates the observed values (of the value added per UAA hectare) in the vicinity of the point for which the model is calibrated’’ (Fotheringham, Brunsdon, and Charlton 2000, p. 125). The map indicates that there is some variation in the R-square statistic; however, the statistic ranges from moderate levels (c. 0.64) to high values (up to 0.87), with the highest values occurring to the north of the study area. These results must nevertheless be interpreted with care since the model is potentially nonstationary

(Fotheringham, Brunsdon, and Charlton 2002). The map of standardized residuals to the bottom left of Figure 1 illustrates that they have no particular spatial pattern as well as no conditions for the existence of positive spatial correlation. Finally, the comparison between OLS residuals (top right) and GWR residuals show the sensible reduction of the second.

5.5.3.2 The GWR model for EU-25

The GWR model for EU-25 is:

$$GVAUAA_i = b_0(i) + b_1(i)WOODSL_i + b_2(i)MHTECH_i + b_3(i)EDUTER_i + b_4(i)VEIPOP_i + b_5(i)HO5005_i + b_6(i)\ GDPIND_i + b_7(i)UNEMPR_i + b_8(i)SOIRIS_i + b_9(i)SELFSH_i + b_{10}(i)BERUPO_i + b_{11}(i)NETMIG_i + b_{12}(i)LEARRU_i + b_{13}(i)HO3555_i + b_{14}(i)OTHGAI_i + b_{15}(i)PUBTOT_i + b_{16}(i)\ CERUAA_i + b_{17}(i)\ BOVUAA_i$$

where:

$b_0(i)$ is intercept term of region i;

$b_{(1\ to\ 17)}(i)$ are the local (regional) parameters of the independent variables.

Table 5.9: Parameters of EU-25 GWR and OLS models

Variable	Minimum	Lwr Quartile	Median	Upr Quartile	Maximum	OLS
Intcpt	-0.4525	-0.1937	0.0242	0.6068	1.8490	2.20E-10
Woodsl	-0.6107	-0.0974	0.0283	0.5518	1.7050	-0.3719
Mhtech	-0.4538	-0.1028	0.0718	0.1686	0.4408	0.0549
Eduter	-0.3704	-0.1121	-0.0257	0.0392	0.1476	-0.0752
Veipop	-1.4090	-0.0224	0.1157	0.3910	1.6820	0.0431
Ho5005	-0.7322	-0.5302	-0.2761	-0.0704	0.2290	-0.1888
Gdpind	-0.1743	0.2253	0.3503	0.4604	0.6916	0.4656
Unempr	-0.5551	0.0036	0.0832	0.1763	0.6075	-0.0050
Soiris	-1.3630	-0.1573	-0.0353	0.2232	1.8710	0.1032
Selfsh	-1.4220	-0.3889	-0.0571	0.1427	0.6956	0.0819
Berupo	-0.6460	-0.2780	-0.1955	-0.0702	0.1575	-0.1629
Netmig	-0.3305	-0.0150	0.0767	0.2805	0.6882	-0.1005
Learru	-0.9986	-0.4928	-0.1549	0.3155	1.1270	-0.1112
Ho3555	-0.3691	0.0617	0.2561	0.3345	1.0570	0.0980
Othgai	-0.3997	-0.1381	0.1746	0.3673	0.4851	0.2903
Pubtot	-0.5329	-0.2239	0.0032	0.3067	0.6894	0.0083
Ceruaa	-0.6025	-0.1748	-0.0522	0.0295	0.3853	-0.1253
Bovuaa	-0.2754	-0.0949	0.0289	0.1809	0.7220	0.0665

Figure 5.7: EU-15 GWR local R-square, residuals from the OLS and GWR models

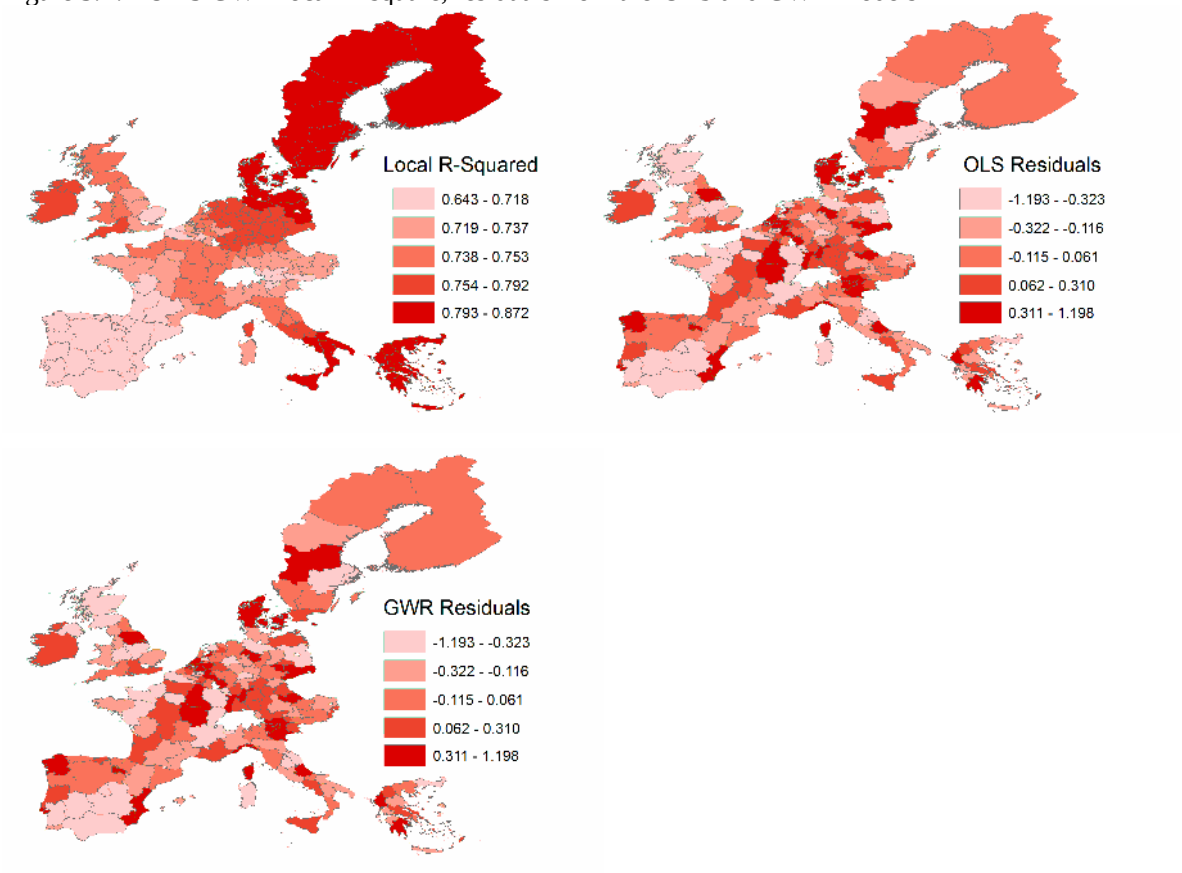


Table 5.10 shows a significant improvement in the GWR estimation, in term of residual sum of square (RSS), with respect to ordinary least square (OLS), while the F test value, as proposed by Brundson et al. (1999), is 3.711 (p-value = 0.000).

Table 5.10: RSS GWR EU-15 improvement vs. OLS

RSS OLS	RSS GWR improvement	RSS GWR
99.672	76.886	22.786

Table 5.11: Spatial nonstationarity of the independent variables of the GWR EU -25 model

Variable	F statistic	Numerator d.f.	Denominator d.f.	Pr.(>F)	Signif. 0.05
Intcpt	0.4876	72.2290	176.39	0.99960	ns
Woodsl	0.1748	32.1486	176.39	1.00000	ns
Mhtech	22.4445	80.5585	176.39	< 2.20E-16	*
Eduter	4.7781	58.4431	176.39	< 4.82E-16	*
Veipop	0.6618	60.6877	176.39	0.968140	ns
Ho5005	0.4857	44.5977	176.39	0.997220	ns
Gdpind	11.0981	55.1708	176.39	< 2.20E-16	*
Unempr	6.1453	52.0245	176.39	< 2.20E-16	*
Soiris	0.2213	56.5719	176.39	1.00000	ns
Selfsh	0.7948	79.2888	176.39	0.876190	ns
Berupo	15.0125	42.8105	176.39	< 2.20E-16	*
Netmig	2.2103	61.2188	176.39	< 2.95E-05	*
Learru	1.5072	82.6070	176.39	0.012480	*
Ho3555	4.5557	67.1800	176.39	< 4.16E-16	*
Othgai	1.6272	79.1346	176.39	0.004240	*
Pubtot	2.2256	89.4631	176.39	< 3.26E-06	*
Ceruaa	0.4981	87.7422	176.39	0.999820	ns
Bovuaa	0.1281	57.6903	176.39	1.000000	ns

In GWR EU-25 model, spatial nonstationarity involves several indicators: MHTECH, EDUTER, GDPIND, UNEMPR, BERUPO, NETMIG, LEARRU, HO3555, OTHGAI and PUBTOT. This show 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.

Figure 5.8 shows the local values of R^2 of GWR EU-25 model; also in this case, the statistic ranges from moderate levels (c. 0.52) to high values (up to 0.96), with the highest values occurring to the north regions of the EU. The map of standardized residuals to the bottom left of Figure 5. illustrates that, again, they have no particular spatial pattern and the improvement of GW R model to respect OLS (top right)

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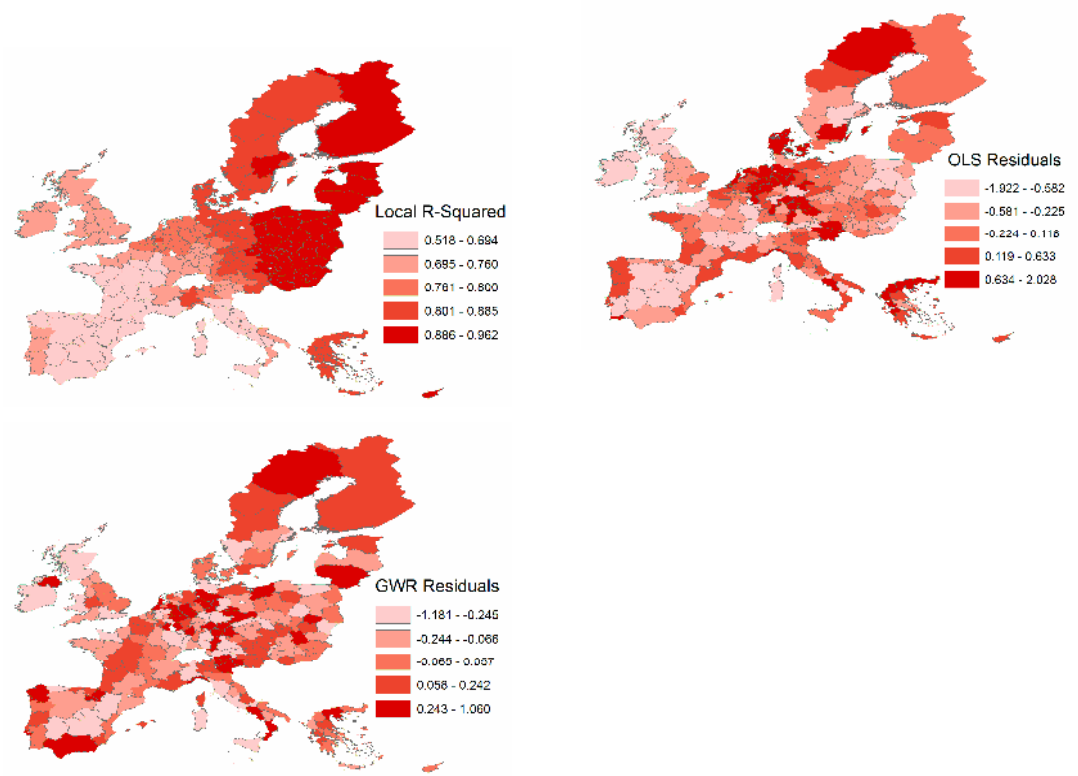
Figure 5.8: EU-25 GWR local R square, residuals from the OLS and GWR models



5.5.4 The discussion of the GWR parameters

5.5.4.1 The EU-15

We will now discuss the results of the GWR models, limiting them to the parameters of the non - stationary variables. In that it is difficult to interpret the results when considering the variables separately, we must evaluate them in their entirety. The effects on the results are interdependent between variables. They are also connected to all of the variables, which are not e xplicitly inserted in the model, by means of the intercept and residuals; these variables contribute to explain the dependent variable. In the same way, the values of the *t-statistics* of the local parameters of the GWR can not be used as indicators for th e acceptance of the single variable. We will present these *t-statistics* values later.

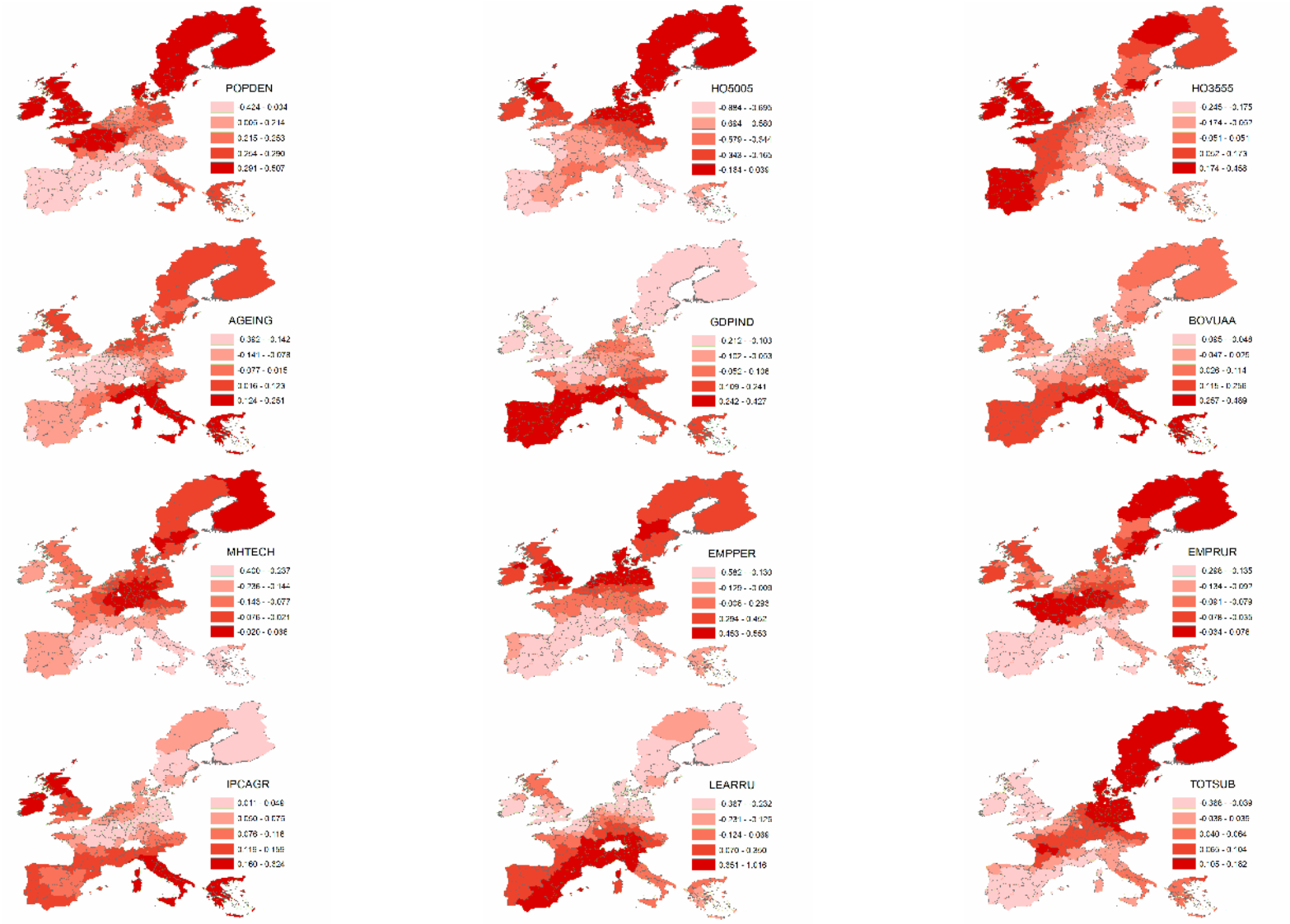
Maps of the spatially varying coefficients of the GWR EU -15 model are found in figure 5.9. At a territorial level, these parameters indicate the different impact of the individual variables on the

formation of the agricultural value added per hectare. The results of the GWR indicated the sensibility of the dependent variable to a change in that specific variable; it shows the different links that are established on the territory between the dependent variable and the independent variables.

In the analysis of the results, it is necessary to distinguish between the variables that are related to the indicators of the social and economic context and those that are related to structural and economic indicators, which are more sensitive to policy interventions. Amongst the first indicators, there are some, such as POPDEN and AGEING, which cannot be considered as factors on which to operate to modify agricultural productivity. In the end, the GWR tool, like the smoothing methods, creates a gradual transition of high to low values or vice versa. One can see this in the maps of the parameters, where the passages between high to low values or low to high values tends to be gradual. The population density, POPDEN, has the highest values in the regions of northern Europe, central and western Europe, Great Britain, and in the southern Mediterranean regions. Regions of the Iberian Peninsula and some regions in southern France and norther n Italy, have a fairly negative value. On the contrary, old age index, AGEING, demonstrates a territorial distribution that usually tends to be the opposite of POPDEN. The highest values are found in the central and eastern regions of the Mediterranean.

The interpretation that is given to the structural and economic indicators should not be separated from general considerations on the conditions of the general economic development of the regions. It is the case of the percentage share of workers employed in the sectors of medium and high technology, MHTECH. The Central and Southern regions of the Mediterranean (Italy and Greece) are characterized by negative parameter values. This does not mean that the development of sectors with medium and high technology would have negative effects on the agricultural value added, but assuming MHTECH as a proxy of overall level of development, a low level of development affects negatively the growth of the agricultural sector.

Figure 5.9:GWR parameter variation across the EU-15 regions by quintile ranges for the nonstationary variables



The most sensitive regions for the relationship between IPC in agriculture and overall, IPCAGR, are found in the south Mediterranean, Ireland, and Great Britain as is shown in the map. The structural indicator HO5005 represents the relationship between large size farms (> = 50ha) and small farms (< =5 ha). This indicator affects negatively on the dependent variable in a large part of the central western regions and the south of the Mediterranean; however, it is almost always positive in the strip of regions that extends from the Iberian Peninsula to Scandinavia, also including Ireland and Great Britain. This result, which brings us back to the observations made at the beginning of the paragraph, should be interpreted taking into account the various types of agriculture that are present in the different regions.

The GDP per capita index, GDPIND, is positively correlated with the agricultural value added in all of the regions in south-central Europe, whereas the total employment index, EMPPER, shows an opposite trend; the highest values tend to be found in the North Central regions.

The life-long learning in rural areas, LEARRU, gathers the positive effects on the added value in the strip of regions that extends from the south of the Iberian Peninsula to the alpine regions of France, Austria, and Italy.

