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## The geography of French agricultural co-operatives: An explanatory spatial data analysis

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# **The Geography of French Agricultural Co-operatives:**

## **An Explanatory Spatial Data Analysis**

*Very first draft – please do not quote*

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### **Summary**

The aim of this paper is to study the spatial dynamics of French agricultural co-operatives. This is achieved by using the recently-developed methods of Exploratory Spatial Data Analysis. With a sample of French districts in 2005, we find strong evidence for global and local spatial autocorrelations in the geographic distribution of agricultural co-operatives. The detection of clusters of high and low agricultural co-operatives presence indicates the persistence of spatial disparities between French districts. The analysis is further refined by the investigation of the spatial patterns of agricultural co-operatives.

### **Keywords**

Agricultural cooperatives, French cooperative system, clusters, explanatory spatial data analysis, spatial autocorrelation

### **JEL classification**

C21, O18, Q13, R11, R12

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## 1. Introduction

Agricultural co-operatives account for nearly 75% of all farmers in France. They have become major actors in the development of rural spaces. Over the past 30 years, French cooperatives have steadily modified their organizational structures in response to changes in the economic environment following a major trend in the world today (Cook and Chaddad, 2004). Whereas most cooperatives started out as simple collectors of agricultural raw materials, they are now likely to invest in the agribusiness market. They have become corporate groups controlled by a head group gathering subsidiaries such as other cooperatives or commercial companies (Filippi, Frey and Torre, 2009). These different entities structure the French agricultural co-operative system. Subsidiarization opportunities particularly decrease the French law that strictly restrains cooperative's actions within a defined territorial circumscription. As a consequence, cooperatives develop organizational structures that are increasingly distended in spatial terms (Filippi, Frey and Triboulet, 2007). Therefore, this paper aims at studying the spatial dynamics of French agricultural cooperatives. We use the recently-developed methods of Exploratory Spatial Data Analysis (ESDA) to examine the spatial distribution of economic activities of agricultural cooperatives. The detection of global and local spatial autocorrelations enables to characterize the localization patterns of agricultural cooperatives in France and so to identify clusters of cooperative activities. In the second section, we show how and why cooperative system reinforced through cooperatives groups emergence and subsidiarization. In the third section, we briefly present the principles and methods of Exploratory Spatial Data Analysis (ESDA). We compute in section 4 a global spatial autocorrelation statistic, as well as local Moran autocorrelation statistics (Moran scatterplot and LISA; Anselin 1995, 1996) in order to detect clusters of high and low agricultural cooperative activities. Indeed, the existence of those clusters would be an indication of the persistence of spatial disparities between French districts. The spatial pattern of agricultural cooperation activities is finally investigated.

## 2. Theoretical Background

Understanding the spatial distribution of productive activities is an important issue for companies and for territorial development stakeholders. Number of tools and methods characterize the location of activities and identify possible geographic concentrations of activities referring to clusters (Combes et al., 2006). We are here interested in the localization of

agricultural cooperatives. This issue is crucial because of the importance of agricultural cooperatives in agribusiness.

*Graph 1. Evolution of the French cooperative system, 1995-2005  
(number of cooperatives, on the basis of 100)*

*Graph 2. Evolution of the French cooperative system, 1995-2005  
(number of employees, on the basis of 100)*

The rise of agricultural cooperative groups since the 1990s reflects cooperative's adjustment to market pressures (Filippi et al., 2006). Cooperative groups have been growing up for two principal reasons. On the one hand, a total control of commercial subsidiaries and on the other hand, the strong interdependence of economic actors through cooperative partnerships (Filippi and Triboulet, 2003). The acquisition of commercial companies is a way to further develop the core business of farmers. But an agricultural cooperative is a firm certified by the French Ministry of Agriculture to conduct activities in a geographical defined area. So there is a defined geographic area in which cooperatives work for members located in this area. Furthermore, cooperatives can't develop a business with non-members only up to 20% of their turnover. Consequently, acquiring commercial companies may be a way to ease difficulties because it allows cooperatives to indirectly work with other farmers in different places and with different products. It allows to reach other consumption markets too. However, the commercial companies can invest downstream sectors to control the food processing to members and develop local resources. Therefore, even if agricultural cooperatives are legally bound to a defined territorial area, they are not subject to this restrictive law with commercial firms they control. So, even if subsidiaries of agricultural cooperatives are located nearby, the spatial extent of cooperative groups is becoming more and more distended (Filippi, Frey and Triboulet, 2008). Therefore it is important to characterize the different aspects of the localization of agricultural cooperatives in France in order to measure the agglomeration intensity of their and, as shown by Maps 1 and 2 below, because the geographic distribution of these activities is not uniform in France.

*Maps 1 and 2. Number of establishments and employees of agricultural cooperatives  
by districts in France, 2005*

Agricultural cooperative's activities, in terms of establishments and employees, are unevenly distributed in France. As the map 1 show, the *Bassin Parisien*, the *south east* and the *west* are privileged areas of agricultural cooperation in France. Map 2 provides information on the geographic distribution of agricultural cooperative's employees: agricultural cooperatives clusters are less pronounced but analyses (by establishments and by employees) give the same

location for cooperatives. Actually, the composition of cooperative's activities in France is 70% of cooperative's establishments belong to the wholesale sector, while 23% belong to agribusiness. In contrast, activities of wholesale sector only attract 52% of all cooperative's employees while agribusiness accounts for 44% of the total agricultural cooperative's employment. Many cooperatives mainly from the wholesale sector have few or no employees. The unequal distribution of agricultural cooperation activities can be found then at regional level (Figure 3):

*Figure 3. Number of employees and establishments of agricultural cooperatives activities by region, 2005*

Figure 3 shows two important facts: firstly, 6 regions have a large number of cooperative establishments (*Bretagne, Rhone-Alpes, Languedoc-Roussillon, Midi-Pyrénées, Pays de la Loire* and *Champagne-Ardenne*). On the other hand, 3 regions have high levels of employees. *Bretagne* is the first region, while *Languedoc-Roussillon* and *Pays de la Loire* have the same profile as possessing significant levels of establishments and employees. These regions appear as real agricultural cooperation areas. Then, the aim of this paper is to identify and measure the agglomeration of cooperative activities within the French territory. The extent of the agglomeration of the French agricultural cooperatives will be done from the tools of exploratory spatial data analysis. Indeed, economic activities have a natural tendency to on a non-uniform in space. A relevant measure of the location of cooperative activities should incorporate a dual evaluation: both the concentration of activities and patterns of localization of these concentrations, but also that of the statistical significance of different spatial agglomerations identified.