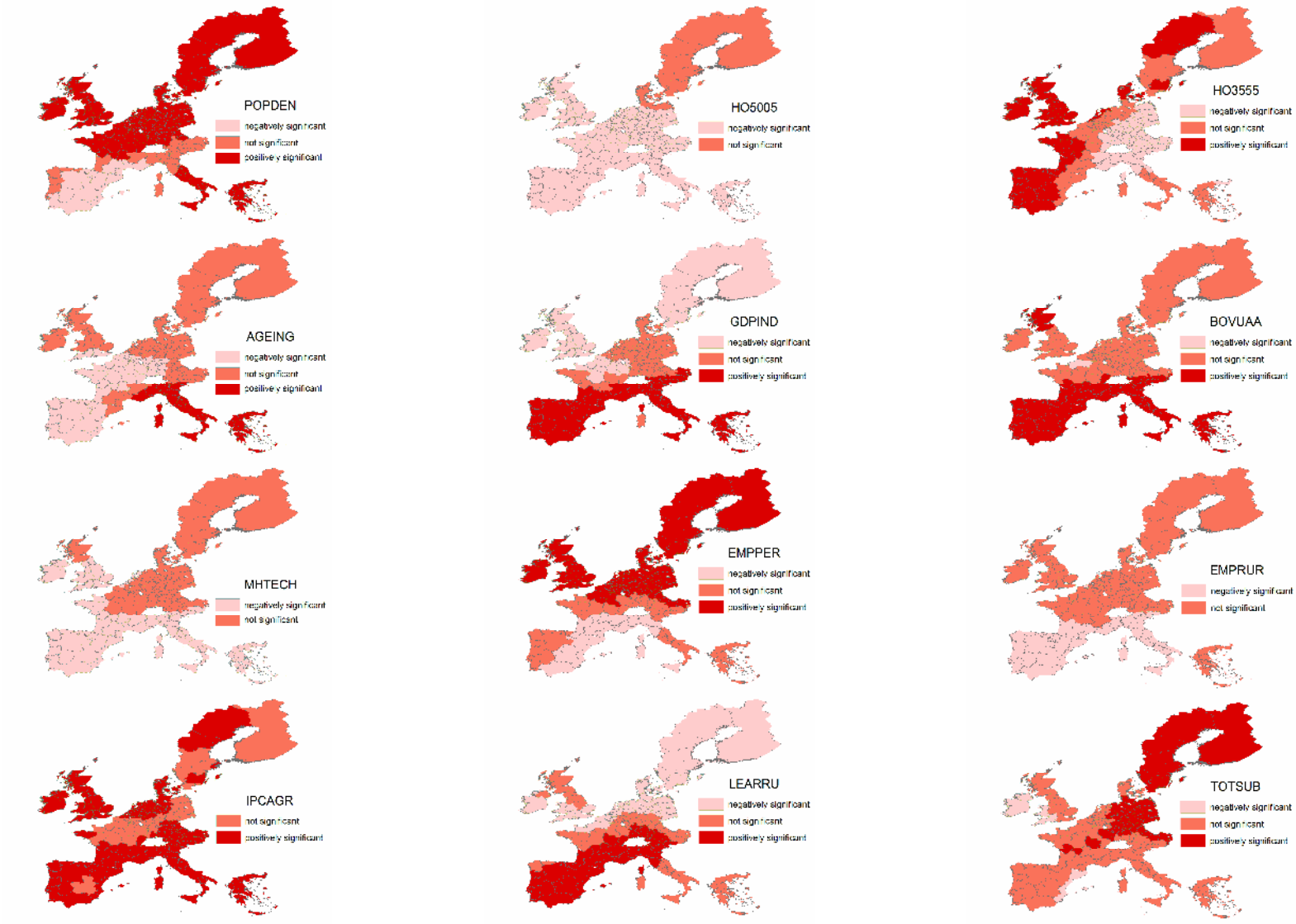
The parameter of the age structure (farmers <35 / > =55 years old), HO3555, is positively correlated to the agricultural value added in the Atlantic regions, from the Iberian Peninsula to Scandinavia, while the negative values, the highest in absolute values, are found in central-western Europe all the way to the northern Italian regions.

The parameter of cows per hectare, BOVUAA, possesses the highest values in the Italian and Greek regions, while it is moderately negative in the regions along the Atlantic, from France to Germany, and not including Denmark.

The employment in predominantly and intermediate rural areas, EMPRUR, has a negative value in almost all of the European regions. The highest absolute values are gathered in the regions of the Iberian Peninsula and the Mediterranean. The total value per hectare of UAA of CAP subsidies, TOTSUB, has a positive correlation with the value added in the regions of North Central Europe.

In figure 5.10, the maps of *t-statistics*, related to the EU-15 GWR parameters, are presented (t < -1.310, negatively significant at 90%, -1.309 >= t <= 1.309, not significant and t >= 1.310 positively significant at 90%). A clear correspondence between the areas where the values of the parameters are highest (fig. 5.9) with the areas where t is negatively or positively significant at 90% is evident.

Figure 5.10: GWR parameter's t-values of nonstationary variables of EU-15 regions



5.5.4.2 The EU-25

Figure 5.11 shows the spatially varying coefficients of the 10 non-stationary variables of the EU-25 GWR model. MHTECH, the percent of high and medium high technology manufacturing sector employment, possesses the highest value in various areas that cover across Europe from Scandinavia to some of the French and Italian Alpine and Mediterranean regions. UNEMPR, the unemployment rate, contains the highest values in the neighboring regions of the Iberian Peninsula, France, and eastern Alpine regions of Italy, Austria, and Germany.

The importance of the parameter of the life-long learning in rural areas, LEARRU, is highlighted especially in the regions in the Iberian peninsula and central France, while the level of education, EDUTER, it has a significant impact on the agricultural gross value add per UAA hectare in the regions in the South of Italy, in the regions in the south of the NMS, and in a group of contiguous regions in Belgium and Holland.

The indicator that summarize the tourism infrastructure in rural areas, BERUPO, has the highest values in the regions of Portugal and the bordering Spanish regions, in many regions of Great Britain, in French regions along the Atlantic coast and in Dutch regions. HO3555, the age structure in agriculture, has a significant impact on the GVA in some regions of western France and in all of Great Britain.

GDPIND, the index of GDP per capita, is strongly related to GVA in Polish regions, in Portuguese regions and some regions in the south of Spain. NETMIG, the migration crude rate, is especially high in a stretch of regions that extends from the Atlantic coast of France to the regions in North-Central Italy.

The parameter concerning farmers with other gainful activities, OTHGAI, shows the highest values in the central-eastern regions, including the NMS and the regions in south-central Italy. Finally, PUBTOT, the employment in the public sector, has the highest values in a large group of Central and Mediterranean regions and Scandinavia.

Figure 5.12 shows the maps of *t-statistics* related to the parameters of GWR EU-25 model. The comparison with the maps of figure 5.11 indicates how also in this case the parameters tend to be significant in the areas where they possess the highest values.

Figure 5.11: GWR parameter variation across the EU-25 regions by quintile ranges for the nonstationary variables

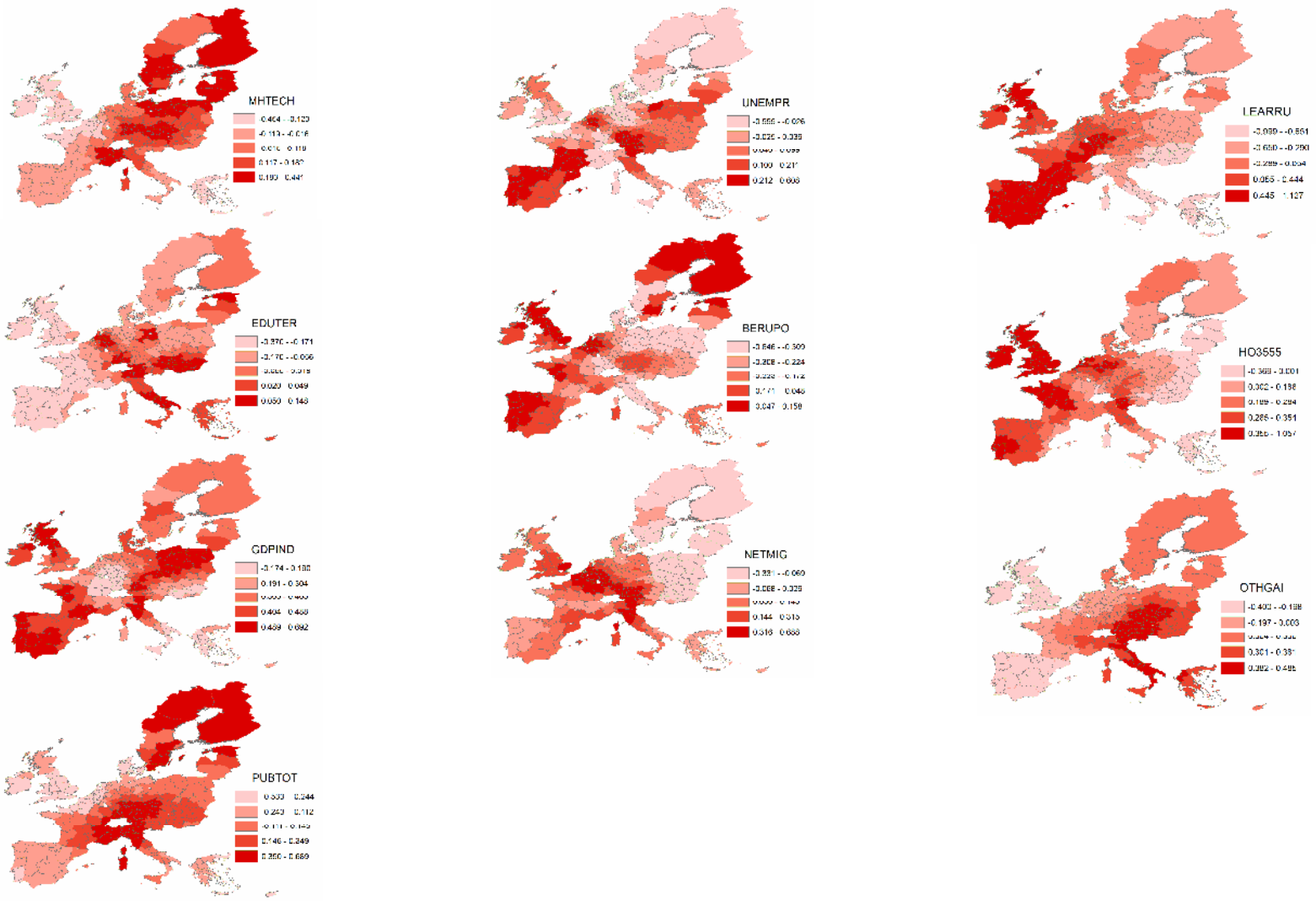
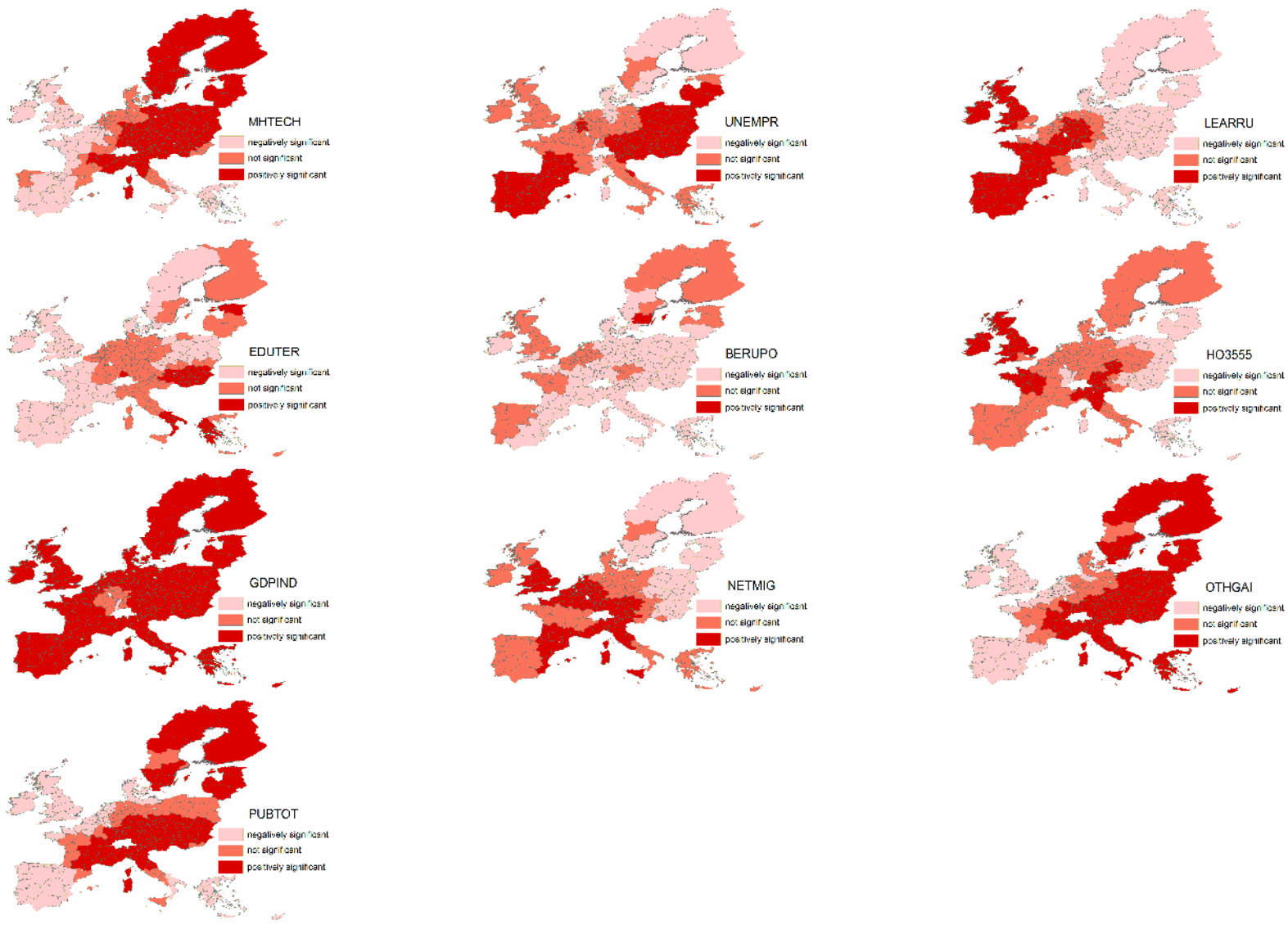


Figure 5.12: GWR parameter's t-values of nonstationary variables of EU-25 regions



5.5.6 The cluster analysis

The Ward method and the R^2 statistics have suggested classifying the 164 regions of the EU-15 and the 205 regions of the EU-25 into six groups. The number of cases in each cluster is shown in Table 5.12.

Table 5.12: Frequency of the clusters

Cluster number	EU-15 regions by cluster		EU-25 regions by cluster	
	Number	%	Number	%
1	48	29	42	21
2	38	24	37	18
3	17	11	42	20
4	12	7	17	8
5	24	14	31	15
6	25	15	36	18
Total	164	100	205	100

More than 50% of the EU-15 regions are concentrated in the first two clusters while for the EU-25 they are almost fairly distributed among the sub-groups a part from cluster 4 that includes the only 8% of the total cases.

Not all of the non-stationary parameters are important to the formation of the cluster [15] (Table 5.13 and 5.14).

Table 5.13: EU-15: relative importance of the parameters

Indicators	Relative importance values
Totsub	**0.6092**
Ho5005	0.0500
Ho3555	**0.5816**
Ipcagr	**0.8641**
Bovuaa	0.0000
Emprur	0.0000
Learru	0.0000
Gdpind	0.1000
Empper	**0.8415**
Mhtech	0.0000
Popden	**1.0000**
Ageing	0.1867

[15] A decision tree calculates the relative importance values that can assume values between 0 (no contribution to the cluster profile) and 1 (maximum contribution to the formation of t he cluster).

Table 5.14: EU-25: relative importance of the parameter

Indicators	Relative importance values
Ho3555	0.0051
Othgai	**0.8145**
Learru	**0.6588**
Berupo	0.3402
Pubtot	0.0000
Netmig	**0.5961**
Gdpind	**0.8302**
Unempr	0.0000
Eduter	**1.0000**
Mhtech	0.2823

Furthermore, certain parameters play a major role in the final regionalization results. For the EU-15, total subsidies is one of these parameters. Those related to the age structure of farmers , the innovation capacity in the agricultural sector, the employment rate and the population density are also of significant relevance. In fact, they have a relative importance value greater than 50%. Also in the EU-25, a set of parameters contribute substantially (that is with a relative importance value greater than 50%) to the diversity of the regions. This set consists of the parameters related to the agricultural multifunctionality, the level of human capital both in rural areas and on total, the income level and the territorial attraction capacity. The regional impact of the parameters' values of these variables is combined with their spatial proximity.

The interpretation of the results is based on the cluster profiles pointed out by the analysis and their spatial representation. More precisely, the input mean for each cluster is compared to the overall means (Figure 5.13 and 5.14) and then each sub-group of regions is represented in a map with a different colour (Figure 5.15 and 5.16). In order to make the comparison easier, in Figure 5.13 and 5.14 the input means are normalised to fall within a range of 0 to 1. However, as the explanatory variables are parameters, another important information regards the sign and the intensity of the parameters themselves. This information is illustrated in Table xx for the EU-15 and in Table 5.16 for the EU-25.

Concerning the clusters profile, the analysis is aimed at emphasising the variables whose parameters are greater than the overall means. Furthermore, among them a specific attention has been given to those that are positively correlated to the dependent variable. The latter can be understood as interesting policy sensitive areas for the agricultural development not only at the regional level but also at the level of a specific sub-group of regions.

For the EU-15 the six sub-groups are characterised as follows (Table 5.17):

- **Cluster 1** – *agricultural productivity strongly sensitive and positively correlated to total subsidies and socio-economic context.*

It includes 48 regions geographically located in the Northern Europe and Scandinavia. The agricultural productivity results strongly sensitive to:

- CAP direct support;
- Farm size;
- Employment rate both in rural and the overall areas;
- Regional innovation capacity;
- Population density.

While total subsidies, total employment rate and population density show a positive relationship with agricultural productivity, the other variables are negatively correlated.

- **Cluster 2** - *agricultural productivity strongly sensitive and positively correlated to total subsidies and rural context.*

It is made of 38 regions in the Central-Northern part of the EU-15. Its profile underlines a relatively high sensitivity of the agricultural productivity to total subsidies, the variables referred to the rural area and those related to the overall innovation capacity. A part from rural employment rate and the innovation capacity, all the other parameters show a positive sign.

- **Cluster 3** - *agricultural productivity strongly sensitive and positively correlated to innovation, human capital, regional welfare.*

It includes 17 Central-Southern regions of the EU-15. In this sub-group all the parameters above their overall mean are characterised by a positive relationship with the agricultural productivity. They are:

- Innovation capacity;
- Environmental indicator;
- Human capital in rural areas;
- Income level;
- Age structure of the population.

- **Cluster 4** - *agricultural productivity strongly sensitive and positively correlated to agricultural context and labour market characters.*

It consists of 12 regions in the UK and Ireland. The agricultural productivity is relatively strong sensitive to the variables representative of the agricultural characters, labour market, population density. Apart from the farm structure they are positively correlated to the dependent variable.

- **Cluster *5*** - *agricultural productivity strongly sensitive and positively correlated to agricultural and rural characteristics.*

It includes 24 regions in the Iberian Peninsula and Western France . The agricultural productivity is relatively high and positively affected by the variables that approximate the agricultural and rural characteristics.

- **Cluster 6 -** *agricultural productivity strongly sensitive and positively correlated to total subsidies, livestock intensity, and socio-economic welfare.*

It consists of 25 Mediterranean regions in Southern Italy and Greece. The agricultural productivity is relatively strongly correlated to subsidies but in a negative way. On the contrary, the index of innovation capacity, livestock intensity, economic welfare and the age structure show a positive relationship.

Looking at the map in Figure 5.15, the first impression is that of a distinct regional and spatial coherence although a great diversity between clusters in terms of sensitivity of the agricultural productivity to the independent variables considered. This suggests the operational of specific characteristics that seems to be connected to the national or sub-national level. In part, the result should depend on the fact that some of variables selected reflect historical, social, physical and geographic conditions that are strongly country related and that should be included in the analysis with specific variables difficult to be quantified according to the available official sources. In addition to this, the classification has carried out significant differences among clusters underlining that the agricultural productivity can be affected differently not only by sector specific measures but also by territorial specific interventions such as those under the Rural Development Policy.

The same considerations hold true including the new 10 Member States, although profiles change due to the exclusion of total subsidies and of certain variables according to data availability.

Concerning the profile, the six clusters referred to the EU-25 regions show the following distinctive characteristics:

Cluster 1 – *agricultural productivity strongly sensitive and positively correlated to farmers age structure, quality of human capital in rural areas and economic context.*

It includes 42 regions of the North-Western side of Europe. The agricultural productivity is relatively strongly and positively affected by the age structure of farmers, the quality of human capital, the income level and unemployment rate. The attraction capacity in rural areas also play a significant role in explaining the different regional agricultural productivity levels, both the correlation has a negative sign.

Cluster 2 – *agricultural productivity strongly sensitive and positively correlated to multifunctional agricultural and level of human capital.*

It is made of 37 regions in Southern Europe and Slovakia. Multifunctional agricultural and human capital in these regions are the only two variables with a relatively strong and positive impact on the dependent variable.

Cluster 3 - *agricultural productivity strongly sensitive and positively correlated to multifunctional agriculture and socio-economic context.*

It groups 42 regions North-Eastern Europe and Estonia, Latvia, Lithuania and Poland. Multifunctional agriculture, social infrastructures, income level and overall innovation capacity are all positively correlated and show parameters with vales greater than the overall mean.

Cluster 4 - *agricultural productivity strongly sensitive and positively correlated to regional attraction capacity, innovation and human capital.*

It collects 17 Central regions including some Southern German and a few Eastern French regions. Human capital in rural areas, social infrastructures, regional attraction and innovation capacity are positively correlated

Cluster 5 - *agricultural productivity strongly sensitive and positively correlated to agricultural structure, rural characters and territorial attraction capacity.*

It includes 31 regions in North-Central Europe. The age structure of farmers, the quality of human capital both in rural areas and at the regional level, the regional attraction capacity positively correlated. Tourist infrastructure affects agricultural productivity negatively but the parameter has a very low value.

Cluster 6 - *agricultural productivity strongly sensitive and positively correlated to agricultural vitality and sustainability and socio-economic context.*

It is made of 36 regions South-Central Europe. Apart from the variables related to rural characteristics, all the other variables affect the agricultural productivity regional disparities in a positive and relatively stronger way. The only exception is represented by the quality level of human capital but the parameter has a low value.