### **3. Exploratory Spatial Data Analysis**

Exploratory Spatial Data Analysis (ESDA) is a set of techniques that aims at describing and visualizing spatial distributions, at identifying atypical localizations or spatial outliers, at detecting patterns of spatial association, clusters or hot spots, and at suggesting spatial patterns or other forms of spatial heterogeneity (Haining 1990; Bailey and Gatrell 1995; Anselin 1998a, 1998b). These methods provide measures of global and local spatial autocorrelation.

#### **3.1 Global spatial autocorrelation**

Spatial autocorrelation can be defined as the coincidence of similar values with similar locations (Anselin 2000). Therefore there is positive spatial autocorrelation when high or low values of a

random variable tend to cluster in space and there is negative spatial autocorrelation when geographical areas tend to be surrounded by neighbors with dissimilar values. The measurement of global spatial autocorrelation is based on Moran's  $I$  statistic, which is the most widely known measure of spatial clustering (Cliff and Ord 1973, 1981; Upton and Fingleton 1985; Haining 1990). This statistic is written in the following way:

$$I_t = \frac{\sum_i \sum_j w_{ij} (x_i - \bar{x})(x_j - \bar{x})}{\sum (x_i - \bar{x})^2}$$

where  $x_i$  is an observation in district  $i$ ,  $\bar{x}$  is the mean of observations across spatial units,  $w_{ij}$  is an element of the spatial weight matrix  $W$ . This matrix contains information about the relative spatial dependence between spatial units  $i$ . Elements  $w_{ii}$  on the diagonal are set to zero, although elements  $w_{ij}$  indicate the way spatial unit  $i$  is spatially connected to the spatial unit  $j$ . The spatial weight matrix we use in this study is based on the 5 nearest neighbors calculated from the great circle distance between region centroids. In France, districts have on average 5 to 6 contiguous neighbors.

In order to normalize the outside influence upon each spatial unit, the spatial weight matrix is row-standardized in order that elements in each row sum to 1.

Larger values of  $I$  than the expected value  $E(I) = -1/(n-1)$  indicate positive spatial autocorrelation, while smaller values than those expected indicate negative spatial autocorrelation. Inference is based on a permutation approach, with 9,999 permutations. In this approach, it is assumed that, under the null hypothesis, each observed value could have occurred at all locations with equal likelihood. But instead of using the theoretical mean and standard deviation (given by Cliff and Ord 1981), a reference distribution is empirically generated for  $I$ , from which the mean and standard deviation are computed. In practice, this is carried out by permuting the observed values over all locations and by re-computing  $I$  for each new sample. Then mean and standard deviation for  $I$  are the computed moments for the reference distribution for all permutations (Anselin 1995).

### 3.2 Local Spatial autocorrelation

Moran's  $I$  statistic is a global measure of autocorrelation: it does not enable us to appreciate the regional structure of spatial autocorrelation. However, one may wonder which spatial unit contributes more to the global spatial autocorrelation, when there are local spatial clusters of high or low values. Finally, to what extent does the global evaluation of spatial autocorrelation mask atypical localizations, i.e. districts or groups of contiguous districts which deviate from the

global pattern of positive spatial autocorrelation. The analysis of local spatial autocorrelation is carried out with two tools: first, the Moran scatterplot (Anselin 1996), which is used to visualize local spatial instability, and second, local indicators of spatial association “LISA” (Anselin 1995), which are used to test the hypothesis of random distribution by comparing the values of each specific localization with those in neighboring localizations.

Inspection of local spatial instability is carried out by the means of the Moran scatterplot (Anselin 1996). Four different quadrants of the scatterplot correspond to the four types of local spatial association between a spatial unit and its neighbors:

- Quadrant HH: a spatial unit with a high value surrounded by spatial unit with high values (Quadrant in top on the right),
- Quadrant LL: a region with a low value surrounded by regions with low values (Quadrant in bottom on the left),

These quadrants refer to positive spatial autocorrelation indicating spatial clustering of similar values.

- Quadrant LH: a spatial unit a with low value surrounded by regions with high values (Quadrant in top on the left),
- Quadrant HL: a spatial unit with a high value surrounded by /regions with low values (Quadrant in bottom on the right).

These quadrants represent negative spatial autocorrelation indicating spatial clustering of dissimilar values.

The Moran scatterplot may thus be used to visualize atypical localizations (HL or LH). Moreover, the use of standardized variables allows Moran scatterplots to be comparable across time. The detection of outliers and sites, which exert strong influence on Moran’s  $I$ , is based on standard regression diagnostics: studentized residuals and leverage measures are used to detect outliers. However, let us note that the Moran scatterplot does not give any indications of significant spatial clustering and therefore, it cannot be considered as a Local Indicator of Spatial Association (LISA) in the sense defined by Anselin (1995).

### 3.3 Local Indicator of Spatial Association

Anselin (1995) defines a local indicator of spatial association as any statistics satisfying two criteria. First, the LISA for each observation gives an indication of significant spatial clustering of similar values around that observation; second, the sum of the LISA for all observations is proportional to a global indicator of spatial association.