Table 5.15: EU-15

Indicators	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
Totsub	**0.10***	**0.07***	-0.01	-0.17	-0.07	**-0.04***
Ho5005	**-0.13***	-0.46	-0.54	**-0.24***	-0.67	-0.73
Ho3555	0.01	-0.08	-0.21	**0.33***	**0.18***	-0.04
Ipcagr	0.06	0.05	**0.13***	**0.14***	**0.12***	**0.27***
Bovuaa	-0.03	0.02	**0.21**	0.033	**0.22**	**0.40***
Emprur	**-0.07***	**-0.01***	-0.12	-0.07	-0.19	-0.10
Learru	-0.23	**0.12***	**0.54***	-0.20	**0.37***	-0.04
Gdpind	-0.08	-0.04	**0.23***	-0.17	**0.34***	**0.13***
Empper	**0.45***	0.13	-0.19	**0.46***	-0.20	-0.08
Mhtech	**-0.04***	**-0.03***	-0.16	-0.14	-0.22	-0.28
Popden	**0.26***	**0.24***	-0.01	**0.33***	-0.18	**0.25***
Ageing	-0.01	-0.19	**0.09***	-0.02	-0.11	**0.20***

* value greater than the overall mean

Table 5.16: EU-25

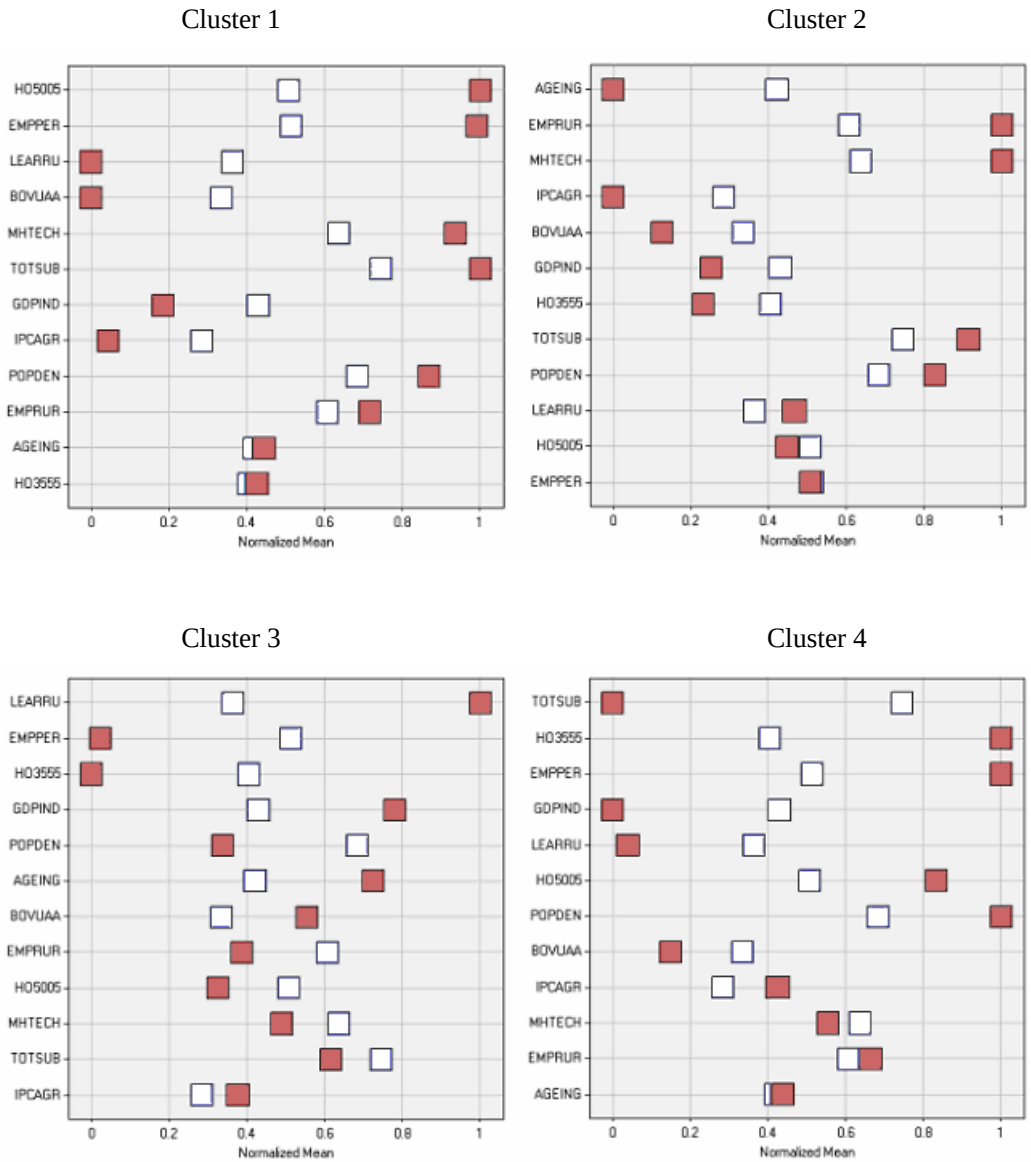
Indicators	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
Ho3555	**0.45***	-0.08	0.11	0.19	**0.33***	**0.25***
Othgai	-0.26	**0.36***	**0.20***	0.08	-0.15	**0.38***
Learru	**0.54***	-0.76	-0.24	**0.55***	**0.10***	-0.38
Berupo	**-0.07***	-0.23	-0.35	-0.28	**-0.03***	-0.20
Pubtot	-0.14	-0.01	**0.10***	**0.26***	-0.30	**0.48***
Netmig	0.09	-0.01	-0.09	**0.27***	**0.37***	**0.25***
Gdpind	**0.47***	0.19	**0.43***	0.07	0.25	**0.42***
Unempr	**0.17***	0.04	0.01	-0.01	**0.11***	**0.12***
Eduter	-0.23	**0.04***	-0.05	**-0.001***	**0.002***	**-0.01***
Mhtech	-0.13	-0.04	**0.18***	**0.10***	-0.08	**0.17***

* value greater than the overall mean

Looking at Figure 5.16 two first general considerations emerge. In the Western side of Europe the regional and spatial coherence increases compared with the EU-15 classification: Cluster 1 includes the Portuguese, Spanish, British, Irish and part of the French regions. On the other side, the new Member States are divided into three groups. The first includes Slovakia that shares the profile of the North-Eastern EU-15 regions. The second consists of Estonia, Latvia, Lithuania and Poland. It becomes part of the Southern Italian and Greek regions. Finally, Slovenia that joins the

South-Central regions of the EU-15. Thus, at the geographical extreme Eastern and Western part of the EU-25 there are three main blocks of regions in which the agricultural productivity reacts to the variables selected in an homogeneous way. On the contrary, the Central part of the EU shows a greater diversity.

Figure 5.13: Cluster profile EU-15 regions



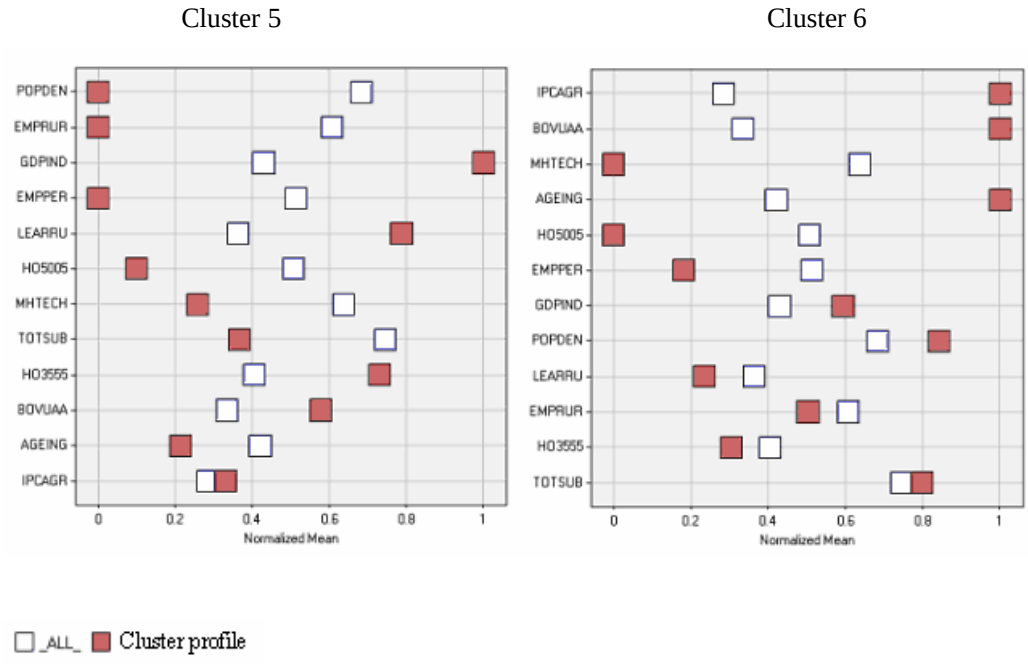
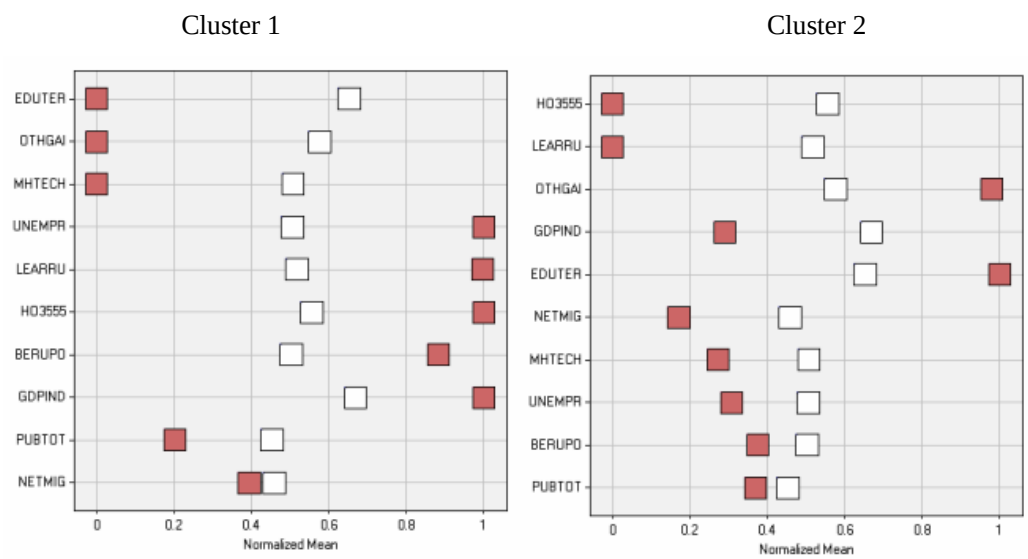
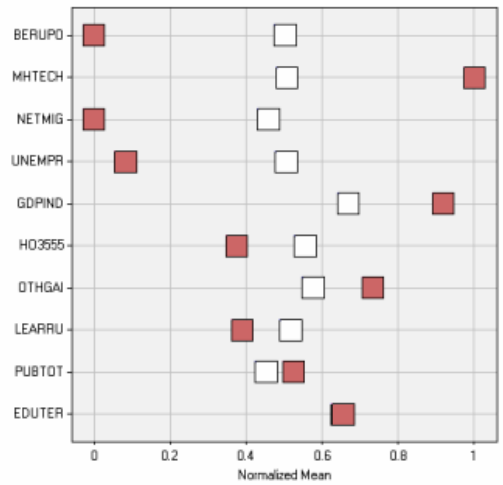


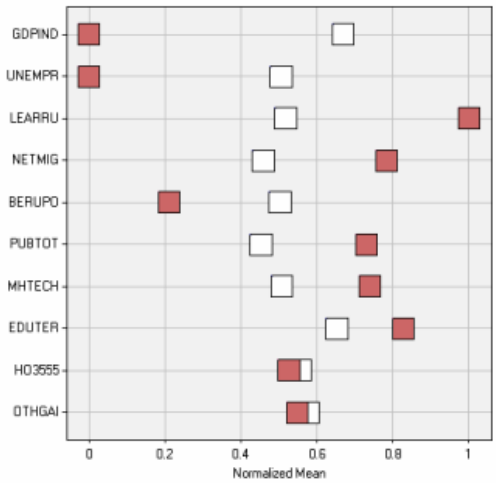
Figure 5.14: Cluster profile EU-25 regions



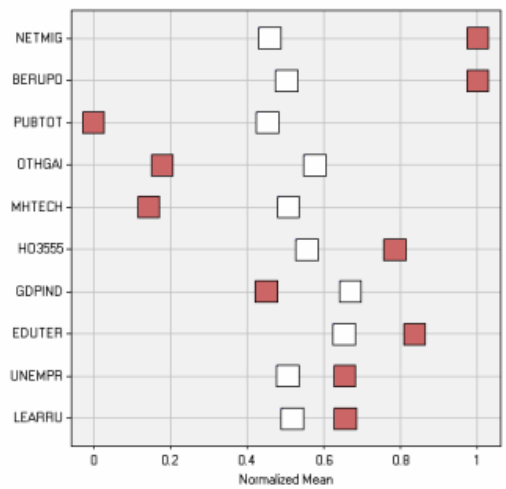
Cluster 3



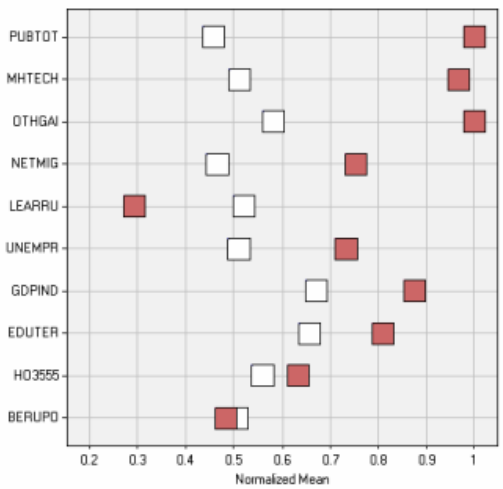
Cluster 4



Cluster 5



Cluster 6



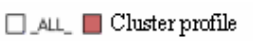


Figure 5.15: Cartographic presentation of the classification result for the EU-15

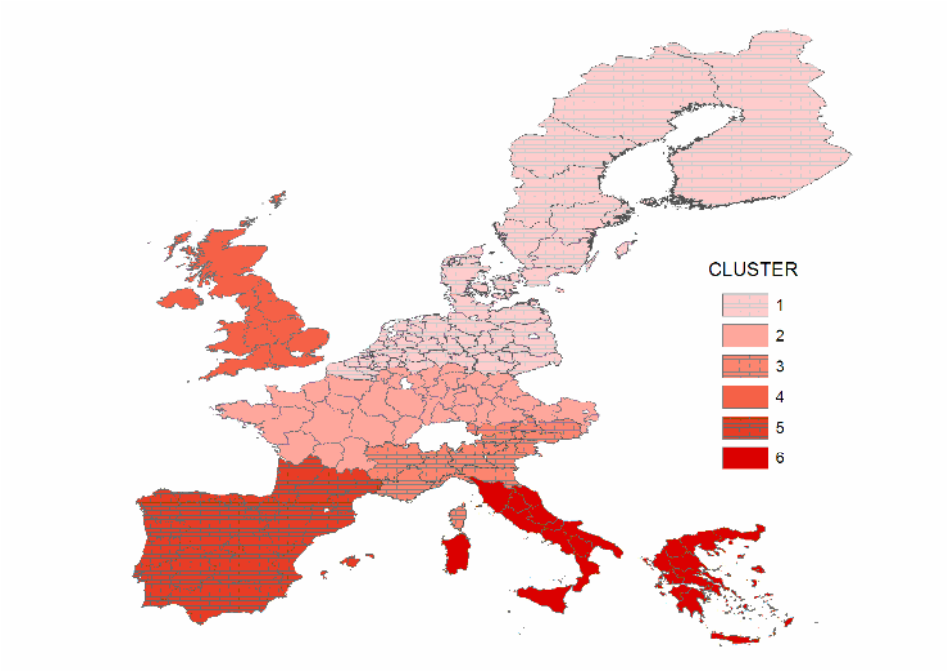


Figure 5.16:Cartographic presentation of the classification result for the EU -25

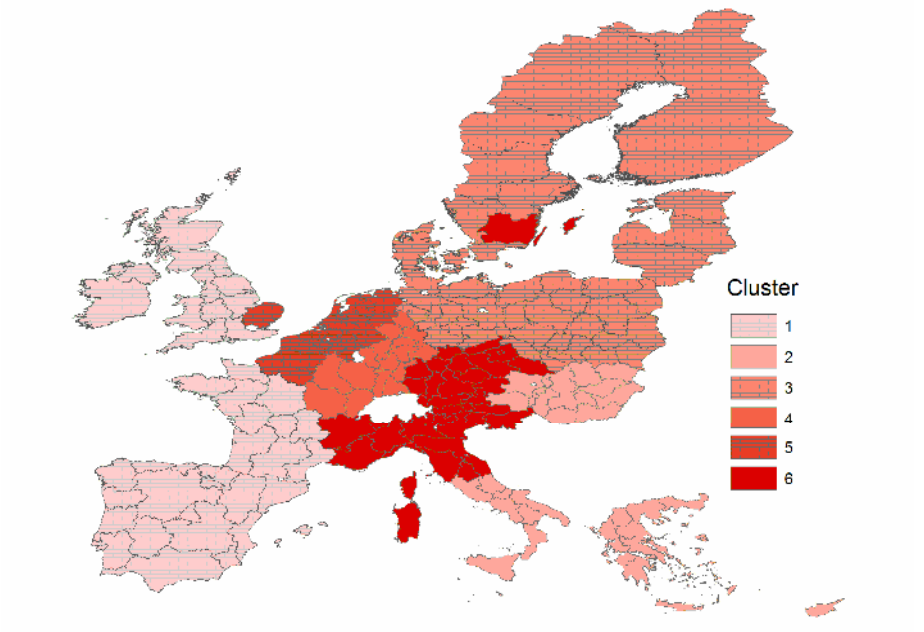


Table 5.17: Regions by cluster number

Nuts code	Cluster number EU-15	Cluster number EU-25	Nuts code	Cluster number EU-15	Cluster number EU-25
at11	2	2	gr11	6	2
at12	2	2	gr12	6	2
at21	3	6	gr13	6	2
at22	3	2	gr14	6	2
at31	2	6	gr21	6	2
at32	3	6	gr22	6	2
at33	3	6	gr23	6	2
at34	3	6	gr24	6	2
be21	1	5	gr25	6	2
be22	1	5	gr30	6	2
be23	1	5	gr41	6	2
be24	1	5	gr42	6	2
be25	1	5	gr43	6	2
be31	1	5	hu10	-	2
be32	1	5	hu21	-	2
be33	2	5	hu22	-	2
be34	2	5	hu23	-	2
be35	2	5	hu31	-	2
cy00	-	2	hu32	-	2
cz01	-	6	hu33	-	2
cz02	-	6	ie0	4	1
cz03	-	6	itc1	3	6
cz04	-	6	itc2	3	6
cz05	-	3	itc3	3	6
cz06	-	6	itc4	3	6
cz07	-	3	itd1	3	6
cz08	-	3	itd2	3	6
de11	2	6	itd3	3	6
de12	2	4	itd4	3	6
de13	2	4	itd5	3	6
de14	2	6	ite1	6	6
de21	2	6	ite2	6	6
de22	2	6	ite3	6	6
de23	2	6	ite4	6	2
de24	2	6	itf1	6	2
de25	2	6	itf2	6	2
de26	2	4	itf3	6	2
de27	2	6	itf4	6	2
de40	1	3	itf5	6	2
de71	2	4	itf6	6	2
de72	2	4	itg1	6	2
de73	1	4	itg2	6	6
de80	1	3	lt0	-	3
de91	1	3	lv0	-	3
de92	1	3	mt0	-	2

Table continues

Table 5.17: (continued)

Nuts code	Cluster number EU-15	Cluster number EU-25	Nuts code	Cluster number EU-15	Cluster number EU-25
de93	1	3	nl11	1	5
de94	1	5	nl12	1	5
dea1	1	5	nl13	1	5
dea2	1	5	nl21	1	5
dea3	1	5	nl22	1	5
dea4	1	4	nl23	1	5
dea5	1	4	nl31	1	5
deb1	2	4	nl32	1	5
deb2	2	4	nl33	1	5
deb3	2	4	nl34	1	5
dec0	2	4	nl41	1	5
ded0	1	3	nl42	1	5
dee1	1	3	pl11	-	3
dee2	1	3	pl12	-	3
dee3	1	3	pl21	-	3
def0	1	3	pl22	-	3
deg0	1	3	pl31	-	3
dk00	1	3	pl32	-	3
ee00	-	3	pl33	-	3
es11	5	1	pl34	-	3
es12	5	1	pl41	-	3
es13	5	1	pl42	-	3
es21	5	1	pl43	-	3
es22	5	1	pl51	-	3
es23	5	1	pl52	-	3
es24	5	1	pl61	-	3
es30	5	1	pl62	-	3
es41	5	1	pl63	-	3
es42	5	1	pt11	5	1
es43	5	1	pt15	5	1
es51	5	1	pt16	5	1
es52	5	1	pt17	5	1
es53	5	1	pt18	5	1
es61	5	1	se01	1	3
es62	5	1	se02	1	3
fi0	1	3	se04	1	3
fr10	2	5	se06	1	3
fr21	2	4	se07	1	3
fr22	2	5	se08	1	3
fr23	2	5	se09	1	3
fr24	2	1	se0a	1	3
fr25	2	1	si00	-	6
fr26	2	4	sk01	-	2
fr30	1	5	sk02	-	2
fr41	2	4	sk03	-	2
fr42	2	4	sk04	-	2

Table continues

Table 5.17: (continued)

Nuts code	Cluster number EU-15	Cluster number EU-25	Nuts code	Cluster number EU-15	Cluster number EU-25
fr43	2	4	ukc	4	1
fr51	2	1	ukd	4	1
fr52	2	1	uke	4	1
fr53	2	1	ukf	4	1
fr61	5	1	ukg	4	1
fr62	5	1	ukh	4	5
fr63	2	1	ukj	4	1
fr71	3	6	ukk	4	1
fr72	2	1	ukl	4	1
fr81	5	1	ukm	4	1
fr82	3	6	ukn	4	1
fr83	3	6			

Chapter VI

A General Equilibrium Analysis of Agricultural Reform at the Regional Economy and Household level: the Italian case

6.1 Data needs for analyzing the rural economy and for establishing a micro - macro link in agricultural policy. The state of the art in EU and new MS and suggestions

As it is well known in the recent years there is a progressive shift in the interest both of the academic community and of the policymakers from agricultural to rural policies. In relation to this change a reflection must be done about the way to provide the data needed to assess the socio - economic impact of the rural policy programs and to monitor the living standard of rural population, that is the main objective of rural policies.