The local version of the Moran’s  $I$  statistic for each region  $i$  can then be written as following:

$$I_i = \frac{(x_i - \bar{x})}{m_0} \sum_j w_{ij} (x_j - \bar{x}) \quad \text{avec } m_0 = \sum_i w_{ij} (x_j - \bar{x})^2 / N$$

A positive value for  $I_i$  indicates clustering of similar values (high or low) whereas a negative value indicates clustering of dissimilar values. Due to the presence of global spatial autocorrelation, inference must be based on the conditional permutation approach: the value  $x_i$  at location  $i$  is held fixed, while the remaining values are randomly permuted over all locations. Finally, using jointly the Moran scatterplot and LISA allow to obtain maps of Moran significance, which show that spatial units are sometimes associated with a significant LISA and indicate with a color-coded in which location pattern these spatial units belong (Anselin and Bao, 1997).

#### 4. Main findings

The database includes 2,467 French agricultural cooperatives for the year 2005. They belong to 41 sectors identified under the French nomenclature of economic activities (NAF). Agricultural cooperatives mainly have an activity in industrial food processing (division 15 of NAF rev.1 out of 151F and 158B to D) or wholesale trade of agricultural products and foodstuffs (NAF 512, 513, 515L). The data are issued from Annual Enterprise Surveys (EAE, INSEE) for food industry and wholesale trade companies. They are included in the Annual Enterprise Survey if they employ at least 10 employees and make more than 5 million Euros in turnover (38 million for wholesale) and have a business core of processing food except bakery or tobacco production. This survey field was completed in 2005 by the Small Cooperatives Survey ("*Enquête Petites Coopératives*" in French) in agriculture and forestry.

Localization is here performed at the establishment level: a cooperative may be mono-establishment and have a only location or multi-establishment with different locations. Database stores 6,887 agricultural establishments with a cooperative status and they represent 64,736 employees. 79% of establishments are from the Annual Enterprise Survey and 21% remaining come from the Small Cooperatives Survey. The most of agricultural cooperatives are mono-establishment because 85% of them have only one establishment. Nevertheless, mono-establishment cooperatives represent only 30% of all establishments of agricultural cooperatives. Table 1 describes the demography of agricultural cooperatives and their establishments contained in the database used here.

Table 1. Demography of agricultural cooperatives and their establishments in France, 2005



Spatial statistical unit used here is the district. District is a subdivision authority and, in most of the time, cantons include several communes. The French metropolitan area has 3,687 districts. The choice of districts as spatial statistical units of this analysis is justified by reducing the number of observation compared to a commune analysis and, secondly, the contiguity of district area facilitates the analysis. We apply ESDA techniques to french district data on agricultural cooperatives. The data are extracted from French national statistical database. Our sample includes 3,687 districts for 22 regions in 2005 and 6,887 agricultural cooperatives. For each of them, the number of employees is known and there are 41 cooperative sectors represented. A cluster is defined as a district (or set of districts) for which the location quotient of cooperatives institutions (LQ) was significantly higher than the average location quotient. The LQ index is defined here as the ratio between the share of the spatial unit in the cooperative activities and the share of the spatial unit in the total activity<sup>4</sup>. Cooperative activities are over-represented in a district if the LQ is higher than 1. We may thus speak of cooperatives agglomeration or cooperatives cluster for neighboring districts with high levels of overrepresentation. Conversely, cooperative activities are under-represented in a district where LQ is less than 1. As Guillain and Le Gallo (2008), we use the average number of neighbors in our sample (5.7) to construct our k-nearest neighbors matrix. The number of neighbors k is set here to 5 because the value of Moran's I for k = 5 is higher than the value of Moran's I for k = 6.

Table 2 displays the evolution of the spatial autocorrelation of agricultural cooperative activities in 2005 for the 3687 French districts of our sample. It appears that agricultural cooperative activities are positively spatially autocorrelated since the statistics are significant with  $p = 0.00015$ . This result suggests that the hypothesis of spatial randomness is rejected and that the distribution of agricultural cooperative activities is by nature clustered. The regions with relatively high agricultural cooperative activities (respectively low) are localized close to other regions with relatively high agricultural cooperative activities (respectively low) more often than if this localization was purely random.

*Table 2. Moran's I statistics for nearest neighbors' matrix, 2005*

Since Moran's I yields a single result for the entire data set, it cannot discriminate between a spatial clustering of high values and a spatial clustering of low values in the case of a global positive spatial autocorrelation. Furthermore, it may mask regions that deviate from this global pattern. These limitations are overcome by the Moran scatterplots.

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<sup>4</sup> INSEE, 2005.

<sup>5</sup> All computations are carried out by the means of the Geoda 0.9.5-i software (Anselin 1999).

Map 3 and Map 4 display the Moran scatterplots for 2005. On the one hand, we can see that agricultural cooperatives are not significantly spatially autocorrelated at a global level.

*Map 3 and Map 4. Moran scatterplots and Significant LISA of agricultural cooperatives (establishments), 2005*

Indeed, Map 4 shows some clearly defined significant areas, where the LQ value of a district is significantly dependent on LQ values of neighboring districts. This is particularly clear in regions surrounding *Paris*, *Champagne-Ardenne*, *Franche-Comté*, *Languedoc-Roussillon*, *Midi-Pyrénées*, *Pays de la Loire* and *Bretagne*. Clusters of agricultural cooperatives are here represented by HH-type districts in the Moran scatterplot because they have a high location quotient and they have neighbors with high value of location quotients too. In addition, HL-type districts are isolated clusters: they recorded a high level of activity and they are surrounded districts with low LQ. The HH and HL localization patterns are represented by red and pale blue colors on Map 3 and Map 4. All values (HH, LL, LH and HL) are detailed in *Table A1 in Appendix*. To produce a comparative analysis of different agricultural cooperatives clusters in France, we now proceed to detailed location patterns at the regional level. The regional level also enables us to identify areas of agricultural cooperation. In addition to Map 3 and Map 4, Figure 4 presents number of HH and HL-type districts, as well as districts with significant local statistics indicator, for each French region.

*Figure 4. Number of HH and LL districts with significance LISA by region, 2005*

More precisely in 2005, 74.6% of the French regions show association of similar values (24.8% in quadrant I (HH) and 49.8% in quadrant III (LL)). This may indicate the existence of two regimes of spatial autocorrelation, the first one corresponding to the HH scheme and the second one to the LL scheme, both of them representing positive spatial association. *Bretagne* and *Champagne-Ardenne* are two regions with the largest levels of HH districts. These clusters comprise respectively 81 and 89 districts (Figure 4). In *Champagne-Ardenne*, the spatial autocorrelation is very high (71% of HH values are significant according to LISA, see Table 3). The importance of cooperative activities in this region is driven by the existence of large cooperative groups in the sugar (*Cristal Union Tereos*), the grains or cereals wholesale (*Champagne Grain*, *Nouricia*) and champagne (*Nicolas Feuillatte*). In addition, at the department level, cooperation is taken up by *La Marne* because of its wine specialization: on the 41 districts

the region has, 32 districts are HH districts and 78% of them are significant. Bretagne is the first French region in terms of agricultural cooperation: there is 70% of positive spatial autocorrelation which 44% of HH-type districts. However, only 27% of them are significant. This area has larger cooperatives primarily in the sectors of wholesale trade (*Coop des Agriculteurs de Bretagne, Vegam, Saveol, Eolys, etc.*), meat (*Coop L'Hunaudaye*), milk (*Coop Laitière de Ploudaniel*) and canning (*Union Fermière Morbihan, Dumenil, etc.*). These two regions are agricultural cooperation areas in France.

Other regions also have large clusters of HH districts: the *Centre* (73 HH districts, 29 are significant, i.e. 40%), the *Bourgogne* (43% significant HH-type districts) and *Franche-Comté* (out of 50 HH districts, 36 are significant). In the region *Centre*, the agricultural cooperation dynamics is mainly active on 2 of 6 departments – the region *Eure et Loir* and the region *Loir et Cher* – as well as the activities of grains and cereals wholesale (*EPIS Centre, LIGEA, Dunois, Coop agricole d'Eure et Loir, etc.*) and to a lesser extent on the canning activities (*ETBS Rene Maingourd*) and sugar (*Cristal Union, Tereos*). The region *Bourgogne* is characterized by many small cooperatives. Wholesale trade, mainly cereals, is the heart of cooperative activity (*Dijon Céréales, 110 Bourgogne*) plus some specific territorial (*SICA de viandes d'Yonne et du Loiret*). There are 144 small cooperatives on the region *Franche-Comté*. They specialize in the manufacture of cheese (155C). However, like *Bretagne* and the region *Champagne-Ardenne*, *Franche-Comté* contains an important proportion of HH districts (43%). Six French regions have a significant level of agricultural cooperatives activities: *Languedoc-Roussillon* (52 districts of HH type), *Midi-Pyrenees* and *Aquitaine* (115 between them), *Poitou-Charentes* (65) and *Pays de la Loire* (64) and *Picardie* (55). The *Languedoc-Roussillon* is characterized by a strong wine activity (321 cooperatives and 2600 employees). It is therefore a cooperation territory characterized by numerous cooperative mono-establishments. However, the positive spatial autocorrelation (70%) primarily results from a large number of LL districts. Polarization of agricultural cooperation activities is insignificant. *Midi-Pyrenees* and *Aquitaine* have grains and cereals wholesale (*Terres de Gascogne, La Toulousaine de Céréales, Unicor, Maisadour, Terres du Sud, Euralis céréales*) and wine activity is also present (*la Périgourdine, Les Vignerons de Buzet, la Cave du Marmandais*). Departments of *Gers* and *Lot-et-Garonne* are the heart of agricultural cooperation in this area. The *Midi-Pyrenees* also includes a large number of HL isolated cooperative clusters. The region *Poitou-Charente* has small cooperative institutions. Grains and cereals wholesale is the heart of cooperative activity (*Lescure Bougon, Synteane, Coop Agricole Charente, Civray CapSud*) plus some specific territorial (*Laiterie du Pays de Gatine, Capribeur, Lescure Bougon in Poitou Charente*). Instead, the region *Pays de la Loire* has large cooperatives with relatively diversified activities: terena over 1,100 employees in wholesale trade sector, but the specialization of the region in gardening activities can be found through the presence of

several relatively large institutions such as *Coopérative des Agriculteurs de Mayenne*, *Coop des Producteurs Légumiers*, *Coop Maraîchère du Val-de-Loire Nantais* or *Coop Agri France Champignon*. In the region *Picardie*, the strong positive spatial autocorrelation is characterized primarily by significant HH form of clustering (55). The manufacture of sugar, with *Terreos* and *Hauts de France* (158H), wholesale (*Invivo*, *Agro Picardie*) is the heart of cooperative activity in *Picardie*. Some French regions have an atypical agricultural cooperation profile. *Rhone-Alpes* is one of regions that have the most important French districts (311) while representing the second largest region in cooperative institutions. Nevertheless, 60% of its districts are LL ones. The region is characterized by 49 HL clusters, and the spatial autocorrelation appears only borderline significance. The main cooperation activities belong to the wholesale trade (*La Dauphine*, *Sicarev CBA*) plus territorial specificities (cheese and wine). Lorraine has many isolated HL clusters, but very few of them are significant. Agricultural cooperation is composed mainly of small establishments, specializing in dairy farming (*Union lait. Vittelloise*), wholesale trade (*EMC<sup>2</sup>*, *Coopérative agricole lorraine*) and meat (*Socopa Est*). Regions *Basse-Normandie* and *Haute-Normandie* have quite similar profiles. However, *Haute-Normandie* is characterized by strong activity in meat production (*Soc. Ind et comm Normandie*) and wholesale (*Cap Seine*). In *Basse-Normandie* dairy activities are much more important, including large cooperatives (*Maîtres Laitiers du Cotentin*, *Isigny-Sainte Mère*). The region also has a large meat production cooperative (*SIC Normandie Bretagne*) and the presence of *Agrial* (wholesale trade).