The aim of this section is to review the statistical surveys that collect information on the standard of living of rural and farm household and to provide a detailed description of the Ismea survey in view of discussing the desirable characteristics of a prototypical survey devoted to collect the information needed to monitor the living conditions of rural and farm population.

The traditional agricultural surveys, such as the RICA-FADN, do not provide the information needed to capture the social impact of farm programs (Figure 1a and Figure 1b). On the contrary farm household surveys, for example the ARMS of the USDA as well as the Ismea survey, provide the data needed to better understand the agricultural household behaviour and to assess its welfare. Accordingly, they can be defined as agricultural household standard of living surveys and they are of little help in analyzing the quality of life of the rural population considering that in many countries, especially in the industrialized ones, the agricultural population is only a small subset of the entire rural population.

Figure 1.a: A snap-shot of a rural-urban continuum of a developed territory

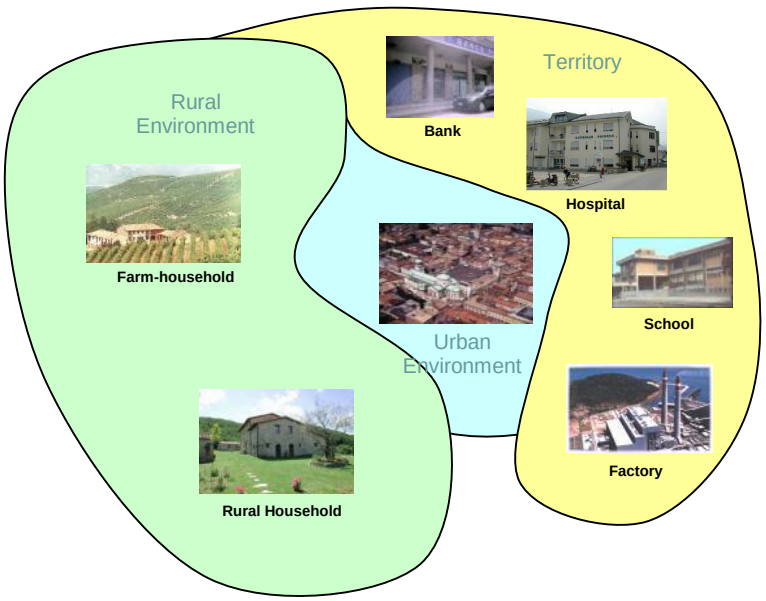
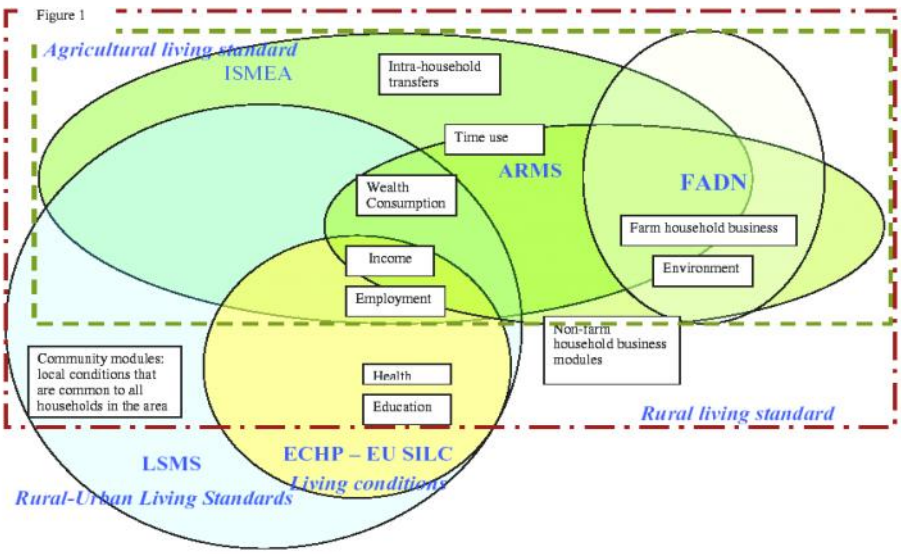


Figure 1b: The design of a rural living standard survey



On the other side, h*ousehold budget surveys* and *living conditions surveys*, for example the EU-Silc, collect data on the household income of the whole rural, agricultural and non, population. As a consequence these surveys can be used to monitor the standar d of living in rural areas. A first problem with this kind of surveys is that the agricultural sub -sample is too little to be statistically

significant (UNECE, 2005). A second problem stems from the kind of information they provide: for example, living conditions surveys do not collect data on consumption, in addition both the kind of surveys do not usually collect data on farm and non farm businesses run by the household, as a consequence their contribution to a rationalization of the political process, to set goals and priorities and to evaluate policy programs, is insufficient due to lack of some of the information needed to model household behaviour.

The most comprehensive survey presently in use is the one proposed by *the Living Standards Measurement (LSM) Unit of the World Bank.* This survey collects data on the socio-economic condition of the households, but also on the business run by the household and on the socio-economic environment in which the household live. The objective of the Living Standard Measurement Unit, originally established by the World Bank in 1980, was to develop new methods for monitoring progress in raising levels of living, to identify the consequences for households of current and proposed government policies, and to improve communications between survey statisticians, analysts, and policymakers to explore ways of improving the type and quality of household data collected by government statistical offices in developing countries (Grosh and Glewwe, 1995). Given the economic environment of the less developed countries, the surveys produced by the LSM Unit are especially concerned with the problems of rural communities and are therefore especially important.

To collect data on many dimensions of household well-being, including consumption, income, savings, employment, health, education, fertility, nutrition, housing and migration the LSMS surveys make usually use of three different kinds of questionnaires. First of all, we consider the *household questionnaire* which collects detailed information on the household members. Because economic welfare is traditionally deduced from consumption data, the measurement of consumption is usually strongly emphasized. A wide range of income information, such as wages or in kind compensations from principal as well as secondary jobs, is also collected. In addition, agriculture and small enterprise modules are designed to yield estimates of net household income from these activities. Data on other sources of miscellaneous income, such as private or public transfers, are also collected. In order to limit the length of the household questionnaire, information on local conditions that are common to all households in the area is gathered in the *community questionnaire*. They are normally used only in rural areas, where local communities are easier to define than in urban areas. Key community leaders and groups are asked to give information on the location and quality of health facilities and schools, the condition of local infrastructure such as roads, the sources of fuel and water, the availability of electricity, means of communication and

agricultural conditions and practices. Eventually, in countries in which prices vary considerably among regions, a *price questionnaire* is proposed to gather information on the prices that households are faced with in practice. A fourth type of questionnaire, the *Special Facility Questionnaires* on schools or health facilities, is sometimes used as well.

6.1.1 The Ismea survey

The Ismea survey is, to our knowledge, the only European survey that provides, in addition to the data on production practices and resource use in agriculture, all the information needed to model farm households' behavior. The survey was sponsored by the Institute for studies on agricultural markets (Ismea[16]) and it was designed and analyzed in collaboration with the *Microsimulation-Unit* of the University of Verona[17]. The survey fulfills the mandate that Ismea builds the agri-food I/O table. In addition, the collected data are critical to the policy analysis mission of Ismea in this way providing the essential information to policymakers (either at the regional, national and Communitarian level) and agricultural organizations when weighing alternative policies and programs that touch the farm sector or affect farm families. The objectives of the Ismea survey were to gather data on the farm and on the household that could be used to asses either the structure and the behaviour of the farm, and to understand household behaviour and welfare in view a lso to evaluate the effect of various agricultural and rural policies on the living conditions of the agricultural population by making use of a collective household approach [18].

The Ismea survey is a probability weighted, stratified survey (by European Size Unit[19] and Farm Type[20]) that collected information from 1881 farms in 1995, 1777 of whom are household farms [21]. Appropriate sample weights (expansion factors) are available to prepare population estimates from the survey results. The collection units are the farms, defined in official statistics as the economical-technical unit composed by land, even if not contiguous, plants and tools, in which

[16] Institute for services in agricultural and agrofood markets.
[17] http://pilar.univr.it/Microsimulation-Unit/progetti-in-corso/inchiesta-ismea95.htm
[18] That is, models that explicitly take into account the existence of differences in resource allocation decisions across the individuals of a same household.
[19] The European Size Unit (ESU) is the indicator used by FADN to measure the economic dimension of a farm. It is based on the standard gross margins (SGM) attributed to the farm, that is on the potential gross margins producible in a farm with given structural characteristics. In 1995: 1ESU = 1200 ecu = 920.95 euro. (INEA, 2000)
[20] "The classification of farms into types is based on the financial potential of the various agricultural activities of the farm and the combination of these activities" (INEA, 2000)
[21] The size of the Ismea survey is in line with the indications given by the LSMS of the Wor ld Bank. LSMS surveys tend to use small samples, often in the order of 1,600 to 3,200 households and rarely more than 5,000 households. Although larger samples would have smaller sampling error, it was judged by survey designers that non-sampling errors would increase more than concomitantly

agricultural, animal and forestry production is undertaken by a person or company or agency which bears the risks. The sampling has been based on the Agricultural Census conducted in 1991 by the Italian National Statistical Institute (ISTAT), censored at the cut-off point of farms with an economic dimension greater of 4 ESU. This criterion has been adopted with th e aim of excluding those enterprises where the agricultural activity is either marginal or dismissed. On the basis of the census results, the universe has been divided in 15 main farm types and 3 ESU classes.
The sample is statistically representative at macro-regional level (North, Center, South).

6.1.1.1 The research program at the basis of the questionnaire design

The elementary unit of the rural economy is the farm-household considered as a joint center of economic activity. Rural economists are interested in knowing the strategies adopted to obtain an adequate level of household income and level of well-being, the levels of poverty and inequality along with the standards of living of the people living in the country and in the urban peripheries, the rules governing the allocation of both farm and household resources on the different activities undertaken on and off both the farm and the family, and the links explaining the relationship between the growth process of the rural economy and the enviro nmental sustainability.

In response to this major change about what is important to understand about the behavior of both rural households and enterprises in the context of the specific local economies, ISMEA has undertaken the socioeconomic survey of Italian agriculture. The design of the ISMEA survey has been developed using a theoretical model at the micro level (Caiumi and Perali 1997), i.e. the farm household general equilibrium micro economy, which allows one to establish links between the micro and macro levels of the economic and policy analysis not previously explored. The corresponding model at the macro level is the general equilibrium model of the macro economy designed with strict micro foundations. The exploitation of this micro-macro mirror image allows the policy analyst to «zoom» the policy and welfare impacts of agricultural, rural and welfare policies «in and out» without loss of relevant information.

The aim is to gather statistical information on the behavior of each family memb er and on the sharing of public and private resources within the household that would permit the empirical analysis of the household decision process. In general, the problems of production decisions, consumption decisions and labor supply decisions are us ually analyzed separately in terms of the behavior of producers, consumers, and workers respectively. Rural households integrate all these

decision units in a single institution. Therefore, it is natural to analyze the linkage between full income, consumption and labor supply of rural households jointly.

Each household can be seen as a household-enterprise producing domestic public goods by transforming factors which are in part nonmarket goods, and therefore not easily measurable. Unlike an urban family, the members of a rural household can allocate their working time with certainty between household and agricultural production activities. For both household types, the value of labor not employed outside the family is implicit. However, only in the case of agricultural activities the value of labor is objectively deducible from the value of the marginal product, since the prices of agricultural output and inputs are determined by the market, while the value of household production is unknown and the value of labor allocated must be implicitly determined.

It is important to emphasize that the model presented here is not specific to the farm households but describes all households involved also in any sort of entrepreneurial activities. Therefore, it can be more properly seen as a «farm/firm» household model. This is the most general model since embeds the case for urban households when farming or other household entrepreneurial activities are not undertaken. The «farm/firm» model is a miniature general equilibrium model where the farm/firm household fully reproduces the characteristics of a macro society at the micro level. In our context, both farming and general household production are marketable domestic goods. In fact, we value household products and inputs using the market approach valuing the different household activities or products at the opportunity cost (Jenkins and O'Leary 1994, 1995, 1996).

The general equilibrium model of the farm household that served as a basis for the survey design, assumes that a household obtains utility from leisure consumption l and from a set of goods $x^* = \{x_z, z_x(x_{zz})\}$ formed by a subset of N purchased goods consumed directly x_z, whose prices are $p^n_{x_z}$ with $n = 1,\ldots,N$, and an aggregate good z_x produced *at home* using a household production technology $z_x(x_{zz}, h): \Re^N_+ \to \Re$, where x_{zz} is the set of V goods purchased in the market as inputs to the household production function, h is time spent in household production activities. The price of the domestic produced good is denoted by p_{z_x}, whereas prices of market inputs to the domestic production are $p^k_{x_{zz}}$ with $k = 1,\ldots,V$. The set of market goods is given by $x = \{x_z, x_{zz}\} = \{x^1 + x^2\}$ $= \{x^1_z + x^1_{zz}\} + \{x^2_z + x^2_{zz}\}$ where the superscript 1 and 2 refer to husband and wife, respectively.

We assume that the household is engaged in the production of both marketable and non-marketable goods. In the present setting, the household economy is endowed with a general technology describing the production processes of marketable goods and goods that cannot be sold

in the market and are consumed either privately or publicly within the household. To distinguish between the two types of products, we term the former house hold products and the latter home products. Interestingly, while a household may not be engaged in producing marketable goods, it is always involved in household activities. In this sense, all households can be considered as household enterprises. For exam ple, rural households engage in farming, urban households may run a job from home being connected to the workplace through internet, may run an ice -cream factory, or a tailor shop. At the same time, they are all involved in managing and undertaking household activities. However, household technologies employed in producing non market goods can be observed if time use data are also available. In the case of complete markets, the implicit valuation of time is the value of the marginal product. If household la bor is allocated both in the household enterprise and household production, then consumption and production decisions are not separable. Profits are exogenous and affect the decision process. When the household product is not marketable, as is the case of family activities undertaken within the household, both the price of the output good and the scale of the activities are unknown. Therefore, the necessary condition to specify an observable technology comes from the assumption of constant returns to scale.

Both household's members work in the household business and in the home activity with the certainty of being employed so that both f^i and h^i are greater than zero. The production environment has no externalities and products are disjoint. Therefore, the pooled optimization problem of the production side of the household economy becomes:

$$\max_{f^i, h^i, F, x_{zz}} \left(pq - \sum_{i=1}^{2} w_i f_i - \sum_{j=1}^{J} r_j F_j \right) + \left(p_{z_x} z_x - \sum_{i=1}^{2} w_i h_i - \sum_{k=1}^{V} p^k_{x_{zz}} x_{zz_k} \right)$$

$$s.t.: \quad q = \psi\left(F, f_i; d_f\right)$$

$$z_x = \zeta\left(x_{zz}, h_i; d_h\right)$$

where p_{z_x} is the endogenous shadow price of the domestically produced good, w_i is the exogenous market wage differentiated by gender, $\varsigma(.)$ is the household production technology and h_i is the time spent in home production activities; $\psi(.)$ is the production technology of the family enterprise producing aggregate output q at price p, f_i is time devoted to the family enterprise activities by the household members and F is a vector of J inputs indexed by $j = 1,\ldots,J$ whose prices are denoted by r_j. Finally, $d = (d_h, d_f)$ is the set of exogenous characteristics pertaining to the household d_h

and d_f to the farm. In the "home market" both the scale of production and objective prices for household products are not observable. Therefore, constant returns to scale are an identifying property of the household technology $\varsigma(.)$, and p_{z_x} is an endogenous shadow price derived by Shephard's lemma applied to the cost function $C(w)z_x$.

Therefore "potential" full income of the household Y is

$$Y = Y_1 + Y_2 = (w_1 + w_2)T + y + \pi_M + \pi_{NM}$$

where T is total endowment of time, $y = y_1 + y_2$ is household non-labor income, π_M is profit from household production and π_{NM} is profit from domestic, non marketable, production.

We consider egoistic utility functions $U^i(x_z^i, z_x^i, l^i)$ for $i \in \{1,2\}$, where x_z^i is an assignable market good, l^i is the individual consumption of leisure and z_x^i is the non-marketable domestic good consumed by member i. The utility function is assumed to be a well-behaved twice continuously differentiable concave function strictly increasing in its elements. Then household budget constraint is

$$p_x \sum_{i=1}^{2} x_z^i + p_{z_x} \sum_{i=1}^{2} z_x^i + \sum_{i=1}^{2} w_i l_i \leq (w_1 + w_2)T + y + \pi_M + \pi_{NM}$$

This formulation of the disposable income-available to acquire market goods for direct consumption, to consume leisure and to consume household products-takes into explicit account labor income from farming in the agricultural profit function and includes the profit function related to household activities. In our set up we assume that all household production is sold in the home market at an implicit price. The right-hand side of the household budget constraint represents the total household financial endowments. Substituting the time constraint, $l_i = \bar{T} - o_i - h_i - f_i$ where $o_i \geq 0$ is labor supply (in hours) differentiated by gender, and the expression for profits π_M obtained from the market and shadow profits π_{NM}, the right hand side of the budget equality can be expanded as:

$$\sum_{i=1}^{2} w_i^l l_i + \sum_{i=1}^{2} w_i^f f_i + \sum_{i=1}^{2} w_i^h h_i + \sum_{i=1}^{2} w_i^0 o_i + \left(pq - \sum_{i=1}^{2} w_i^f f_i - \sum_{j=1}^{J} r_j F_j \right)$$
$$+ \left(p_{z_x} z_x - \sum_{i=1}^{2} w_i^h h_i - \sum_{k=1}^{V} p_{x_{zz}}^k x_{zzk} \right) + y$$

Note that wages differ by gender *i* weather time is employed in activities on farm, off-farm and off-household, on-household, and on leisure as summarized by the set of wages $\underline{w}_i = \left\{ w_i^l, w_i^f, w_i^o, w_i^h \right\}$. Then, further arrangements with the left hand side of the budget equality in (3) lead to:

$$\sum_{i}^{1,2} \sum_{n=1}^{N} p_{x_z}^n x_{z_j}^i + \sum_{i}^{1,2} \sum_{k=1}^{V} p_{x_{zz}}^k x_{zz_k}^i \le \sum_{i}^{1,2} w_i^o o_i + pq - \sum_{j=1}^{J} r_j F_j + \sum_{i=1}^{2} y_i$$
$$= \sum_{i}^{1,2} w_i^o o_i + \sum_{i}^{1,2} \rho_i \pi_M (p, r) + \sum_{i=1}^{2} y_i = Y$$

Household exogenous income *Y* is given by the sum of income obtained from labor supplied outside the household, non wage income y and total returns earned from the family enterprise. Individual full income Y_i is given by the sum of income obtained from labor supplied outside the household, non wage income y_i specific for each agent and farm profits assigned to each member according to the amount of labor provided: $\rho_1 = f_1 / (f_1 + f_2)$ and $\rho_2 = (1 - \rho_1)$. This assumption implies that the value of the marginal product of labor is equal for husband and wife. Note that if there is no farm production $q(.)$, then $\pi_M = 0$ and $f_i = 0$ and the rural model reduces to the urban one.