## 5. Conclusion

The study of the spatial distribution of agricultural cooperatives activities in France in 2005 using Exploratory Spatial Data Analysis (ESDA) highlights the importance of spatial interactions and geographical locations in regional cooperation and convergence issues. ESDA appears therefore as a powerful tool to finely reveal the characteristics of cooperative development of each region in relation to those of its geographical environment. The paper presents a dual originality: first, it reflects spatial changes of cooperatives and, secondly, it identifies agricultural cooperation areas in France. Even if number or size of territorial units included in the analysis - districts - varies consistently in each region, and consequently affects value of index levels, the MAUP problem (Modifiable Areal Unit slows down the rendering, Arbia [2001a]) however is mitigated by the use of the nearest-neighbors matrix (Guillain and Le Gallo, 2008).

Localization patterns of French agricultural cooperatives have been identified and we find, from the Moran's I value, they are highly concentrated and polarized, particularly in regions such as

Brittany, Champagne Ardenne, Centre, or Franche-Comte. These regions have a large number of clusters in agricultural cooperative. Here we show particular characteristics through their economic activities. The database was created using different surveys (Annual Enterprise Surveys and Small Cooperatives Survey) to identify exhaustively all French agricultural cooperatives. However, a limit of the analysis focuses on only the presence of agricultural cooperatives. The analysis could be improved if all the French cooperative area - agricultural cooperatives more commercial companies they control - was discussed. This would involve the investigation of other databases such as LiFi, a French Financial linkages survey, for example. Intensification of research on specific organizational forms, that cooperatives are, therefore is an important issue in Europe where 2010 is the year of the social economy.

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## Graphics, Maps and Tables

Figure 1. Evolution of the French cooperative system, number of firms, (on the basis of 100)

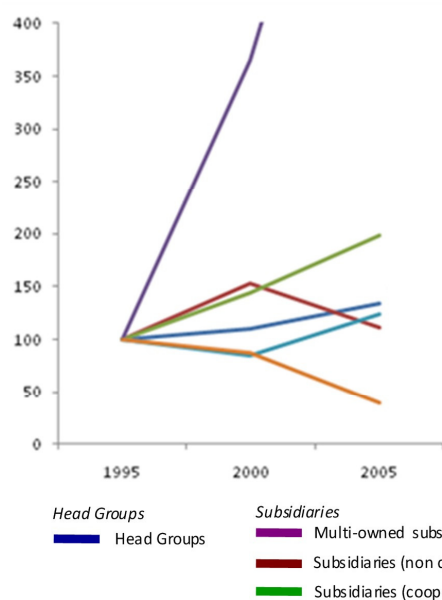
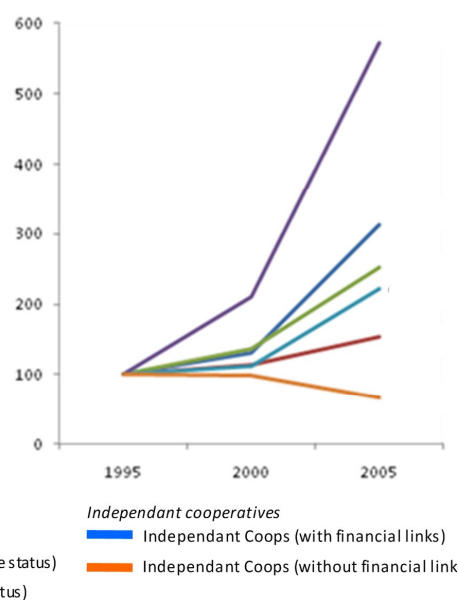
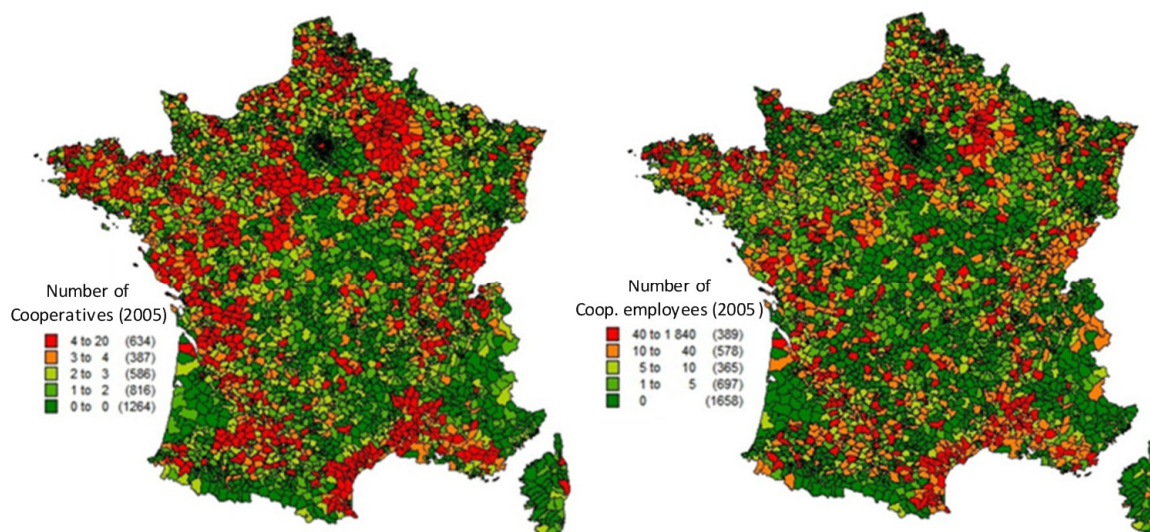


Figure 2. Evolution of the French cooperative system, number of employees, (on the basis of 100)



Source : Agreste Primeur, 235, december 2009

Maps 1 and 2. Number of establishments and employees of agricultural cooperatives by districts in France, 2005



Data Source: EAE 2005 and Small cooperatives surveys, 2005, INSEE



Map 3 and Map 4. Moran scatterplots and LISA statistics of agricultural cooperatives (establishments), French districts, 2005

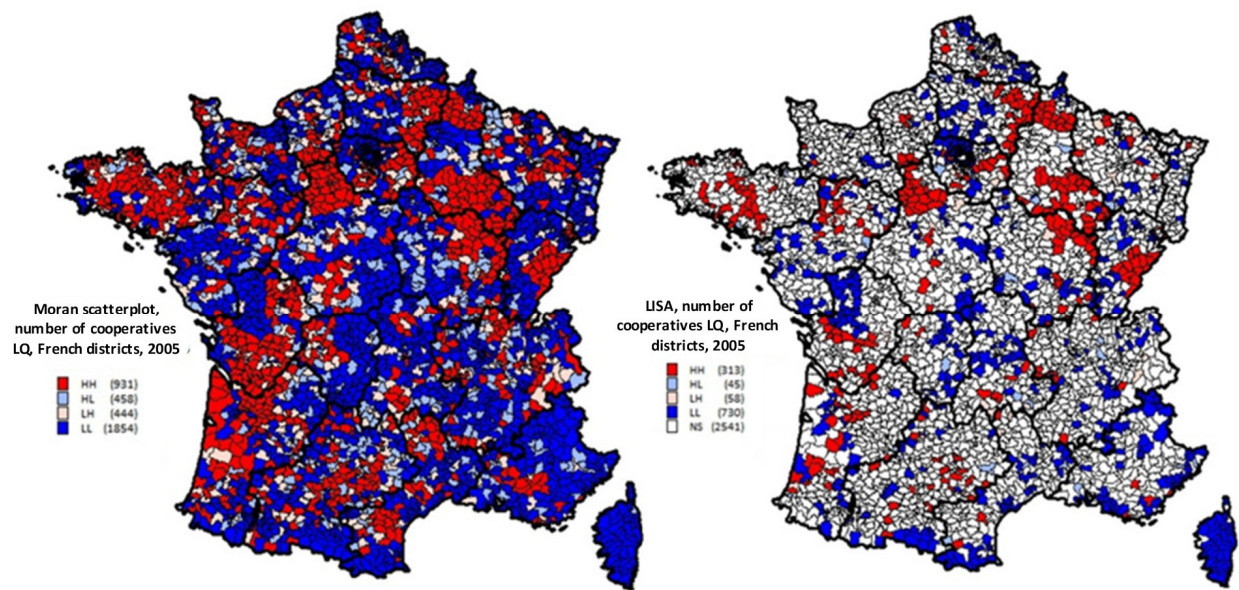


Figure 3. Number of employees and establishments of agricultural cooperatives activities by region, 2005

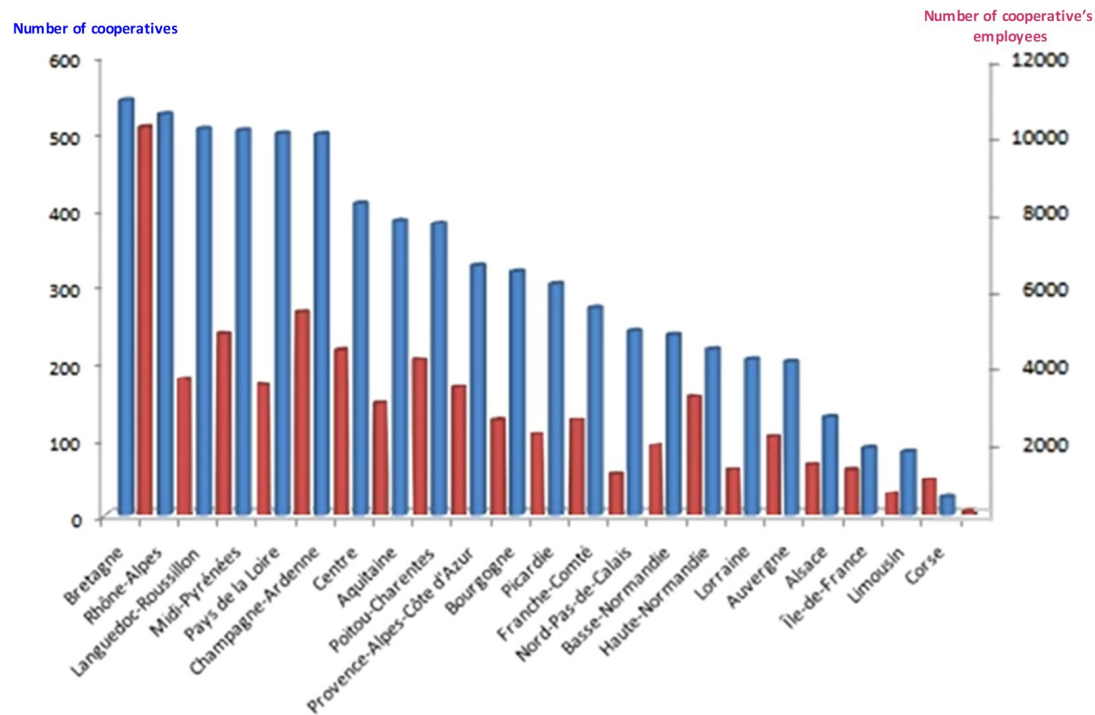




Table 1. Démography of French cooperatives and data sources, 2005

Number of Cooperatives	EAE Survey	Small Cooperatives Survey	Total Firms	Total Establishments	Cumuled % Establishments	Number of employees
1	605	1492	2097	2097	30.4%	
from 2 to 5	232		232	658	9.6%	
from 6 to 9	39		39	289	4.2%	
from 10 to 49	75		75	1698	24.7%	
from 50 to 215	24		24	2145	31.1%	
Total	975	1492	2467	6887	100.0%	64532