Within a collective framework we can describe the Paretian program:

$$\begin{aligned} &Max \left\{ U^1(x_z^1, z_x l^1; d, \gamma) \;\middle|\; U^2(x_z^2, z_x l^2; d, \gamma) \ge u_2 \right\} \; or \\ &Max \left\{ \mu U^1(x_z^1, z_x l^1; d, \gamma) + (1-\mu) U^2(x_z^2, z_x l^2; d, \gamma) \ge u_2 \right\} \end{aligned} \qquad \text{(P1)}$$

subject to the following additional constraints:

i. Budget constraint:

$$\sum_{i}^{1,2}\sum_{n=1}^{N} p^{n}_{x_z} x^{i}_{z_n} + \sum_{i}^{1,2}\sum_{k=1}^{V} p^{k}_{x_{zz}} x^{i}_{zz_k} \le \sum_{i}^{1,2} w^{o}_{i} o_i + \sum_{i}^{1,2} \rho_i \pi_M (p, r) + \sum_{i}^{1,2} y_i = Y$$

ii. Time constraint:

$$l_i = \bar{T} - o_i - h_i - f_i, \quad i = 1,2$$

iii. Household technology constraint:

$$z_x = g\left(x^{i}_{zz}, h_i; d_h\right)$$

iv. Farm technology constraint:

$$q = \varphi\left(F, f_i; d_f\right)$$

v. Capacity and non-negativity constraint:

$$x^{i}_{z_n} \le x;\ x^{i}_{zz_k} \le x;\ x \ge 0;\ l_i \ge 0;\ f_i \ge 0;\ h_i \ge 0;\ z_x \ge 0;\ y_i \ge 0;\ Y \ge 0$$

where u_2 is the level of utility of member 2 before decisions are made by member 1 that must be maintained to ensure Pareto efficiency; γ is the shifting parameter of the household welfare function affecting the decision process but not preferences. $\bar{T} = T - \bar{I}$ where $\bar{I}_i$ is time devoted to rest specific to each household member, and T is total time. The parameter μ is the Lagrange multiplier associated to the Pareto constraint included in the first maximand. Here, the multiplier can be interpreted as the implicit weight of each member egoistic utility in the collective decision process (Chiappori 1992) and as an indicator of the level of intra-household inequality. Chiappori (1992) shows that the program in (P1) is equivalent to the following sharing rule interpretation representing the maximization problem of a single household member facing the own budget constraint:

$$\max_{x^{i}_{z}, z^{i}_{x}, l^{i}} U^{i}(x^{i}_{z}, z^{i}_{x}, l^{i};\ d, \gamma)$$

$$s.t.: \sum_{j=1}^{N} p_{x_z} x^{i}_{zj} + \sum_{k=1}^{V} p_{zz_k} x^{i}_{zz_k} \le w^{o}_{i} o_i + \varphi_i(w_1, w_2, y_1, y_2, \gamma) = Y_i \qquad \text{(P2)}$$

and the set of time and technology constraints in (P1)

where $\varphi_i(.)$ is the sharing rule in reduced form and as such it is a function only of exogenous variables. This result is a direct consequence of the Second Welfare Theorem. As pointed out by Chiappori (1992), the sharing function $\varphi_i(.)$ may be negative or greater than total full income Y when one member demands more than available in the shared income so that transfers from other components of the full income have to occur.

The solution of (P1) or (P2) yields the following reduced form system:

Production side			*Consumption side*		
q	=	$\tilde{\varphi}_f(F_j, f_i; d_h, d_f)$	x_i	=	$\tilde{x}_i(P_i, \varphi_i(w_{1,}w_{2,}y_{1,}y_{2,}; d_h, d_f, \gamma), d)$
F_i	=	$\tilde{F}_j(p, r, w_i; d_h, d_f)$	z_i	=	$\tilde{z}_i(P_i, \varphi_i(w_{1,}w_{2,}y_{1,}y_{2,}; d_h, d_f, \gamma), d)$
f_i	=	$\tilde{f}_i(p, r, w_i; d_h, d_f)$	l_i	=	$\tilde{l}_i(P_i, \varphi_i(w_{1,}w_{2,}y_{1,}y_{2,}; d_h, d_f, \gamma), d)$
o_i	=	$\tilde{o}_i(p, r, w_i; d_h, d_f)$			
h_i	=	$\bar{T} - o_i(.) - l_i(.) - f_i(.)$			

where $P_i = (p_x, p_z, \underline{w}_i)$. The production and consumption sides of the farm/ firm household economy illustrate the general equilibrium structure of the model. The exogenous characteristics of both the household and the farm affect both sides of the micro economy. Within the theory of the farm-household this is an interesting feature since it permits testing of the separability hypothesis between consumption and production decisions (Benjamin 1992, Udry 1996). The separation between production and consumption decisions is ensured by the household rational behavior in presence of complete markets. Recent empirical works (Benjamin 1992, Pavoni and Perali 2000) show that production decisions do depend on farmers' preferences and endowments. The jointness in decision making is evident even in the absence of market failures when the same input, such as time, is shared across the household and home production processes and in presence of home consumption of the household marketable product. Imperfections in the labor, credit and land markets are commonly observed in empirical work. Such deviations from perfectly functioning markets and the peculiarities of individual behavior related to the decisions to participate in the labor, capital or goods markets are difficult to model within an econometric model especially if the model describes production and consumption choices jointly. This is not the case if the estimated model is transferred within a mathematical programming environment which treats corner solutions

in a natural way. By so doing, a researcher can pool the statistical power of econometric microsimulation models with the mathematical precision of a programming tool capable of implementing corner choices at the individual level.

6.1.1.2 The questionnaire

The design of the Ismea questionnaire was inspired by the questionnaires in use for the data collection of the farm production (for example that used by the RICA-FADN), those on the consumption of household members (such as the one used by ISTAT), by the EU time budget and by the questionnaire used by the Bank of Italy to collect data on household incomes. The final result is a set of questions very close to those suggested by the Living Standards Measurement Study[22] to assess the welfare of rural households.

The Ismea survey was designed in such a way to provide the information needed to assess not only the economic impact of policy programs at the farm level, but also the socio-economic impact at the farm household level, that is to assess the impact on the living standard and economic welfare of farm households. In order to allow the analyst to evaluate and measure such a socio-economic impact the Ismea survey contains a module of questions gathering information on the quality of life and on other characteristics of farm households. Accordingly, a multi-topic questionnaire was designed to collect data on many dimensions of the farm and of the household well-being, including consumption at the individual level, income, savings, financial wealth, governmental and intra-household transfers, education and housing (see Table 1). In other words, an important characteristic of the questionnaire is that the attention is shifted from the traditional farm operation perspective to the farm household-firm unit one. For examples, information on the social characteristics (gender, age, level of education, professional characteristics, etc.) not only of the farm operator but of all family members are collected.

There is a first group of questions on housing characteristics, the answers to these questions can be used to infer the standard of living of the agricultural household.

A second group of questions collects detailed information on the household consumption: the consumption of food, either bought from the market - recording both quantities and prices- and grown in the farm, and the consumption of both semi durables and durable goods -distinguishing between children and adult goods. Measurement of consumption is emphasized in the

[22] The Living Standards Measurement Study was established by the World Bank in 1980 see paragraph 3.1 for more details.

questionnaires because this kind of information allows the researcher to estimate household models and to measure household economic welfare.

The first part of the questionnaire is complemented by a module containing questions on the intra-household decision making process for both farm and household de cisions, on the household goods (household header growths in farm, time spent in family, farm inheritance and farm legacy), on intra-household transfers, on subjective measures about the risk associated to future investments in agriculture and intentions about the future development of the farm. This is a set of information, usually not available in the traditional agricultural statistics, that proved to be very useful, for example, in order to tackle problems such as modelling the intergenerational succession of household farms, or the on- and off-farm labor decisions within the farm household.

The set of data on the household welfare is eventually completed by a group of questions on the household income (comparable to the survey on household income conducted by the Bank of Italy and by the European Community Household Panel), the savings and financial investments of the family.

In addition, the questionnaire contains a stylized time sheet [23] describing how much time each family component is devoting to activities such as on and off-farm work, household work, child care and pure leisure time. This last kind of information is very useful when the work roles and off-farm labor participation of different members of the family are analyzed. In addition, the data gathered in the time budgets are also essential for estimating the full and extended household income.

The inspection of Table 2 reveals that the Ismea survey contains a very large subset of the information on the household suggested by the Living Standards Measurement Study of the World to analyze the quality of life of households. The information gathered by the Ismea survey make the analyst able to analyze the agricultural household living standard. It is easy to see that to make it possible to study the living standard not only of the agricultural but of all the rural household it is necessary to extend the data set collected by Ismea with information on non farm enterprises run by the household members and on the services access and use.

Finally, another peculiarity of the Ismea survey is that, differently from the questionnaire used by the RICA-FADN, both the sections on production and the one on factor use are structured by activity. This level of details of the data is needed when the information is gathered in order to build the input/output table of the agricultural sector.

[23] Comparable to that used by ISTAT in the "Multiscopo survey" and in the Communitarian survey on time budget conducted by Eurisko.

Table 1: Modules in the Ismea survey

Module	**Respondent**	**Subject**
Section I : «General information about the household»		
Tenure, legal status, structural and other characteristics of the farm	Best-informed farm member	Tenure, owned and rented land, physical size, altitude, etc.
Section II: «Characteristics of the households and labor organization:»		
Information on the family	Best-informed family member	Social characteristics (gender, age, level of education, professional characteristics, etc.) and hours of labor worked by the household members
Information on wage workers (fixed and temporary)	Best-informed farm member	Gender, hours of labor worked in high and low season, gross monthly wage by qualification???.
Section III: «Commercialization:»		
Purchase of inputs and sales of farm products	Best-informed farm member	Product marketing and institutional arrangements
Section IV: «Production:»		
Crops, livestock and products of livestock.	Best-informed farm member	Quantities produced, self-employed and processed products, stocks, sales and prices, premiums and subsidies.
Other farm revenues	Best-informed farm member	It collects information on farm revenues different from the sale of agric. products (machine hiring, custom work, land rents, production contracts, agriturism, insurance payments, etc.)
Section V: «Factor use:»		
Inputs and labor used for crops and livestock	Best-informed farm member	Cash expenditure for inputs (fertilizers, other chemicals, seeds, feeds, water, oil and insurances) by activity and number of hours worked by family members, waged workers and machines.
Labor cost	Best-informed farm member	Salaries payed
Other expenses	Best-informed farm member	Overheads, environmental, etc.
Section VI: «Investments and financial activities:»		
Land and investments	Best-informed farm member	Value of land capital and investments

6.1.1.3 A prototypical rural living standard survey

In order to assess the impact of policy programs on the standards of living of rural households a new kind of survey has to be designed, that allows to collect detailed information either on farm household but even on other non farm households enterprises as well as on the whole socio-economic environment in rural areas. In the previous paragraphs, it was explained what kind of information are needed to assess the socio-economic impact of various governmental policies, that is the impact on the level of living of household.

In order to assess the welfare of rural household, the multi -topic structure used by the LSMS can be integrated with some modules providing details such as those in the Ismea survey. For example, it has been already pointed out the importance of information about consumption in order to assess the economic well being of the household.

Table 2: A prototypical rural living standard questionnaire

	Rural/urban	Agricultural		
	LSMS	Ismea	ARMS	Rica/FADN
HOUSEHOLD MODULES				
DEMOGRAFIC DATA	x	x	x	x
CHARACTERISTICS OF HOUSING	x	x		
EDUCATION	x	x	x	
HEALTH	x			
EMPLOYMENT	x			
TIME USE	x	x		
MIGRATION	x			
AGRICULTURAL ACTIVITIES	x	x	x	x
NON AGRICULTURAL HOUSEHOLD ENTERPRI SE	x			
EXPENDITURE ON FOOD	x	x		
EXPENDITURE ON NON FOOD	x	x		
FERTILITY	x			
OTHER INCOME	x	x	x	
SAVING AND BORROWING	x	x		
ANTHROPOMETRIC	x			
BEQUEST AND PREFERENCES ABOUT CHILDREN		x		
TECHNOLOGY AND ENVIRONMENT		x		
INTRAHOUSEHOLD DECISIONS		x		
INTRAHOUSEHOLD TRANSFERS		x		
COMMUNITY MODULES				
DEMOGRAPHIC INFORMATION	x			
ECONOMY AND INFRASTRUCTURE	x			
EDUCATION	x			
HEALTH	x			
AGRICULTURE	x			
PRICE MODULE				
	x			
SERVICES				
access, need, reason for not using, satisfaction, type use	x			

Information on the household assets are needed to define the household wealth. Modules providing information on the technology adopted by the household farm and on the propensity

toward risk can also be of help for a better understanding and analysis of the household behavior. A prototypical rural living standard questionnaire integrating the LSMS modules with the Ismea ones is presented in Table 2.

These recommendations are an integral part of the work published by the workgroup on Rural Households' Livelihood and Wellbeing. They are also incorporated in a survey of new generation to measure Rural living Standards et described in in the web s ite http://dse.univr.it/rsls.
It is important to stress that the holistic approach adopted in designing a rural living standard survey is fundamental to establish a macro-micro link which is complete in the sense that the production and consumption side of the economy are also jointly considered at the household level. This aspect will be apparent in the next two sections which illustrate the impact of the CAP reform both at the at the regional and household level.

6.2 The impact of the CAP reform using a general equilibrium model disaggregated at the regional level

The general equilibrium impact of reforms on Italian agriculture is here developed both at the macro and micro level of analysis. The Applied General Equilibrium Model (MEG) is based on a social accounting matrix which incorporates seven farm-household types, one rural household type and three urban classes of households. This macro level of analysis is statistically linked to the micro level of analysis, represented by the farm-household, because the aggregate SAM at the core of the general equilibrium model is constructed from the aggregation of the household level micro-data.

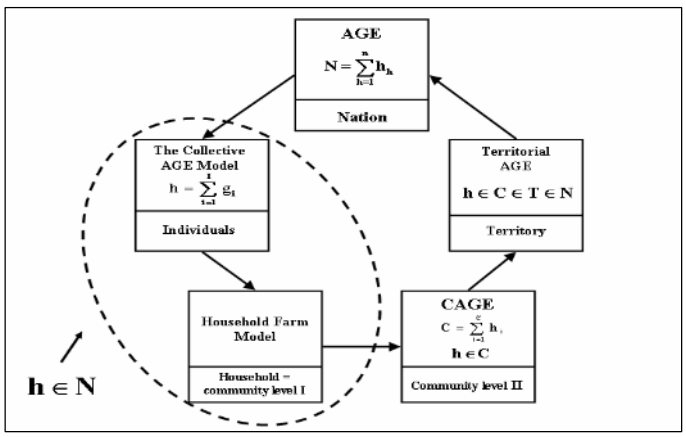
The micro-level of the farm-household analysis presented in section 6.1.1.1 is carried out by first estimating the micro-econometric model of the farm-household, and, in sequence, constructing a farm-household general equilibrium model calibrated using the estimated elasticities of the econometric model and the average data of each farm-household type. The simulations of the application are behavioral both at the macro and micro level.

This application seeks to evaluate the macro distributional impacts of agricultural reforms and trade agreements on policy-relevant farm, rural and urban household types in Italy by describing the households' behavioral response to the policy changes. The analysis contributes to improving our knowledge on the possibility to make the macro and micro level of analysis as complementary as possible in order to understand the welfare consequences of policy changes both at the household and individual level. The application intends also to learn something about the transition

from a macro description of the economy, where most markets function, to a micro understanding of the farm-household economy, where most market fails or are absent. At the micro -level, most policy changes are likely to induce internal reallocations of income and of other resources such as time affecting households' real adjustment capabilities in a way which is not obv ious in situations where markets are missing. The Italian case study also sheds lights on some of the conditions in survey design, data interpretation and model building for the micro -macro approach to be applied in distributional analysis for other develo ped and developing countries.

Figure 2 describes the micro-macro link between the general equilibrium model at the macro level of the economy and the general equilibrium at the micro level of the household economy which differentiates for individual behavior. The dashed set diagram emphasizes the fact that the primitive macro-micro link is the one aggregating all household individuals into the family seen as a macro-society. Then, households at the micro level aggregate up to the macro -level of the whole economy. As shown in the right panel of the figure, households can aggregate also at the intermediate level of a community, such as a village, or of a territory such as a natural park, an industrial district or a region. The statistical consistency acr oss levels of aggregation is ensured by the peculiar design of the underlying information source which is the same across levels.

Figure 2: The Micro-Macro link



Then, the modeling effort of this application develops in two directions: 1) the macro applied general equilibrium (MEG) model specialized at the regional level (MEG -R) developed in collaboration with ISMEA, 2) the micro general equilibrium model of the farm -household based on a micro econometric model of the farm -household (Menon, Perali 2005) discussed in Section 6.2.

Each farm-household is then treated as a miniature economy within a general equilibrium framework which is best suited to analyze the micro impact of the macro policies un der non competitive conditions.

6.2.1 Data

The ISMEA data set comprises 5 survey types in one: (a) Farm budget data (b) Input/Output Table (c) Stylized Time Use Budget (d) Household Consumption Survey (e) Household Income Survey. The Input/Output information about the farm resource (ISMEA 1997) use is also the basis to construct both a Social Accounting Matrix (SAM) and a 4 5 sectors Applied General Equilibrium (AGE) model of the Italian farm economy. One single source of information feeds both the micro and macro behavioral model.

Table 3 shows the data sources used to build the Italian SAM. Note that the ISMEA survey provides by itself all the information necessary to build the SAM of th e Italian agricultural sector. The ISMEA survey was designed to build the input-output table of agriculture for the Ita lian economy and include the budget of the farming business along with the expenditure, income, wealth and time-use component. The other nationwide sources of information described in the table, that is the household expenditure survey conducted by the Ita lian Statistical Institute (ISTAT), the household income and wealth survey run by Bank of Italy and the time use survey implemented by Eurisko, are needed to extend the agricultural SAM to the SAM of the Italian economy.

Table 3: Data Sources

	Agricultural Households	***Rural and Urban Households***
Farm Budgets *Household Budgets* *Income* *Leisure*	*ISMEA*	*Italian Input-Output Table* *ISTAT '95, Household Budgets* *Banca d'Italia '95, Income data* *Eurisko '95, Time Use Data*

Individual survey households are aggregated into three regional farm-household types using both the farm and household information contained in the ISMEA data set as summarized in Table 4. These farm-household types are: 1) the farm-household of Northern agricultur e, 2) the farm-

household of Central agriculture, 3) the farm-household of Southern agriculture, 4) rural non-farm households, 5) urban households (separated into three income categories: low, middle and high). Both the micro and macro level models include leisure as measured from the stylized time use budget which is a characteristic unique to the ISMEA survey. Leisure is defined as the sum of time devoted to recreational activities, personal care and rest.

Table 4: Composition of the 7 households classes

Farm-households	**Non agricultural households**	
	Rural	**Urban**
(i) North (ii) Centre (iii) South	(viii) rural	(ix) high income (x) mid income (xi) low income

6.2.2 The Regional General Equilibrium Model – MEG-R

The MEG-R model includes 45 sectors and places particular emphasis on the agricultural sector: As illustrated in Table 5, agriculture is disaggregated into 23 agricultural sectors which vary by macro-region (North, Centre, South), agro-industry in 9 sectors, other industries in 7 sectors, and services in 2 sectors. Each sector produces a single output, using intermediate goods and primary factors according to a two levels CES production function. The agricultural sectors use 10 production factors: land (distinguished in three types as shown in Table 6), agricultural capital, labour (distinguished in independent farm labour and dependent labour), and animals (distinguished in four types), while the other sectors use two production factors: non agricultural capital and labour. The MEG-R distinguishes two institutional sectors, the households and the government. The MEG-R includes 3 farm-household types describing the agricultural production-consumption specificities of the North, Center and South of Italy, 1 rural household type, and 3 urban classes. This classification permits an accurate distributional and welfare analysis of the impact of agricultural policies upon policy relevant farm-household types Finizia, Magnani and Perali (2004). International trade is introduced in the model by considering two trade areas: European Union (EU) and the rest of the world (RoW). The model incorporates the main features of the CAP reform (OECD 1988, Weyerbrock 1998, De Muro and Salvatici 2001) and is designed to compare the social desirability of the total versus partial decoupling options proposed by the reform. This set of characteristics has been summarized in Table 7.

The MEG-R model is comparable to other national models used for policy analysis such as the French MEGAAF (Gohin, Gouyoumard, La Mouël 1999, 2002, Gohin 2002) and Adelman and Robinson (1978), De Melo (1988), Hertel (1999), Shoven and Whalley (1984) for general references of general equilibrium models applied applied to agricultural policies. The MEG-R distinguishes itself for the regional feature that will be described in Section 6.2.2.

Total decoupling gives the market back both the allocative and the redistributive function thus favoring greater efficiency in the use of resources in activities and areas of greater comparative advantage. Income levels of farming households are maintained by granting a non distortive lump-sum corresponding to the amount of premiums received in the reference situation of year 2001-2002. In general, a totally decoupled scheme would mitigate the problem of distributive justice associated with coupled payments which, by design, benefit mainly the large producers. The adjustment process induced by the reform may encourage farmers to adopt least cost practices and activities with the objective of minimizing the use of labor and other inputs in agriculture. The increase in pasture production at the expenses of durum wheat in the Italian south is an example of such a change.