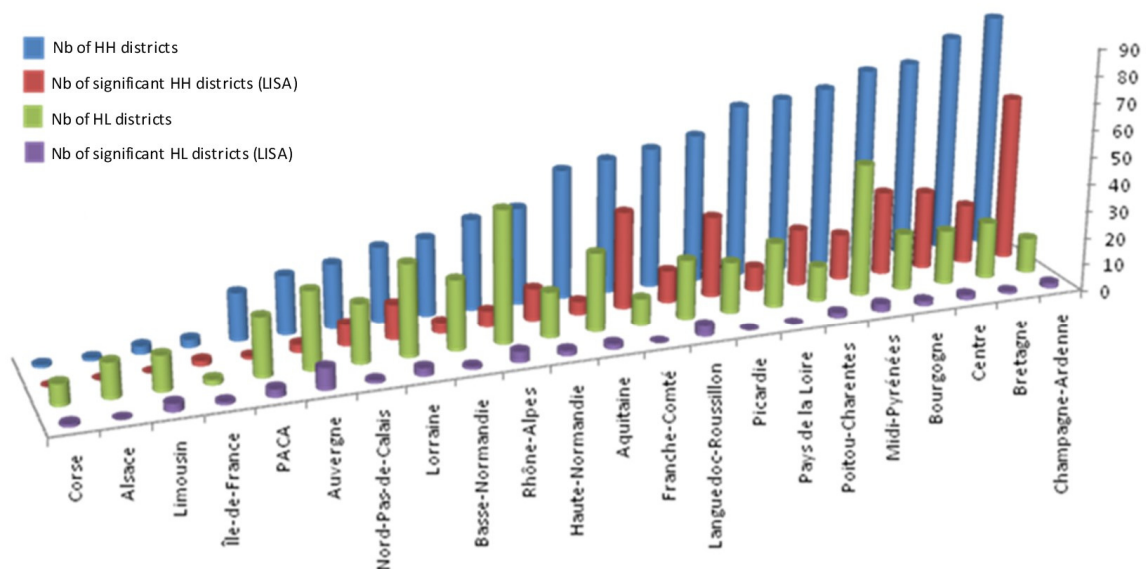
Data Source: EAE 2005 and Small cooperatives surveys, 2005, INSEE

Table 2. Comparison of Moran  $I$ 's values with different spatial weight matrix  $W_{ij}$

$W_{ij}$ $k$ -nearest neighbors matrix	Variable	Moran I	Std. Dev.	Prob.
$k=5$ neighbors	$QL_{coop,i}$	0,4194	0,0097	0,0000
	$QL_{sal,i}$	0,0812	0,0097	0,0000

Moran  $I$ 's Statistical inference is based on a conditional permutation approach with 9,999 permutations

Figure 4. Number of HH and LL districts with LISA significance by NUTS 2 region, 2005



## Appendix

*Map A1. French Metropolitan regions*



*Table A1. Local Indicators of Spatial Association (LISA), agricultural cooperatives LQ,  
French district, 2005*

Regions	Nb of Districts	Nb of HH districts	Nb of sig HH districts	Nb of HL districts	Nb of sig HL districts	Nb of LH districts	Nb of sig LH districts	Nb of LL districts	Nb of sig LL districts
Champagne-Ardenne	146	89	61	11	1	14	7	32	13
Bretagne	187	81	24	21	1	32	2	53	6
Centre	185	74	29	19	3	21	4	71	25
Bourgogne	177	72	29	21	2	20	5	64	16
Midi-Pyrénées	286	68	17	48	4	40	0	130	38
Poitou-Charentes	158	65	20	13	1	32	3	48	9
Pays de la Loire	192	64	3	24	0	39	4	65	12
Picardie	133	55	28	19	0	24	7	35	7
Languedoc-Roussillon	170	54	10	20	4	29	1	67	9
Franche-Comté	116	51	35	9	0	17	2	39	22
Aquitaine	231	50	5	27	2	30	2	124	51
Haute-Normandie	103	39	15	14	2	20	6	30	9
Rhône-Alpes	311	36	5	47	4	28	1	200	59
Basse-Normandie	147	31	5	24	1	16	2	76	6
Lorraine	156	29	15	33	3	22	7	72	24
Nord-Pas-de-Calais	170	25	7	21	1	19	3	105	52
Auvergne	156	22	3	29	6	17	2	88	24
Provence-Alpes-Côte d'Azur	193	17	0	23	3	14	0	139	73
Ile-de-France	267	3	2	2	1	6	0	256	237
Limousin	96	3	0	13	4	3	0	77	21
Alsace	64	2	0	12	0	0	0	50	6
Corse	43	1	0	8	2	1	0	33	11