An example may help describing this behavioral reaction to decoupling. In the center region of Italy cereal farmers traditionally face the choice of planting either soft or durum wheat. In the pre-reform situation coupled premiums were giving durum wheat a comparative advantage over soft wheat in terms of a lower cost to returns ratio. Under a decoupled scheme, the terms of convenience are inverted. However, neither durum nor soft wheat would be produced by a rational farm because both crops have costs higher than gross returns. It is therefore more allocatively efficient to switch, for example, to low cost pasture production while receiving the lump-sum payment based on the cereal production of the reference situation. This new configuration frees resources in surplus such as labor and other inputs available for more efficient uses in other sectors of the economy. Agricultural surplus labor may give rise to unemployment, especially in the south, where employment opportunities lack. The farm enterprise keeps farming but at an activity level low in input use. We term farm-households adopting this behavior as “disactivated.” This reaction is in line with the spirit of the reform.

Interestingly, the policy implications of this example can be fully captured only if the macro model is developed with a regional detail as it is done in the present research.

Table 5: Sector Definitions

	Agriculture by region	
1	*CEREALS*	Soft wheat
2		Durum wheat
3		Rice
4		Corn and other cereals
5	*VEGETABLES*	Fodder (maize silage)
6		Non irrigated fodder
7		Potatoes
8		Tomatoes
9		Other vegetables and legumes (beans, peas, garlic, cabbages, mushrooms...)
10	*INDUSTRIAL CROPS*	Sugar beet
11		Soy-bean
12		Other industrial crops (hemp, linen, cotton, peanuts, sesame, other oil seeds)
13		Raw tobaccos
14	*VITICULTURE*	Grapes
15	*OLIVE*	Olives
16	*FRUIT*	Citruses, fresh and dry fruit
17	*FLORICOLTURE*	Floriculture and other products (flowers and seeds, spices, sugar, coffee…)
18	*MILK*	Bovine Milk
19	*BEEF*	Bovine meat livestock
20	*FORESTRY*	Forestry
21	*OTHER LIVESTOCK*	Sheep and goats
22		Pork, chicken, rabbits
23	*FISH*	Fish and other sea products
	Agro-food sector	
24	*BOVINE*	Fresh and preserved bovine meat
25	*MILK PRODUCTS*	Milk and milk products
26	*TRASF. CEREALS*	Cereal products
27	*BREAD*	Bread products
28	*PASTA*	Pasta products
29	*VEG-FRUIT*	Processed and preserved fruit and vegetables
30	*OIL*	Olive oil
31	*FATS*	Other vegetal oils, fats
32	*FEED*	Feeds
33	*TOBACCO*	Cigarettes
34	*SUGAR*	Sugar
35	*WINE*	Wine
36	*OTHER AGRO-FOOD IND*	Alcoholic beverages, beer, non alcoholic bevera ges, tea, coffee
	Other industries sector	
37	*FUEL AND LUBRIF*	Fuel and oils
38	*ENERGY*	Electric power
39	*WATER*	Water
40	*FERTILIZERS*	Fertilizers
41	*PESTICIDES*	Pesticides
42	*OTHER CHEM.- PHARMAC. PROD.*	Other chemical and pharmaceutical products

Table continues

Table 5: (continued)

Other industries sector (continues)		
43	*HEAVY INDUSTRY*	Maintenance, other indust. products, agric. and indust machinery, constructions and public works, other indust. productions (products of iron and steel, glass, motor vehicles, ships, aircrafts, spinning and webbing, footwear, furniture...)
Services sector		
44	*TRCOMUNCRINS*	Transports and communication, credit and insurance
45	*OTHER SERVICES*	Other services (business, hotels and public services, recreaton services, Public Admin. services, public and private health services…)

Table 6: Composition of the groups of land

LAND A	**LAND B**	**LAND C**
Soft wheat	Potatoes	Grapes
Durum wheat	Tomatoes	
Rice	Other vegetables	
Corn	Olives	
Fodder	Fruits	
Non irrigated forage		
Sugar beet		
Soy-bean		
Other industrial crops		
Raw Tobacco		
Floriculture		
Bovine Milk		
Bovine meat livestock		
Forestry		
Sheep and goats		
Other livestock		

6.2.3 The Regional Extension of the Model

The regional extension of the MEG model allows for a better micro-funded approach giving a territorial dimension to the results. The MEG-R model permits:

a) to estimate the impact of agricultural policies on production decisions across regions. In the aggregate MEG, where productions are aggregated at national level as in most of the general equilibrium models adopted by developed countries governments, the impact analysis is based on the assumption that all crops are produced in all regions. On the contrary, in Italy, for instance, maize is produced only in the northern region, while durum wheat only in the South.

b) to link the production and consumption side of the farm household in each macro-region. In the aggregate MEG the representative Italian farm has a unique production technology

separated from the consumption decisions of the seven household typologies. In the MEG - R, the representative farm household production and consumption decisions are linked and differ across macro-regions. Each region is considered as a micro general equilibrium model where the representative household farm behaves a closed economy.

c) to analyze factor allocations (labor, capital and land) taking into account, for each household type, the possibility that certain factors may not be employed. For instance, it could be convenient, under particular policy conditions, to supply family labor on off farm activities rather than on farming.

d) to analyze price effects at the regional level.

Table 7: The structure of the Italian regional MEG-R model

- A multi-regional multi-sector static CGE model of the Italian economy focused on agriculture and agri -food sector
- Calibrated on the 1995 ISMEA I/O table updated to 2003
- Perfect competition in all markets and neoclassical macroeconomic closure.
- 45 sectors: 23 in the primary sector, 14 in the agro -food sector, 7 in the industrial sector, 2 in the service sector
- 2 trade areas: the rest of the European Union (EU) and the Rest of the World (RoW)
- 2 institutional sectors: the households (3 regional agricultural households, 1 rural and 3 urban classes) and the Italian government.
- Two-stage constant-returns to scale production functions with imperfect substitution between inputs, including intermediate inputs using nested CES functions.
- 11 types of primary production factors: labor (dependent labor and farm independent labor); capital (capital and agricultural capital); land (three types of land); animals (four types of animals for the sectors 18, 19, 21, 22)
- Household preferences are described using a two-stage CES utility function. In the first stage, the utility depends on aggregate consumption and leisure. In the second step each class decides, on one hand, the optima l allocation of the aggregate consumption across the goods produced by the 45 sectors, and, on the other, the optimal allocation of labor supply between dependent labor and farm independent labor.
- International trade.
  On the export side, the relation between domestic sales and exports is described with a CET function.
  On the import side, domestic and foreign goods are "Armington" imperfect substitutes. We have two cases:
  1) large country hypothesis for some goods: imperfect s ubstitution between production and import so that their prices are different and the market equilibrium price is endogenous.
  2) small country hypothesis with respect to the rest of the world for wheat, durum wheat, soy -bean assuming perfect substitution between production and import so that their prices are identical and the market equilibrium price is exogenously fixed at the world level.
- Modeling of the Common Agricultural Policy's main features such as the s ingle farm payment, intervention price mechanism, import tariffs, production quotas, set-aside, decoupling and all the CMO's but for fruits and viticulture.

In order to extend the aggregate model at the regional level, it has been necessary to:

1. update and balance the SAM on which the MEG-R is calibrated to the year 2003;

2. decompose the national SAM in 3 regional sub matrices as illustrated in Figure 3 ensuring the conditions for exact aggregation requiring that the 3 regional SAMs add up to the national SAM as described in Table 8 and Table 9;
3. including the micro general equilibrium models of the representative regional household farms within the macro model as shown in Figure 4;
4. adopting a mixed complementary framework (MCP) based on the Kuhn-Tucker theorem which allows for the decision of not producing a particular kind of crop in the different regions. The optimization problem includes both equality and inequality constraints and takes into account the distribution of crop productions across regions, i.e some crops are not produced in all macro – regions. Changes in agricultural policies may alter the necessary conditions and affect the crop portfolio choice of a particular region.

The Social Accounting Matrix for 2003 is based on the input – output table of the Italian economy (2003) which has been extended using information from the national statistics institute (ISTAT, Survey on Household expenditure 2003) and the central bank (Bank of Italy, Survey on household income, 2003) referred to non agricultural sectors and households. As regard the agricultural aspects, information still refers to the Socio-economic Survey of Italian farm households conducted by Ismea in 1995 which has been updated to 2003 during the balancing process. Given the heterogeneity of the information sources used, the initial SAM was not balanced and the matrix accounts has been harmonized using the *Cross Entropy Method*. This method exploits the information contained in the initial matrix and allows for submatrices and aggregates to being fixed to specific targets. In particular, we collected disaggregate and complete information on imports and export from and to Europe and the Rest of the World, taxes and contributes, value of production, value added components for non agricultural sectors and household income and consumptions. Agricultural data, e.g. inter-sector transactions and value added components has been derived from the 1995 input – output table rescaled in accordance with available data in 2003. The initial unbalanced SAM, therefore, has been obtained combining data released in 2003 and constructed data based on 1995 information. The *Cross Entropy Method* has been applied fixing the cell contents, when complete information was available (see above), and including some targets such as value added in agriculture and in the agri-food sectors. The balanced SAM for 2003 maximizes the contribution of initial disaggregate information ensuring the correspondence with national aggregate statistics.

Figure 3: Exact regional aggregation

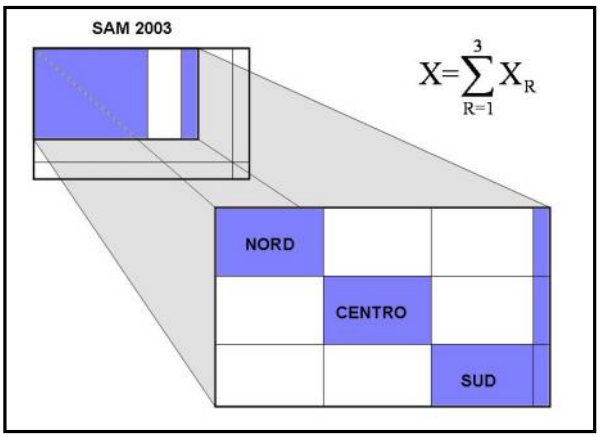
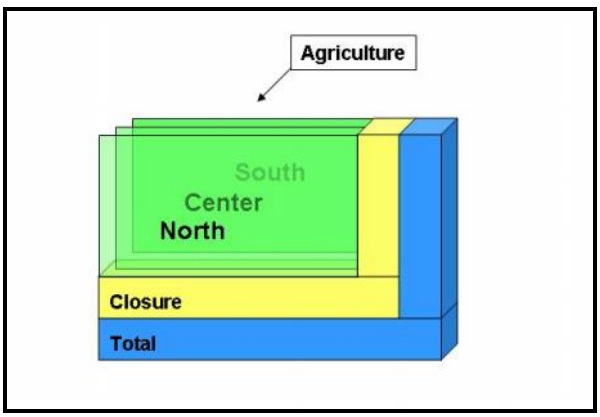


Figure 4: Integration of the regional farm-household enterprises within the macro model



In the construction of the Regional Social Accounting Matrices (RSAM), three matrices of weights, representing the contribution of each region to the national agricultural production, have been used. These matrices have been constructed using micro data collected by the 1995 Ismea Socio economic survey of Italian farm households. They contain the shares in terms of input s and factors of production employed and outputs produced by each region and referred to the 22 branches in which the agricultural sector has been divided. They also include the shares of consumption expenditure by agricultural households in the three regi ons. No information is available from the micro data on the proportions of imports and exports of each region therefore, at the moment, these accounts have not been disaggregated and are considered only at the national level. Further development may involve the disaggregation of imports and exports on the basis of data released by the national statistic institute (Istat) to account for inter-regional trade.

The national SAM 2003 has been multiplied by each respective matrix of weights to obtain a Regional Social Accounting Matrix. As it regards the agricultural sector, the three RSAM aggregate exactly in the sense that they add up to the national SAM. A "closure account", which contains imports, exports, non agricultural sectors accounts and non agricu ltural households accounts, is needed to obtain the entire national SAM.

Table 9: Regional SAM disaggregation of the agricultural sector North – Center – South - in millions of euros

		Agriculture			Consumption
		North	**Center**	**South**	
Agriculture	**North**	1729			1028
	Center		543		374
	South			914	843
Other sectors		6859	2924	4500	79897
Factors		11347	6053	11476	
Government		-136	-840	-595	
Total		19799	8680	16295	82142

Table 8: Aggregate SAM (2003) data in millions of euros

	Sectors	**Factors**	**Households**	**Government**	**Investments**	**Exports**	**Total**
Sectors	1428248		794785	262653	277871	368260	3131817
Factors	1161635					25497	1187132
Households		1187132		224485			1411617
Government	148177		194000				342177
Savings			422832	-144961			277871
Imports	393757						393757
Total	3131817	1187132	1411617	342176	277871	393757	

6.2.4 The Distributional Impact at the Macro and Regional Level of Total Decoupling

We analyze the general equilibrium effects at the regional aggregate level of the implementation of total decoupling, as approved by the Italian government in the summer of 2004, by focusing our attention on the impact upon the 1) activity portfolio and value added composition, 2) changes in production prices, 3) land and other factor prices such as labor demand and remuneration, and 4) farm-household incomes and welfare levels.

The macro results differentiated by region under the total decoupling scenario are described in Table 10 which describes the activity choices, in Table 11,12 and 13 which presents the percentage change in production (Xs) and domestic consumption prices (Pd) and in Table 14 describing the percentage changes in factor prices.

Inspection of Table 10 reveals that the production of soft wheat is mainly concentrated in the North 63.3 percent), while production is significantly lower in the Centre and South of Italy. In line with the agronomic vocation of the Italian agricultural territory, 73.4 percent of durum wheat is in the South and 25.1 percent is produced in the Centre. Ric e production is concentrated in the North. Corn production follows a similar regional pattern as for soft wheat.

As shown in Table 11, 12 and 13, the impact on production choices at the regional level shows a highly differentiated pattern that would be hidden at the aggregate level. The regionalization of the macro model can implement both economic and agronomic constraints effectively, thus making the policy analysis more real and potentially effective. The impact on production and consumption prices of crops is described at the detailed level to show that the small effect on both the level of production and price is the effect of the weighted aggregation which hides the large fluctuations for wheat, fodder, soy beans and other industrial crops. The reduction in crops is especially pronounced in the Centre region. The fruit and vegetable sector shows a small impact in all regions because it is not directly interested by the reform. The milk sector shows a negligible impact from decoupling in all regions. Livestock production, especially beef, is expected to increase by about 15 percent in the North, remains unchanged in the Centre and decreases sharply by 32.7 percent in the South of Italy. Note that prices are the same in all regions because markets cl ear at the national level. Interestingly, the livestock sector increases in the North independently from a reduction of 2.2 percent of beef prices thanks to a reduction of the price of fodder and dry hay.

Table 14 illustrates the percentage changes in factor prices. Note that only the price of land varies regionally. The impact of the reform on hired-labor is negligible, while the demand for farm labor decreases slightly in response to a small increase in the cost of family labor employed in the

Table 10: Regional Production Choices (in value)

	North	Centre	South	Italy
1 *Soft Wheat*	318.46	108.69	75.81	502.96
	63.3%	**21.6%**	**15.1%**	
2 *Durum Wheat*	16.30	272.75	797.95	1087.00
	1.5%	**25.1%**	**73.4%**	
3 *Rice*	593.00			593.00
	100.0%			
4 *Corn and Other Cereals*	1304.64	303.64	362.79	1971.08
	66.2%	**15.4%**	**18.4%**	
5 *Fodder (Maize Silage)*	546.23	133.47	421.95	1101.65
	49.6%	**12.1%**	**38.3%**	
6 *Non Irrigated Fodder*	548.88		164.33	713.21
	77.0%		**23.0%**	
7 *Potatoes*	165.51		378.49	544.00
	30.4%		**69.6%**	
8 *Tomatoes*	830.20		355.80	1186.00
	70.0%		**30.0%**	
9 *Other Vegetables*	1853.54	1984.37	3285.10	7123.00
	26.0%	**27.9%**	**46.1%**	
10 *Sugar Beet*	118.87	101.61	44.52	265.00
	44.9%	**38.3%**	**16.8%**	
11 *Soy-Bean*	129.00			129.00
	100.0%			
12 *Other Industrial Crops*	117.14	510.62	136.10	763.87
	15.3%	**66.8%**	**17.8%**	
13 *Raw Tobaccos*		232.40	138.60	371.00
		62.6%	**37.4%**	
14 *Grapes*	1140.48	992.68	1382.84	3516.00
	32.4%	**28.2%**	**39.3%**	
15 *Olives*		536.70	1901.30	2438.00
		22.0%	**78.0%**	
16 *Citruses, Fresh and Dry Fruit*	1545.74	1148.26	2123.07	4817.07
	32.1%	**23.8%**	**44.1%**	
17 *Floriculture*	1495.00		209.19	1704.20
	87.7%		**12.3%**	
18 *Bovine Milk*	2897.35	213.86	831.79	3943.00
	73.5%	**5.4%**	**21.1%**	
19 *Bovine Meat Livestock*	2607.55		1006.45	3614.00
	72.2%		**27.8%**	
20 *Forestry*	63.54	410.46		474.00
	13.4%	**86.6%**		
21 *Sheep and Goats*	78.33	163.63	468.04	710.00
	11.0%	**23.0%**	**65.9%**	
22 *Pork, Chicken, Rabbits*	3093.07	1482.79	1854.13	6430.00
	48.1%	**23.1%**	**28.8%**	

farm. The demand for agricultural capital increases markedly as a result of a decrease in the price of capital. It is unclear what the impact on the environment from higher inputs can be as a result of the implementation of decopling. Higher land prices, especially in the North, are expected to curb transactions of land properties, but may activate the rental market for land.

Table 11: % Change in production (Xs) and Domestic Consumption Prices (Pd) Under a Total Decoupling Scenario – Detail and aggregate results NORTH

		Xs Production	Pd Domestic Price	Weight	Weighted Xs	Weighted Pd
Crops						
1	*Soft Wheat*	-14.32	0.25	4.4%	-0.63	0.01
2	*Durum wheat*	-48.70	0.25	0.3%	-0.15	0.00
3	*Rice*	-4.69	-1.32	9.4%	-0.44	-0.12
4	*Corn*	6.09	-1.76	21.8%	1.33	-0.38
5	*Fodder*	40.90	-10.00	8.9%	3.63	-0.89
6	*dry hay*	3.60	-14.98	9.0%	0.32	-1.34
7	*Potatoes*	5.11	-2.20	2.6%	0.13	-0.06
8	*Tomatoes*	2.18	-1.60	11.4%	0.25	-0.18
9	*Other vegetables*	-1.53	0.46	23.6%	-0.36	0.11
10	*Sugar beet*	-16.20	-31.86	1.6%	-0.26	-0.52
11	*Soy beans*	-99.75	0.25	5.8%	-5.80	0.01
12	*Other industrial crops*	-68.77	3.04	1.2%	-0.85	0.04
13	*Tabacco*		8.12	4.4%	0.00	0.00
Total				**100.00%**	**-2.84**	**-3.33**
Fruits and vegetables						
14	*Grapes*	0.61	-0.05	26.1%	0.16	-0.01
15	*Olives*		-1.30	0.0%	0.00	0.00
16	*Citruses, fresh and dry fruits*	0.68	-0.21	31.8%	0.22	-0.07
17	*Floricolture*	2.30	-1.11	41.0%	0.95	-0.46
20	*Forestry*	-7.53	-2.40	1.0%	-0.08	-0.02
Total				**100.00%**	**1.24**	**-0.56**
Milk	\					
18	*Milk and milk products*	-0.22	-2.36			
Total					**-0.22**	**-2.36**
Livestock						
19	*Beef*	31.05	-2.17	51.1%	15.87	-1.11
21	*Sheep and goats*	274.64	-1.30	1.6%	4.37	-0.02
22	*Other livestock*	-9.80	-0.49	47.3%	-4.64	-0.23
Total				**100.00%**	**15.60**	**-1.36**

The land market may also suffer from legal conflicts due to the unclear definition of property an d rental rights in the reference situation leading to higher transaction costs. Farm wages decrease slightly but the value of land would be seriously affected.

Table 12: % Change in production (Xs) and Domestic Consumption Prices (Pd) Under a Total Decoupling Scenario – Detail and aggregate results CENTRE

		Xs Production	Pd Domestic Price	Weight	Weighted Xs	Weighted Pd
Crops						
1	*Soft Wheat*	-32.17	0.25	2.85%	-0.92	0.01
2	*Durum wheat*	-12.51	0.25	10.27%	-1.28	0.03
3	*Rice*		-1.32	0.00%	0.00	0.00
4	*Corn*	2.53	-1.76	8.98%	0.23	-0.16
5	*Fodder*	25.03	-10.00	3.78%	0.95	-0.38
6	*dry hay*		-14.98	0.00%	0.00	0.00
7	*Potatoes*		-2.20	0.00%	0.00	0.00
8	*Tomatoes*		-1.60	0.00%	0.00	0.00
9	*Other vegetables*	0.39	0.46	42.57%	0.16	0.19
10	*Sugar beet*	-9.42	-31.86	2.48%	-0.23	-0.79
11	*Soy beans*		0.25	0.00%	0.00	0.00
12	*Other industrial crops*	13.38	3.04	11.57%	1.55	0.35
13	*Tabacco*	-49.20	8.12	17.50%	-8.61	1.42
Total				**100.00%**	**-8.16**	**0.67**
Fruits and vegetables						
14	*Grapes*	0.46	-0.05	43.92%	0.20	-0.02
15	*Olives*	3.54	-1.30	26.80%	0.95	-0.35
16	*Citruses, fresh and dry fruits*	0.69	-0.21	29.28%	0.20	-0.06
17	*Floricolture*		-1.11	0.00%	0.00	0.00
20	*Forestry*	7.59	-2.40	43.92%	0.00	0.00
Total				**100.00%**	**1.35**	**-0.43**
Milk	\					
18	*Milk and milk products*	1.16	-2.36			
Total					**1.16**	**-2.36**
Livestock						
19	*Beef*		-2.17	0.00%	0.00	0.00
21	*Sheep and goats*	39.21	-1.30	19.65%	7.70	-0.26
22	*Other livestock*	-4.32	-0.49	80.35%	-3.47	-0.40
Total				**100.00%**	**4.23**	**-0.65**

Table 13: % Change in production (Xs) and Domestic Consumption Prices (Pd) Under a Total Decoupling Scenario – Detail and aggregate results SOUTH

		Xs Production	Pd Domestic Price	Weight	Weighted Xs	Weighted Pd
Crops						
1	*Soft Wheat*	-58.68	0.25	1.44%	-0.84	0.00
2	*Durum wheat*	-29.56	0.25	18.71%	-5.53	0.05
3	*Rice*		-1.32	0.00%	0.00	0.00
4	*Corn*	-7.54	-1.76	7.20%	-0.54	-0.13
5	*Fodder*	15.02	-10.00	7.50%	1.13	-0.75
6	*dry hay*	128.79	-14.98	2.90%	3.74	-0.43
7	*Potatoes*	4.83	-2.20	6.40%	0.31	-0.14
8	*Tomatoes*	6.82	-1.60	5.87%	0.40	-0.09
9	*Other vegetables*	-1.59	0.46	42.46%	-0.67	0.19
10	*Sugar beet*	-31.48	-31.86	0.71%	-0.22	-0.23
11	*Soy beans*		0.25	0.00%	0.00	0.00
12	*Other industrial crops*	-29.68	3.04	1.53%	-0.45	0.05
13	*Tabacco*	-26.20	8.12	5.27%	-1.38	0.43
Total				**100.00%**	**-4.08**	**-1.05**
Fruits and vegetables						
14	*Grapes*	0.23	-0.05	25.14%	0.06	-0.01
15	*Olives*	-0.85	-1.30	39.69%	-0.34	-0.51
16	*Citruses, fresh and dry fruits*	0.17	-0.21	31.51%	0.05	-0.07
17	*Floricolture*	4.05	-1.11	3.66%	0.15	-0.04
20	*Forestry*		-2.40	0.00%	0.00	0.00
Total				**100.00%**	**-0.08**	**-0.63**
Milk	\					
18	*Milk and milk products*	0.56	-2.36			
Total					**0.56**	**-2.36**
Livestock						
19	*Beef*	-67.38	-2.17	43.10%	-29.04	-0.94
21	*Sheep and goats*	-58.13	-1.30	19.56%	-11.37	-0.25
22	*Other livestock*	20.62	-0.49	37.33%	7.70	-0.18
Total				**100.00%**	**-32.71**	**-1.37**

Table 14: Percentage Changes in Factor Prices - Total Decoupling Scenario

	% Change of Factor Prices
Dependent Labor	0.02
Farm Labor	0.62
Non Agricultural Capital	-0.02
Agricultural Capital	-10.52
Animal - milk	-3.20
Animal - beef	-9.54
Animal – sheep and goats	-63.77
Animal- other livestock	-7.00
Land (national)	16.28
Land North	20.39
Land Centre	12.30
Land South	14.86

Table 15: Impact of Total Decoupling on the farm-households levels of income, welfare, consumption, time use and consumption prices

	Equivalent variation	% Change of available income	% Change in consumption levels	% Change in leisure consumption	% Change in the levels of consumption prices
Farm household – region North	1.816	1.875	1.904	1.615	-0.071
Farm household – region Centre	-1.941	-1.896	-1.874	-2.129	-0.071
Farm household – region South	-0.218	-0.164	-0.138	-0.311	-0.049
Rural Household	0.082	0.114	0.129	0.031	-0.044
Urban household – low income	0.065	0.124	0.153	0.021	-0.066
Urban household – mid income	0.076	0.127	0.153	0.022	-0.066
Urban household – high income	0.085	0.126	0.146	0.022	-0.061

Table 15 reports the impact of the policy scenarios on welfare, consumption levels, consumption prices and time use for all household types considered. The relative change in equivalent variation is large for the urban households and medium and large family farms as a result of the adopt ion of a totally decoupled scheme. The adoption of total decoupling produces positive effects on the income and welfare levels of the farm-households of the North of Italy due also to a general reduction of the price levels implying a change in life-style associated with higher consumption of both goods and leisure. The farm-household prototype of the Italian centre, on the other hand,

suffer a marked income and welfare loss, while the farm-household in the South maintains its income and welfare level almost invariant. Rural and urban households, for all income strata, benefit slightly from the CAP reform.

At the moment the macro model exhibits the following structural limits:

1. It does not model the entry and exit from the market of regional household farms. It would be contradictory since the representative household cannot exit the market. This problem, which is of particular interest, should be addressed at micro level considering the possibility of exit of each household in the sample. Actually, this analysis can be conducted using the micro-modeling of the household farm for each household unit, not for aggregate farm-households as proposed in the analysis that follows.
2. It does not take into consideration inter-regional trade transactions because the information is not available.
3. It does not consider the partial use of certain factors of production. For instance, decisions regarding the allocation of land, labor and capital should consider also the possibility of idle factors. This aspect, only partially realizable at the macro level but fully attainable at the micro level, is particular important in the case of fruit and viticulture production. In these 2 sectors the reduction of the national production quotas and the introduction of limits at local level may induce the exit of less efficient households which may find more advantageous the employment of certain factors in other activities.

These aspects will be developed in future research.

The policy question of interest now moves from the macro to the micro dimension where we describe what are and how different the behavioral responses are across household types. Note that at the micro level of analysis, prices, which are endogenous at the macro-level, become exogenous. We inquire how strongly the shocks stemming from the totally decoupled CAP reform are felt at the micro level and the reaction strategies put in place by the farm-household types under consideration. The objective is to describe the behavioral response of the different farm-household types to the shocks generated by the *de-regulation* of European agricultural markets. The micro analysis is conducted to help identifying who wins from those who looses and by how much, and to recognize how the macro effect differ from the micro effect. We implement the micro phase of the investigation by estimating a micro-econometric model specified within the collective theory of the household and then constructing the corresponding general equilibrium model of the farm-household.

6.3 General equilibrium impact of the CAP reform at the farm households' micro level

The general equilibrium approach to the modeling of the farm-household micro-society is a powerful tool to describe the behavioral responses of both the farm and the household to economic and social policies and to evaluate their impact on welfare levels.

The farm-household programming model reproduces the "collective" farm-household theoretical model underlying the econometric specification. It is calibrated using the estimated elasticities of the econometric model and the average data of each farm-household type. For the sake of policy simulations, the programming approach, as compared to the econometric tool, enjoys the flexibility of any general equilibrium model which can produce timing and relevant results by applying simple adaptations to the model without the need of re-estimating the econometric model. The farm-household programming model plays the role of a policy lab which simulates the micro impact of the macro policy changes under several assumptions about the market functionings and degree of openness. When the farm-household is treated as a closed economy and (shadow) prices are endogenously determined, then the solution comes from a general equilibrium. The policy impacts are evaluated under more realistic assumptions where some markets clear and others fail. The farm-household models are adapted to disaggregate farm-household types in order to compare the differential policy impacts.

6.3.1 The farm-household model

The "family/firm" model presented in this section is general since it describes the household as involved both in production, in a family owned business, and in consumption. It embraces both urban and rural households in relation to the location of both the household and the entrepreneurial activity. When family owned business activities are not undertaken, then the household sells labor either to the job market or to the household. In this case, the general model of a "family/firm" reduces to a "family" engaged in household production. The "family/firm" model is a miniature general equilibrium model where the household enterprise fully reproduces the characteristics of a macro society at the micro level. In other words, the household enterprise (Becker 1965), be it a farm or a firm, is the micro-level mirror image of the macro-economy.

Whether the domestic goods, from farming or activities undertaken within the house, are marketable has an important implication on the structure of the model. If markets are complete, the domestic production can be sold on the market, or, the same goods and services can be bought on the market at a given price. Since households are price takers for every commodity including labor, production decisions are taken independently from consumption and labor supply decisions. If markets are incomplete, the price of the domestic good is endogenous to household behavior and the separation property, between production and consumption decisions, does not longer hold. In both cases, the value of labor not employed outside the family is implicit. However, only in the complete market case the value of labor is objectively deducible from the value of the marginal product, while in the case of missing markets the value of labor may be imputed at the opportunity cost.

It should be stressed that the farm/firm household model is intrinsically non separable, namely, within a household enterprise, production and consumption decisions are non-separable. This property of the decision making process has been empirically tested (Benjamin 1992, Benjamin and Kimhi 2003, Lambert, Magnac 1994, Pavoni and Perali 2000, Lofgren and Robinson 1999). These studies rejected the separability assumption both in a static and in a dynamic setting. The household endowment of time is in fact allocated to farming activities, off-farm employment and domestic production. Farm production is partly sold and partly consumed by the household. This is the structural cause explaining why production and consumption decisions are inter-locked in the micro-economy of a household enterprise. As far as information about domestic production is available and modeled, urban households are household enterprises as rural households do.

6.3.2 The Collective Farm-household Model

The model presented in this section is general also in the sense that the household is represented as a collection of individuals. Differently from the traditional micro-economic approach that considers the household as the basic decision unit with a joint preference structure, collective models describe the household as a group of individuals each of whom characterized by specific preferences interacting within a collective decision process explaining the rules of intra-household allocation of individual consumption and welfare. The collective approach makes no assumption about the decision process. It only requires that the outcome of the decision process is Pareto efficient. Therefore, the process is cooperative. Decisions take place as if it were a two-stage budgeting process. Supposing that the workers of the household pool their incomes, total household

income is then allocated to single members according to a predetermined sharing rule defining the intra-household income distribution. It follows that each member, while choosing the most preferred utility maximizing bundle of goods and leisure, faces an individual budget constraint. This approach permits recovering both private consumption and individual welfare functions. Finally, the knowledge of the welfare levels of household members opens up the possibility to account for gender and inter-generational differences in the evaluation of policy impacts.

The farm-household programming model reproduces exactly the "collective" farm-household theoretical model underlying the econometric specification and described in section 6.1.1.1. It is calibrated on the elasticities estimated in the econometric model (Menon and Perali 2004) and on the household social accounting matrix specific to each farm-household type: the average, the "less professional" which is the mean of the limited-resources, pension, residential and small, the "professional" farm-household type is formed by the medium and large farm-households. Therefore, the need for calibration is reduced to a minimum limited to the calibration of the intercepts of demand and production equations to match the levels of the household SAMs. It should be remarked that the distinction between "professional" and "less professional" farm-households is of interest because "professional" farm-households are the elected recipients of agricultural policies, while "less professional" farm-household are the subject of interest of rural policies, which, interestingly, can be financed by the modulation of agricultural policy. This distinction between farm-household types can be useful to gauge the differential effects of "coupling" agricultural with rural policies. Table 16 describes the main features of the professional (P) and non-professional (NP) farm-households. Considering that the production and consumption technology is the same across farm-household types, the differential levels of the variables are responsible for the differential qualitative response.

6.3.2.1 The model

The household produces four outputs (crops, beef, milk, and fruit, olives and grapes) using hired labor, chemicals, materials, capital stock and family labor. The productions are sold on the market. The production factors are demanded on the market and they are remunerated from the value added. The household economy, that is decentralized in husband and wife, spends the full income, derived as the sum of off farm income, domestic income, the remuneration of family labor, the value of leisure and non labor income, to a) purchase the market goods (food, cloth and other goods), and b) consume the domestic good and leisure. The economy acquires the assets produced

from the household, pays the family off farm and non-labor income and gains from the factors supply, the selling of market goods and from household savings. This accounting scheme of the farm-household economy is reported in Table 17 for the professional farms grouping the medium, large and very large farm-households and in Table 18 for the non-professional farms grouping the limited-resource, retired, residential, small-farm type. Tables 19 and 20 show, for non professional farm-households and professional ones, the repartition of household income between the husband and the wife. Finally, Tables 21 and 22 show how the inputs of production (hired labor, chemicals, materials, family labor, capital and land) are employed for each specific output (namely crop, beef, milk and fruit). These farm-households SAMs describe the links between the farm - household and the rest of the economy.

Table 16:Main features of the Non-Professional and Professional Farm-Household Types

	Non professional farm-households	**Professional farm-households**
Number of observations	309	947
Farm dimension	6.34	15.27
Land value	147.82	147.82
Capital price	2.88	2.88
On farm wage	5.99	12.75
Off farm wage	8.15	11.45
INPUT DEMAND IN SHARE		
Hired labor	0.07	0.08
Material	0.17	0.29
Chemical	0.06	0.07
Capital	0.36	0.20
Land	0.18	0.16
Family labor	0.17	0.19
PRODUCTION IN SHARE		
Crop production	0.40	0.40
Beef production	0.20	0.25
Milk production	0.04	0.23
Fruit production	0.36	0.12
INCOME		
Full income	9031.56	16391.79
Saving	943.82	7950.13
TOTAL COST		
Cost	5224.81	13941.78

Table 17: Household SAM – Professional Farm-Households

	hi_lab	chemi	mater	cap	fam_l	terra	Xtot	crop	beef	milk	fru	fam	husb	wife	r_off	r_nla	r_dom	r_lei	cloth	food	other	econ	tot
hi_lab							1156.6																1156.57
chemi							1017.4																1017.44
mater							4097.9																4097.93
cap							2798.8																2798.75
fam_l							2614.1																2614.05
terra							2257																2257.04
Xtot								5107.9	3129.4	2964	1568.7											1171.7	13941.8
crop																						5107.9	5107.87
beef																						3129.4	3129.41
milk																						2964	2964.04
fru																						1568.7	1568.74
fam					2614.1	2257									167.99	6058.5	2002.9	3291.4					16391.8
husb												3872.6											3872.59
wife												4569.1											4569.07
r_off																						167.99	167.99
r_nla																						6058.5	6058.47
r_dom													787.71	1215.2									2002.87
r_lei													1511.5	1779.9									3291.37
cloth													14.07	14.63									28.7
food													626.08	626.08									1252.16
other													933.28	933.28									1866.56
econ	1156.6	1017.4	4097.9	2798.8								7950.1							28.7	1252.2	1866.6		20168.2
tot	1156.6	1017.4	4097.9	2798.8	2614.1	2257	13942	5107.9	3129.4	2964	1568.7	16392	3872.6	4569.1	167.99	6058.5	2002.9	3291.4	28.7	1252.2	1866.6	20168	

Legend:					
hi_lab	hired labor		**fam**	family
chemi	chemicals		**husb**	husband
mater	materials		**wife**	wife
cap	capital		**r_off**	off farm income
fam_l	family labor		**r_nla**	non labor income
terra	land		**r_dom**	domestic income
Xtot	aggregate production		**r_lei**	leisure value
crop	crop production		**cloth**	cloth demand
beef	beef production		**food**	food demand
milk	milk production		**other**	other good demand
fru	fruit production		**econ**	economy

Table 18:Household SAM – Non professional Farm-Households

	hi_lab	chemi	mater	cap	fam_l	terra	Xtot	crop	beef	milk	fru	fam	husb	wife	r_off	r_nla	r_dom	r_lei	cloth	food	other	econ	tot
hi_lab							369.85																369.85
chemi							301.1																301.1
mater							866.88																866.88
cap							1873.4																1873.44
fam_l							877.01																877.01
terra							936.53																936.53
Xtot								1648.4	799.92	160.93	1503.2											1112.4	5224.81
crop																						1648.4	1648.42
beef																						799.92	799.92
milk																						160.93	160.93
fru																						1503.2	1503.18
fam					877.01	936.53									547.7	1112.7	1829.2	3728.4					9031.56
husb												3861.7											3861.71
wife												4226											4226.03
r_off																						547.7	547.7
r_nla																						1112.7	1112.71
r_dom													796.04	1033.1									1829.18
r_lei													1801	1927.4									3728.43
cloth													9.86	10.69									20.55
food													536.87	536.87									1073.74
other													717.92	717.92									1435.84
econ	369.85	301.1	866.88	1873.4								943.82							20.55	1073.7	1435.8		6885.22
tot	369.85	301.1	866.88	1873.4	877.01	936.53	5224.8	1648.4	799.92	160.93	1503.2	9031.6	3861.7	4226	547.7	1112.7	1829.2	3728.4	20.55	1073.7	1435.8	6885.2	

Table 19: Household SAM – Repartition of family income between the husband and the wife for non-professional farm-households

	Husband's income	**Wife's income**	**Family income**
Remuneration of household labor supply	551.429	325.581	877.01
Remuneration of domestic labor supply	796.040	1033.14	1829.18
Remuneration of market labor supply	315.200	232.5	547.7
Non labor income	631.950	480.76	1112.71
Leisure value	1801.020	1927.41	3728.43

Table 20: Household SAM – Repartition of family income between the husband and the wife for professional farm-households

	Husband's income	**Wife's income**	**Family income**
Remuneration of household labor supply	1789.441	824.609	2614.05
Remuneration of domestic labor supply	787.71	1215.16	2002.87
Remuneration of market labor supply	42.05	125.94	167.99
Non labor income	4373.05	1685.42	6058.47
Leisure value	1511.45	1779.92	3291.37

Table 21: Household SAM – Inputs use for each production for non-professional farm-households

	Crop	Beef	Milk	Fruit	TOTALE
Hired Labor	20.728	3.322	0.819	6.365	31.234
Chemicals	0.255			0.092	0.347
Materials	0.372	0.174	0.057	0.195	0.798
Land	4.837			1.499	6.336
Capital	210.466	221.107	74.827	143.275	649.675
Family Labor	57.617	38.722	11.125	39.071	146.535

Table 22: Household SAM – Inputs use for each production for professional farm-households

	Crop	Beef	Milk	Fruit	TOTALE
Hired Labor	77.622	12.439	3.065	23.834	116.96
Chemicals	0.767			0.278	1.045
Materials	1.209	0.565	0.186	0.634	2.594
Land	11.657			3.612	15.269
Capital	314.417	330.314	111.785	214.04	970.556
Family Labor	80.64	54.195	15.57	54.683	205.088

6.3.3 Modelling Labour Market Failures

All markets function perfectly, but the labor market. As we saw in the econometric analysis, the on farm wage differs significantly from the off-farm wage, because of nonseparability. We model the failure in the labor market as a Mixed Complementarity Problem (MCP) (Löfgren and Robinson 1997, 1999). An MCP model consists of a set of simultaneous equations that are a mix of equalities and inequalities, with each inequality linked to a bounded variable in a complementarity-slackness condition (Rutherford 1995).

Mixed complementarity problems can be represented as a complementarity between a variable and an equation where the variable is non zero only if the equation is a strictly binding constraint and, vice versa, the constraint is binding when the variable is zero. In other words, the complementarity conditions state that either the nonnegative variable must be zero or the corresponding inequality must hold with equality, or both.

For example, if we consider the professional farm-household type, characterized by an endogenous on-farm wage greater than the exogenous off-farm wage, the farm household will supply on-farm labor at the fixed upper bound only if the wage-on farm is greater than the off-farm wage. However, if the on-farm wage is less than or equal to the off-farm wage, the family labor supply decreases. For the non professional farm-household type, the situation is mirrors to the previous one. The farm household increases the on farm labor supply only if the wage-on farm is greater than or equal to the off-farm wage; otherwise it supplies an amount of on-farm labor equal to the fixed lower bound corresponding to the observed level. This Kuhn-Tucker rule is applied both for the husband and the wife.

The associated complementarity-slackness condition is:

$$FS\_lab_g \quad \left(w\_off_g - wage\_on\right) \;=\; 0 \;, \qquad g \in G = \{husband, wife\}$$

where:

$$FS\_lab_g = 0 \;\text{ if }\; w\_off > wage\_on$$
$$FS\_lab_g > 0 \;\text{ if }\; w\_off = wage\_on$$

PROFESSIONAL*: observed wage gradient*

w_off	<	wage_on	→	$FS\_lab_g = FS\_lab_g0$	*(Upper bound)*
w_off	≥	wage_on	→	$FS\_lab_g < FS\_lab_g0$	

NON PROFESSIONAL*: observed wage gradient*

$$w\_off > wage\_on \rightarrow FS\_lab_g = FS\_lab_g0 \quad \textit{(Lower bound)}$$

$$w\_off \leq wage\_on \rightarrow FS\_lab_g > FS\_lab_g0$$

Legend:

Variable	***Description***
FS_lab_g0	Individual on farm labor supply: observed level (upper or lower bound)
FS_lab_g	Individual on farm labor supply
w_off	Off farm wage
wage_on	On farm wage

6.3.4 Micro-simulation results

The objective of the micro-simulation is to estimate the impact at the farm-household level of agricultural reforms. Special attention is devoted to measure the behavioral response to a macro policy in terms of changes in production, consumption, labor patterns and welfare levels both for the household and the individual.