*Source:* Annual Enterprises Survey 2005; Small Cooperatives Survey 2005, INSEE

Table A2. Demography of French agricultural cooperatives by region, 2005

NUTS Regions	Nb of coops	Nb of employees	Economic Sectors	Majors Cooperatives Establishments
Alsace	129	1306	159G, 512A, 155A	Laiterie Coop Alsace Lait (155A) Comptoir Agricole Achat Vente (512A) Cave Coop Vinico Eguisheim Dambach (159G)
Aquitaine	385	4158	512A, 159G, 513A	Maïsador (512A) SCA Terres Du Sud (512A) Euralis Céréales (512A)
Auvergne	201	1449	513G, 512A, 512E	Centre Lait-Union Coop Agricoles (513G) Sucrerie de Bourdon (158H)
Basse-Normandie	236	3201	155C, 151A, 512A	Coop Agri Lait Maîtres Laitiers Cotentin (155C) SIC Normandie Bretagne (151A) Coop Isigny-Sainte Mère (155C)
Bourgogne	318	2240	512A, 151A, 159G	SICA De Viandes de l'Yonne et du Loiret (151A) Soc Coop Agricole Dijon Céréales (512A)
Bretagne	542	10145	151A, 157A, 512A	Coop l'Hunaudaye (151A) Coop des Agriculteurs De Bretagne (513G) Coop du Gouessant (151A)
Centre	408	3038	512A, 158H, 153E	Epis Centre (512A) Coop Ligea (512A) Coop Agricole du Dunois (512A)
Champagne-Ardenne	498	4384	512A, 158H, 157A	Cristal Union (158H) Champagne Céréales (512A)
Corse	24	210	159G, 513J	SICA Union Vignerons Ile de Beauté (513J)
Franche-Comté	271	1202	155C, 512A	Coop Agricole Interval (512A) Coop des Monts de Joux (155C)
Haute-Normandie	217	1332	512A, 151A, 151E	Soc Ind. & Comm. Normandie (151A) Normival (151E)
Île-de-France	89	697	512A	Union Invivo (512A)
Languedoc-Roussillon	505	4810	159G, 513A, 512A	Groupe coop occitan G.C.O. (512A) SCA Audecoop (512A)
Limousin	84	1056	513A, 512E, 151A	Coop fruitière du Limousin (513A)
Lorraine	204	2168	512A, 155C, 151A	Union lait. Vittelloise (155C) EMC2 (512A) Socopa Est (151A)
Midi-Pyrénées	503	3508	512A, 513A, 159G	La Quercynoise (151E) Société coop agricole Unicor (512A) Société coop agricole Terres de Gascogne (512A)
Nord-Pas-de-Calais	241	1972	158H, 512A, 513G	Tereos (158H) Société coop agricole Uneal (512A) Sucreries distilleries hauts de France (158H)
Pays de la Loire	499	5364	512E, 512A, 513A	Terrena (512E) Coop agri France champignon (153E) CAVAC (512A) Coop des agriculteurs de la Mayenne (512E)
Picardie	302	2618	512A, 158H, 513A	Tereos (158H) Union Invivo (512A)
Poitou-Charentes	381	3455	512A, 155C, 155A	Soc coop Civray Capsud (512A) Terrena poitou (512A) SCA Synteane (512A)
PACA	326	2590	159G, 513A, 515L	Coop agricole Provence Languedoc (515L)
Rhône-Alpes	524	3629	512A, 155C, 159G	Coop agricole la Dauphinoise (512A) Union Valcrest (155C) SICA C.B.A (512A)
Total France	6887	64532		

Source: Annual Enterprises Survey 2005; Small Cooperatives Survey 2005, INSEE

Tableau A3. French Economic Activity Nomenclature (700 positions), NAF 700 rev. 1, 2003

NAF700	Economic Sector	NAF700	Economic Sector
15.1A	Butchery manufacturing	15.9F	Champagne manufacturing
15.1C	Poultry manufacturing	15.9G	Winery
15.1E	Meat industrial preparation	15.9J	Cider manufacturing
15.1F	Cooked pork meat	15.9L	Other spirits manufacturing
15.2Z	Fischery	15.9N	Brewery
15.3A	Potatoes transformation and conservation	15.9Q	Malt-house
15.3C	Fruit juice and vegetables transformation	15.9S	Water production
15.3E	Vegetables transformation and conservation	15.9T	Fresh drinks manufacturing
15.3F	Fruits transformation and conservation	51.1A	Agricultural raw products and animals intermediaries
15.4A	Oil and raw grease manufacturing	51.1C	Chemical and material intermediaries
15.4C	Refined Oil and Grease manufacturing	51.1E	Wood intermediaries
15.4E	Margagraine manufacturing	51.1G	Engineering material intermediaries
15.5A	Milk manufacturing	51.1J	Furnitures intermediaries
15.5B	Butter manufacturing	51.1L	Textile intermediaries
15.5C	Cheese manufacturing	51.1N	Food products intermediaries
15.5D	Other milk products manufacturing	51.1P	Food central purchasing agencies
15.5F	Ice cream manufacturing	51.1R	Others intermediaries
15.6A	Flour trade	51.1T	Others business intermediaries
15.6B	Other activities of Flour trade	51.1U	Non-food central purchasing agencies
15.6D	Starchy products manufacturing	51.2A	Cereal and livestock food wholesale
15.7A	Pet food manufacturing	51.2C	Plants and flowers wholesale
15.7C	Domestic pet food manufacturing	51.2E	Livestock wholesale
15.8A	Bread and pastry manufacturing	51.2G	Leather wholesale
15.8B	Bakery products	51.2J	Non-manufactured Tobacco wholesale
15.8C	Bakery and Pastry shop products	51.3A	Fruits and vegetables wholesale
15.8D	Pastry	51.3C	Meat wholesale
15.8F	Crackers manufacturing	51.3D	Meat products wholesale
15.8H	Sugar manufacturing	51.3E	Poultry wholesale
15.8K	Chocolate manufacturing	51.3G	Milk wholesale
15.8M	Batter manufacturing	51.3J	Drinks wholesale
15.8P	Tea and coffee manufacturing	51.3L	Tobacco wholesale
15.8R	Condiment manufacturing	51.3N	Sugar and chocolate wholesale
15.8T	Fabrication d'aliments adaptés à l'enfant et diététiques	51.3Q	Cafe and tea wholesale
15.8V	Other food industries	51.3S	Fish wholesale
15.9A	Eau-de-vie manufacturing	51.3T	Food wholesale
15.9B	Hard liquor manufacturing	51.3V	Deep-frozen products wholesale
15.9D	Alcohol manufacturing	51.3W	Non-specialized food wholesale

Source: French Economic Activity Nomenclature (700 positions), NAF rev 1, INSEE, 2003