Tables 23 reports the results of the simulation of the impact of total decoupling on the average professional and less professional farm-household type. The results are in line with economic expectations and have direct implications for both agricultural and rural policies. The description of the differential impact of the CAP reform can be stylized as follows:

- Demand for family labor: does not vary for NP and for P, for both husband and wife.
- Demand for hired labor: increases for P and for NP.
- Demand for other factors: decrease for both P and NP.
- Hours off farm: decrease for NP and increase for P both for husband and wife.
- Shadow prices: the shadow wage of family labor of P and NP decrease. The shadow price of capital and land also decreases.
- Production in levels: for NP production decreases for crop and beef. Decrease in crop production and fruit for P.
- On-farm Incomes: on-farm incomes decrease for NP and for P.

Table 23: Micro-Simulation of the CAP – Total Decoupling Scheme

Variable	NON PROFESSIONAL			PROFESSIONAL		
	base	simul	var%	base	simul	var%
PRODUCTION SIDE						
INPUT DEMAND						
Hired Labor	31.233	34.901	11.744	116.96	115.446	-1.294
Chemicals	0.347	0.3	-13.5	1.045	0.907	-13.187
Materials	0.799	0.716	-10.395	2.594	2.423	-6.582
Capital	649.675	649.675		970.556	970.556	
Land	6.336	6.336		15.269	15.269	
Family Labor:	146.535	146.535 6		205.088	205.088	
Husband	92.135	92.135		140.392	140.392	
Wife	54.399	54.399		64.696	64.696	
ENDOGENOUS INPUT PRICE						
On Farm Wage	3.674	3.446	-6.221	7.825	7.251	-7.331
Capital Price	1.77	1.66	-6.221	1.77	1.641	-7.331
Land Price	90.748	85.103	-6.221	90.747	84.095	-7.331
TOTAL COST						
Total Production Cost	3207.575	3008.042	-6.221	8559.03	7931.601	-7.331
PRODUCTION						
Crop	41.864	36.846	-11.985	134.119	118.003	-12.017
Beef	2.08	2.316	11.366	8.035	8.429	4.898
Milk	1.928	1.852	-3.908	36.11	36.521	1.139
Fruit	21.804	22.031	1.043	22.644	21.541	-4.872
CONSUMPTION SIDE						
INCOME AND SAVING						
Off Farm Income	336.24	274.257	-18.434	103.131	134.07	30
Domestic Income	1122.956	1108.22	-1.312	1229.587	1448.965	17.842
Leisure Value	2288.929	2326.147	1.626	2020.613	2342.445	15.927
Agricultural Income	1113.354	1044.097	-6.221	2990.42	2771.21	-7.331
Single Farm Payment						
Full Income	5544.586	5587.881	0.781	10063.122	10933.765	8.652
Saving	579.423	585.077	0.976	4880.683	5116.683	4.835
EXPENDITURE AND CONSUMPTION (in share)						
Husband:						
Expenditure	2370.751	2388.724	0.758	2377.431	2668.571	12.246
Leisure	0.466	0.470	0.712	0.390	0.400	2.575
Cloth	0.003	0.003	-0.871	0.004	0.003	-9.512
Domestic Good	0.206	0.203	-1.726	0.203	0.225	10.417
Food	0.139	0.139	0.033	0.162	0.147	-8.991
Other Goods	0.186	0.186	0.108	0.241	0.225	-6.787
Wife:						
Expenditure	2594.412	2614.08	0.758	2805.008	3148.51	12.246
Leisure	0.456	0.469	0.907	0.309	0.404	3.786
Cloth	0.003	0.003	-0.257	0.003	0.003	-6.690
Domestic Good	0.244	0.239	-2.312	0.266	0.276	1.464
Food	0.127	0.128	0.396	0.137	0.128	-6.943
Other Goods	0.170	0.171	0.601	0.204	0.195	-4.364

Table continues

Table 23: (continued)

Variable	NON PROFESSIONAL			PROFESSIONAL		
	base	simul	var%	base	simul	var%
TIME USE						
Husband:						
Market Labor Supply	38.675	32.926	-14.864	3.672	4.774	30
Farm Labor Supply	92.135	92.135		140.392	140.392	
Domestic Labor Supply	84.599	87.566	3.507	83.713	113.02	35.009
Leisure Demand	188.49	191.272	1.476	158.185	182.128	15.136
Wife:						
Market Labor Supply	28.528	21.888	-23.274	10.999	14.299	30
Farm Labor Supply	54.399	54.399		64.696	64.696	
Domestic Labor Supply	109.796	112.962	2.884	129.14	160.215	24.063
Leisure Demand	207.762	211.235	1.672	191.864	223.512	16.495
VALUE OF TIME						
Husband:						
Market Wage	5.003	5.003		7.029	7.029	
On Farm Wage	3.674	3.446	-6.221	7.825	7.251	-7.331
Domestic Wage	5.777	5.527	-4.331	5.777	5.303	-8.2
Leisure Price	5.866	5.869	0.0005114	5.866	5.868	0.0003409
Wife:						
Market Wage	5.003	5.003		7.029	7.029	
On Farm Wage	3.674	3.446	-6.221	7.825	7.251	-7.331
Domestic Wage	5.777	5.527	-4.331	5.777	5.303	-8.2
Leisure Price	5.866	5.869	0.0005114	5.866	5.868	0.0003409

Considering that in 2002 the poverty line was 823.45 Euros (ISTAT Bulletin, October 13 2004) for a couple without children, the loss of income for the NP generates an income level below the poverty line when on-farm income is the sole source of income.

- Global incomes: the level of global income (on plus off-farm income) for the NP is about 1030 Euros per adult equivalent considering that the average number of children in the NP household is 1.1 giving rise to a household equivalence scale of 2.3. The poverty line at the a dopted equivalence scale is 1095.2. The average NP household is at a high risk of poverty. The level of global income for P is slightly more than twice as much.
- Full income: while in terms of global incomes the P/NP ratio is about 2.2, in terms of ful l incomes the P/NP ratio reduces to 1.8 signaling a modest equalizing effect.
- Consumption: consumption patterns are comparable across husband and wife. For NP the share of domestic goods decreases more the share of the market goods. For P the share of leisure and domestic goods increase while the shares of domestic goods decrease.

With regards to professional farm-households, the on-farm wage decrease induces household members to increase their market labor supplies, to consume more leisure and to wor k more inside the household. For non professional farm-household domestic wage and leisure value are greater than on farm wage. The policy impact reduces on farm wage more than domestic wage, then this induces household members to spend more time in domest ic activities and enjoying leisure.
In general, the reform in the short run may affect the distribution of power by changing the relative price of leisure and other goods. On the other hand, a change of the distribution of power may be a powerful and useful tool to correct part of the undesirable effects of the reform.

Table 24: Sets, Parameters, Variables and Equations

SET:

$f, j \in F (=J) = \{hi\_lab,\ chemic,\ mater,\ cap,\ fam\_lab,\ land\}$ = *Factors*

$fi(f) \in FI (\subseteq F) = \{hi\_lab,\ chemic,\ mater\}$ = *Variable Factors*

$ffi(f) \in FFI (\subseteq F) = \{cap,\ fam\_lab,\ land\}$ = *Quasi Fixed Factors*

$q, s \in Q (=S) = \{crop,\ beef,\ milk,\ fru\}$ = *Outputs*

$i, r \in I (=R) = \{leis,\ cloth,\ food,\ dom,\ other\}$ = *Commodities*

$g \in G = \{husb,\ wife\}$ = *Household members*

$d \in D = \{D1\_d, D2\_dD12\_d, Z1star\_d, Z2\_d, Z3\_d\}$ = *Demographic Variables (Production)*

$k \in K = \{D1\_k,\ D2\_k,\ D3\_k,\ D4\_k\}$ = *Demographic Variables (Consumption)*

VARIABLES:

ENDOGENOUS			
Production Side		***Consumption Side***	
LPi		red_full	full income
LPif(fi)		red_on	on farm income
RSLPi(q)		red_terra	land value
RSLPO(q)		red_dom	domestic income
LPO		red_off	off farm income
LPOf(fi)		red_lei	leisure value
QPi(fi)		risp	saving
QPo(q)		CILPgdh(i)	
QPIo(fi)		CILPgdw(i)	
MD_P		emme	
Md_fn		lnphi	
So_fn		LYSTAR_m	
Z1_star		LYSTAR_f	
lnTCH	log of total cost	Lpstar_m	
altri_premi	other premia	Lpstar_f	
shihm(fi)	variable input share	quotah(i)	consumption share-husband
shoh(q)	output share	quotaw(i)	consumption share-wife
q_inpu(fi)	variable input demand	XDh(i)	good demand-husband
q_inp(ffi)	quasi fixed input demand	XDw(i)	good demand-wife
FS_hl	input supply-hired labor	spesa_fam	family expenditure
FS_c	input supply-chemicals	spesa(g)	individual expenditure
FS_m	input supply-materials	w_dom(g)	domestic labor remuneration
w_land	land remuneration	P(“dom”,g)	Price of domestic good
w_cap	capital remuneration		
q_out(q)	output		
XD_econ(q)	market demand		

EXOGENOUS		**POSITIVE**	
wf(fi)	variable input price	FS_labh	on farm labor supply-husband
FS_k	capital supply	FS_labw	on farm labor supply-wife
FS_l	land supply	hours_offh	off farm labor supply-husband
PI(i,g)	good price	hours_offw	off farm labor supply-wife
nwlexp_m		wage_on	on farm wage
nwlexp_f			
P_out(q)	output price		
w_off(g)	off farm wage		
red_nla	non labor income		
w_lei(g)	leisure remuneration		

EQUATIONS*:*

PRODUCTION SIDE:			*VARIABLE*
MD_P(fi)	=	$\sum_{d} dtp(fi,d)*DDD(d)$	
so_fn	=	$\sum_{fi} MD\_P(fi)*lof(wf(fi))$	
Z1_star	=	$log(q\_inp("fam\_lab"))-m\_a0$	
MD_fn	=	*dt1*D1 + dt2*D2+ dt3*D12 + dt4*z1star0 + dt5*z0("cap") + dt6*z0("land")*	
LPi	=	$\sum_{fi} b(fi)*\log(wf(fi))$	*Linear functions of inputs prices in the cost function*
LPif(fi)	=	$\sum_{j} bfj(fi,j)*\log(wf(ji))$	*Linear functions of inputs prices in the cost share*
LPo	=	$\sum_{q} a(q)*\log(q\_out(q))$	*Linear functions of output in the cost function*
LPof	=	$\sum_{q} gfq(fi,q)*\log(q\_out(q))$	*Linear functions of output in the cost share*
QPi(fi)	=	$0.5*\sum_{j} bfj(fi,j)*\log(wf(fi))*\log(wf(j))$	*Input price quadratic functions*
QPo(q)	=	$0.5*\sum_{s} aqs(fi,j)*\log(q\_out(q))*\log(q\_out(s))$	*Output quadratic functions*
QPio(fi)	=	$\sum_{q} gfq(fi,q)*\log(wf(fi))*\log(q\_out(q))$	*Input/output quadratic functions*
shihm(fi)	=	$b\_micro(fi)+LPif(fi)+LPof(fi)+md\_p0(fi)$	*Variable input share*
RSLPi(q)	=	$\sum_{fi} gfq(fi,q)*\log(wf(fi))$	*Linear functions of inputs prices in the revenue share*
RSLPo(q)	=	$\sum_{s} aqs(q,s)*\log(q\_out(s))$	*Linear functions of output in the revenue share*
shoh(q)	=	$a\_micro(fi)+RSLPi(q)+RSLPo(q)$	*Output share*
lnTCH	=	$new\_a0+LPi+LPo+\sum_{fi} QPi(fi)+\sum_{q} QPo(q)+\sum_{fi} QPio(fi)+md\_fn0+so\_fn0$	*Total cost in log*

Table continues

EQUATIONS: ***(CONTINUED)***

Log(q_out(q))	=	$aaa(q)+\sum_{fi}\frac{gfq(fi,q)}{shoh(q)*(1-shoh(q))}*\log(wf(fi))+$ $\sum_{s}aqs\_inv(q,s)*\log(p\_out(q))*(1+t\_premi(s))+\sum_{ffi}\gamma^{*}2(ffi)*\log(q\_inp(ffi))$	*Output supply in log*
q_inpu(fi)	=	$shihm(fi)*exp(\ln TCH)/wf(fi)$	*Variable input demand*
q_inp(ffi)	=	$shih(ffi)*exp(\ln TCH)/wff(ffi)$	*Quasi fixed input demand*
FS_hl,c,m	=	$q\_inpu("hi\_lab","chemic","mater")$	*Variable input supply*
FS_labh+FS_labw	≥	$q\_inp("fam\_lab")$	*On farm wage*
FS_l,k	=	$q\_inp("land","cap")$	*Land and Capital remuneration*
XD_econ(q)	=	$q\_out(q)$	*Market good demand*
exp(lnTCH)	=	*SUM(q, p_out(q)*q_out(q)) + SUM(q, t_premi(q)*p_out(q)*q_out(q)) + altri_premi;*	*Other premia*
INCOME AND SAVING:			
red_full	=	$red\_on+red\_terra+red\_dom+red\_off+red\_nla+red\_lei+premio\_UNICO$	*Full income*
red_terra	=	$wff("land")*ha$	*Land value*
red_on	=	$wff("fam\_lab")*(FS\_labh+FS\_labw)$	*On farm income*
red_dom	=	$w\_dom("husb")*XDh("dom")+w\_dom("wife")*XDw("dom")$	*Domestic income*
red_off	=	$w\_off("husb")*hours\_offh+w\_off("wife")*hours\_offw$	*Off farm income*
red_lei	=	$w\_lei("husb")*XDh("lei")+w\_lei("wife")*XDw("lei")$	*Leisure value*
risp	=	$prop\_s*(red\_on+red\_terra+red\_off+red\_nla+premi\_UNICO)$	*Saving*
CONSUMPTION SIDE:			
spesa_fam	=	$red\_full-risp$	*Family expenditure*
sh_rule("husb")	=	$lambda\_star("husb")/\exp(emme)$	*Sharing rule*
sh_rule("wife")	=	$1-sh\_rule("husb")$	*Sharing rule*
spesa(g)	=	$sh\_rule(g)*spesa\_fam$	*Individual expenditure*
CILP_gdh(i)	=	$\sum_{r}elai\_h(i,r)*\log(PI(i,"husb"))$	*Price function*
CILP_gdw(i)	=	$\sum_{r}elai\_w(i,r)*\log(PI(i,"wife"))$	*Price function*
emme	=	$theta3*\left(\frac{PI("leis","wife")}{PI("leis","husb")}\right)+theta5*\left(\log\left(\frac{PI("cloth","husb")}{PI("cloth","wife")}\right)\right)+eta1*nwl\exp\_f+$ $eta2*nwl\exp\_m+lambda1*D7+lambda2*D9+lambda3*D101+lambda4*D11$	*Scaling function*

Table continues

EQUATIONS: ***(CONTINUED)***

lnphi	=	$\log(spesa("husb")) - Lpstar\_m + emme$	*Sharing rule*
lystar_m	=	$\ln phi - \sum_i Sc\_gdh0(i) * \log(PI(i,"husb"))$	*Individual income - husband*
lystar_f	=	$\log(spesa("wife")) - Lpstar\_f - emme - \sum_i Sc\_gdw0(i) * \log(PI(i,"wife"))$	*Individual income - wife*
lpstar_m	=	$\sum_i sedh(i) * log(PI(i,"husb")) + 0.5 * \sum_{(i,r)} elai\_h(i,r) * log(PI(i,"husb")) * log(PI(r,"husb"))$	*Price aggregator - husband*
lpstar_f	=	$\sum_i sedw(i) * \log(PI(i,"wife")) + 0.5 * \sum_{(i,r)} elai\_w(i,r) * \log(PI(i,"wife")) * \log(PI(r,"wife"))$	*Price aggregator - wife*
quotah(i)	=	$culh(i) + Sc\_gdh0(i) + CILP\_gdh(i) + merh(i) * lystar\_m$	*Good demand in share*
quotaw(i)	=	$culw(i) + Sc\_gdw0(i) + CILP\_gdh(i) + merw(i) * (lystar\_f - lpstar\_f)$	*Good demand in share*
*XDh(i)*PI(i,"husb")*	=	$quotah(i) * spesa("husb"),$	*Commodities demand*
*XDw(i)*PI(i,"wife")*	=	$quotaw(i) * spesa("wife")$	*Commodities demand*
w_dom(g)	=	*PI("dom",g)*	*Identity*
log(w_dom(g))	=	*h0+ h1*log(wff ("fam_lab")) + h2* log(wff ("fam_lab")) + h3*log(w3) + h4* log(w4) + demot + demo1.*log(wff ("fam_lab")) + demo2*log(wff ("fam_lab")) + demo3.* log(w3) + demo4.* log(w4) +0 .5[b11**log(wff ("fam_lab"))*log(wff ("fam_lab")) + b12*log(wff ("fam_lab")) *log(wff ("fam_lab")) + b13*log(wff ("fam_lab"))* log(w3) + b14*log(wff ("fam_lab")).* log(w4) + b12*log(wff ("fam_lab"))*log(wff ("fam_lab")) + b22*log(wff ("fam_lab"))*log(wff ("fam_lab")) + b23**log(wff ("fam_lab")).* log(w3) + b24*log(wff ("fam_lab"))*gd_4pr + b13* log(w3) *log(wff ("fam_lab")) + b23* log(w3) *log(wff ("fam_lab")) + b33* log(w3).* log(w3) + b34* log(w3).* log(w4) + b14* log(w4) *log(wff ("fam_lab")) +b24* log(w4) *log(wff ("fam_lab")) + b34* log(w4).* log(w3) +b44* log(w4).* log(w4)]*	*Domestic wage*
TIME CONSTRAINT:			
Time("husb")	≥	$FS\_labh + XDh("leis") + XDh("dom") + hours\_offh$	*Off farm labor*
Time("wife")	≥	$FS\_labw + XDw("leis") + XDw("dom") + hours\_offw$	*Off farm labor*
COMPLEMENTARITY CONDITIONS:			
*FS_labh * (w_off("husb")-wff("fam_lab"))*	=	0	*On farm labor*
FS_labw (w_off("wife")-wff("fam_lab"))*	=	0	*On farm labor*

6.4 Recommendations to policy makers in order to improve agricultural and rural policies

This research has developed a general equilibrium model of the Italian economy to evaluate the macro effects of the CAP reform to be transmitted at the micro level of analysis in order to estimate the behavioural and welfare impact of the farm-households within a farm-household general equilibrium model. The micro general equilibrium collective model is not calibrated because it incorporates as such the econometric model of the farm household and the estimated technologies of production and consumption. The macro-micro link is fully carried out in our experiment because the macro effect is evaluated at the micro level both at the household and at the individual level as a result of the econometric estimation of the rule governing the intra-household process of resource allocation.

The micro-macro link built within the present research has the virtue of allowing for an exact statistical aggregation (Stoker 1993) between the micro and macro level of analysis. For this to realize, it is necessary to run the policy micro simulation at the level of each farm-household type identified also at the macro level. This statistical consistency across levels of aggregation is ensured by the peculiar design of the underlying information source which is the same across levels. Therefore, embedded in the micro-macro approach adopted in this study there is the potential of a natural micro-macro closure.

The approach also suffers from another type of aggregation problem. At the macro level the effects on production are not differentiated by farm-household type because the production technology is the same for all farm types. The incorporation of this feature would require the enlargement of the model to host 23 activities for each farm type allowing for the possibility for each type to adopt an optimal subset of activities. This exercise is left for future developments of the model.

The macro shock from the CAP reform generates significantly different behavioral responses at the micro level of the professional and non-professional farm-households. The reform impacts differently upon husbands and wife employed in agriculture. Demand for farm labor decreases in both the professional and non-professional farm-households, but wives reduce their involvement in farming activities by more than twice with respect to the husband. Women employed both in the professional and non-professional farm-households are more flexible. Both professional and non-professional farms suffer a reduction in global incomes, but the loss of income, and of welfare, can be critical for the non-professional farm-households who are more exposed to the risk of poverty.

In this sense, the non-professional farm-households are a more appropriate target for rural rather than agricultural policies. In general, competitive markets are welfare deteriorating for the professional households and welfare improving for the non professional farm-households.

The micro and macro results are in general consistent. The behavioral responses at the micro level reveal a differentiated pattern which calls for targeted policies. The household's capability to adjust to changes by reallocating its resources acts as a powerful cushion against the risk of incurring welfare losses. Under a policy perspective, it is fundamental to realize that this mitigation effect is in place only if output and factor markets function properly. Otherwise, households would not be able to compensate negative effects by selling its resources off farm or acquiring resources through the land, labor and capital markets. As a suggestion for future research, incorporating these aspects in the modeling framework is crucial for a full understanding of the real impact of reforms.

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